



Operation Manual

PRODUCT NAME

Digital Flow Switch
(Modular type)

MODEL/ Series/ Product Number

PF3A701H
PF3A702H

SMC Corporation

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Safety Instructions

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

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.

ISO 4413: Hydraulic fluid power -- General rules relating to systems.

IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)

ISO 10218: Manipulating industrial robots -Safety.

etc.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

Warning

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

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

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

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

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

The product specified here may become unsafe if handled incorrectly.

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

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

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

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

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

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

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

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

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

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



Safety Instructions

Caution

1. The product is provided for use in manufacturing industries.

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

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***2) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.

2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Caution

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

Products that SMC manufactures or sells are not measurement instruments that are qualified by pattern approval tests relating to the measurement laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the measurement laws of each country.

■ Operator

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

■ Safety Instructions

Warning

- Do not disassemble, modify (including the replacement of board) or repair.
Otherwise, an injury or failure can result.
- Do not operate the product outside of the specifications.
Do not use the product with flammable or harmful fluids.
Fire, malfunction, or damage to the product may result.
Check the specifications before use.
- Do not use in an environment where flammable, explosive or corrosive gases are present.
Otherwise, fire, explosion or corrosion may occur.
The product is not designed to be explosion proof.
- Do not use the product with flammable fluid
Fire or an explosion may result.
Only air and N₂ are applicable.
- Do not use the product in a place where static electricity is a problem.
Otherwise failure or malfunction of the system can result.
- 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.
 - Stop the air supply, exhaust the residual pressure in piping and verify that the air is released before performing maintenance work.Otherwise an injury can result.

Caution

- Do not touch the terminals and connectors while the power is on.
Otherwise electric shock, malfunction and damage to the product can result.
- After maintenance is complete, perform appropriate functional inspections and leak test.
Stop operation if the equipment does not function properly or there is leakage of fluid.
When leakage occurs from parts other than the piping, the product itself may be damaged.
Cut off the power supply and stop the fluid supply.
Do not apply fluid if the system is leaking.
Otherwise, an unexpected malfunction may occur and it will become impossible to ensure safety.

■ Handling Precautions

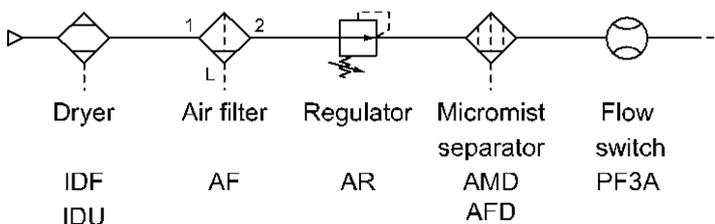
- Follow the instructions given below for selecting and handling.
 - The instructions on design and selection (installation, wiring, environment, adjustment, operation, maintenance, etc.) described below must be followed.
 - *Product specifications
 - Use the specified voltage.
Otherwise failure or malfunction can result.
Insufficient supply voltage may not drive a load due to a voltage drop inside the product.
Check the operating voltage of the load before use.
 - Do not apply a load that exceeds the max. load voltage or current.
This may cause damage or shorten the lifetime of the product.
 - Data stored by the product is not deleted, even if the power supply is cut off.
(Limit to rewrite: 1,500,000 times)
 - The applicable fluids for this product are dry air and N₂.
The operating fluid temperature range is 0 to 50 °C.
 - Before designing piping confirm the pressure loss (Characteristic data) at the sensor from the pressure loss graph. Confirm pressure loss of the sensor from the characteristics data.
 - For the details of compressed air quality, refer to JIS B 8392: 2012[4: 6: -].
 - Use within the specified measurement flow rate and operating pressure.
Otherwise it will not be able to perform proper measurement due to delivery delay of the fluid.
 - Reserve a space for maintenance.
Design the system allowing the required space for maintenance.

● **Product handling**

* **Mounting**

- Tighten to the specified tightening torque.
If the tightening torque is exceeded, the product can be damaged.
Insufficient torque can cause displacement of the product from its proper position and the looseness of the mounting screws.
- If a commercially available switching power supply is used, be sure to ground the frame ground (FG) terminal.
- Do not drop, hit or apply excessive shock to the product.
Otherwise damage to the internal components may result, causing malfunction.
- Do not pull the lead wire forcefully, or lift the product by the lead wire.
(Tensile strength 49 N or less)
Hold the product by the body when handling to prevent damage.
- Any dust left in the piping should be flushed out by air blow before connecting the piping to the product.
Otherwise it can cause damage or malfunction.
- Refer to the flow direction of the fluid indicated on the product label for installation and piping.
- Do not mount the body with the bottom facing upwards.
Do not mount the product with the display facing upward.
Retention of air can cause inability to measure accurately.
- Do not insert metal wires or other foreign matter into the flow path.
This can damage the sensor causing failure or malfunction.
- Never mount the product in a place that will be used as a scaffold during piping.
The product may be damaged if excessive force is applied by stepping or climbing onto it.
- Do not apply excessive rotation force to the monitor.
The monitor with integrated display can be rotated 90° clockwise.
Rotating the display with excessive force will damage the end stopper.
- Visibility decreases if the display is viewed from the opposite side to the buttons.
Check the settings and display from in front of the display.
- If there is a risk of foreign matter entering the fluid, install a filter of mist separator at the inlet to avoid failure and malfunction.
Otherwise it can cause damage or malfunction. Or the flow switch will become unable to measure accurately.
Air quality specified in the product specifications can be satisfied by using the pneumatic circuit below.
- If the fluid flow on the IN side (entry side) of the product is unstable, correct measurement will not be possible.
If a valve is used on the IN side (entry side) of the product, the fluid may be unstable due to the change of the effective area, and there may be an error in the flow measurement results.
- If a residual pressure release 3-port valve is installed on the inlet side of the flow switch and air flows backward, the displayed flow rate will fluctuate.
- Avoid installing the lubricator on the inlet side of the digital flow switch as it may cause oil inflow and damage internal parts.

Recommended pneumatic circuit example (for compressed air)



*Wiring (Including connecting/ disconnecting of the connectors)

- Do not pull hard on the lead wire. Especially never lift the product equipped with fitting and piping by holding the lead wires.

Damage to the connector, circuit board, cover or internal components may result, causing failure or malfunction.

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

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

If the lead wire can move, secure 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 the damaged lead wire with a new one.

- Wire correctly.

Incorrect wiring may cause malfunction or damage to the product.

- Do not perform wiring while the power is on.

Otherwise damage to the internal components may result, causing malfunction.

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

Route the wires of the product separately from power or high voltage cables to prevent noise and surge from entering the product.

- Confirm correct insulation of wiring.

Poor insulation (interference with other circuits, poor insulation between terminals etc.) can apply excessive voltage or current 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 30 m.

When using it as an IO-Link device, do not use a cable longer than 20 m.

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

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

*Operating environment

- Do not use the product in an environment where the product is constantly exposed to water splashes. 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 can be splashed. Otherwise damage to the internal parts can result, causing malfunction.
- Do not use the product in a place where the product could be splashed by oil or chemicals. If the product is to be used in an environment containing oils or chemicals such as coolant or cleaning solvent, even for a short time, it may be adversely affected (damage, malfunction, or hardening of the lead wires).
- Do not use in an area where surges are generated. When there are machines or equipment that generate large surges near the product (magnetic type lifter, high frequency inductive furnace, motor, etc.), this can result in deterioration and damage of the internal components. Take protective measures to isolate 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 directly driven, use the product with built in surge protection.
- 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 it can cause damage or malfunction.
- Do not use the product in the presence of a magnetic field. Malfunction can result.
- Do not let foreign matter, such as wire debris, get inside the product. Otherwise it can cause damage or malfunction.
- Do not use the product in an environment that is exposed to temperature cycle. Heat cycles other than ordinary changes in temperature can adversely affect the internal components of the product.
- Do not expose the product to direct sunlight. If using in a location directly exposed to sunlight, protect the product from the sunlight. Failure or malfunction may occur.
- Keep within the specified ambient temperature range. The ambient temperature range is 0 to 50 °C. Operation under low temperature may lead to damage or operation failure due to frozen moisture in the fluid or air. Protection against freezing is necessary. Mounting of an air dryer is recommended for elimination of drainage and water. Avoid abrupt temperature changes even within the specified temperature range.
- Do not operate close to a heat source, or in a location exposed to radiant heat. Insufficient air quality may cause operation failure.

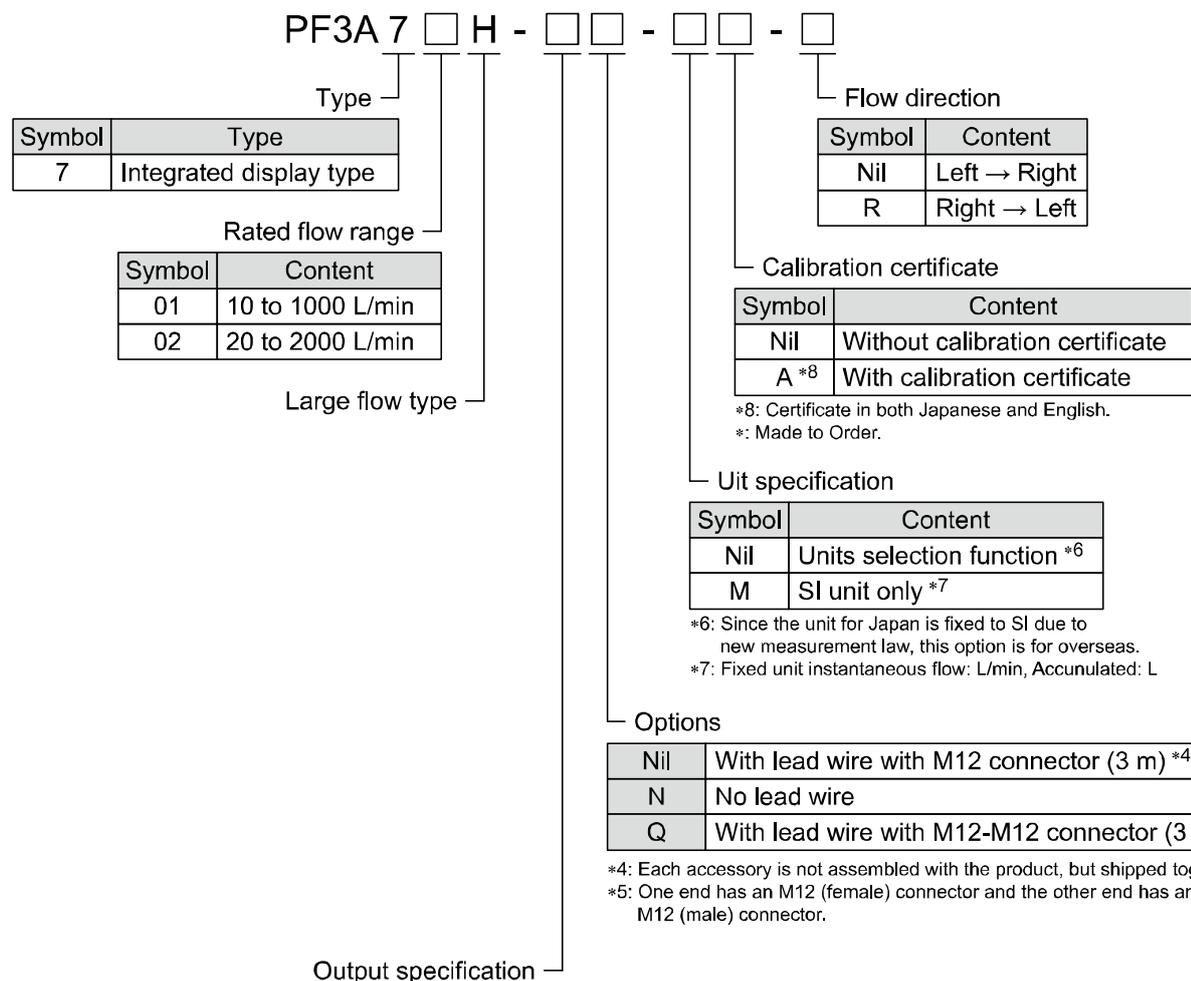
*Adjustment and Operation

- Connect the load before turning the power supply on.
- Do not short-circuit the load.
Although error is displayed when the product load has a short circuit, generated over current may lead to the damage of the product.
- Do not press the setting buttons with a sharp pointed object.
This may damage the setting buttons.
- Supply power under no flow conditions.
- If using the product to detect very small flow differences, warm up the product for 10 to 15 minutes first.
There will be a drift on the display/ analogue output of approx 2 to 3% for 10 minutes after the power supply is turned on.
- The product doesn't produce and output signal for 3 seconds after the power is supplied.
- Perform settings suitable for the operating conditions.
Incorrect setting can cause operation failure.
- During the initial setting and flow setting, the product will switch the measurement output with the condition before setting.
Check the effect to the equipment before setting.
Stop the control system for setting, if necessary.
- Do not touch the LCD during operation.
The display can vary due to static electricity.

*Maintenance

- Perform regular maintenance and inspections.
There is a risk of unexpected failure of components due to the malfunction of equipment and machinery.
- Before performing maintenance, turn off the power supply, stop the air supply, exhaust the residual compressed air in the piping, and verify the release of air.
Otherwise, unintended malfunction of system components can result.
- Remove the condensate periodically.
If condensate enters the secondary side, it can cause operating failure of pneumatic equipment.
- Do not use solvents such as benzene, thinner etc. to clean the product.
This may damage the surface of the body or erase the markings on the body.
Use a soft cloth to remove stains.
For heavy stains, use a damp cloth that has been soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

Model Indication and How to Order



| Symbol | OUT | FUNC *1 | Applicable monitor |
|--------|-----------------------------|--|--------------------|
| CS | NPN | Analogue voltage output *2 ⇔ External input *3 | PFG300 series |
| DS | NPN | Analogue current output ⇔ External input *3 | PFG310 series |
| ES | PNP | Analogue voltage output *2 ⇔ External input *3 | PFG300 series |
| FS | PNP | Analogue current output ⇔ External input *3 | PFG310 series |
| L | IO-Link/Switch output (N/P) | - | - |
| L3 | IO-Link/Switch output (N/P) | Analogue voltage output *2 ⇔ External input *3 | PFG300 series |
| L4 | IO-Link/Switch output (N/P) | Analogue current output ⇔ External input *3 | PFG310 series |

*1: Analogue output or external input can be selected by pressing the buttons.

Analogue output is set as the default setting.

Output option symbol "L" is not available because the FUNC terminal is not connected.

*2: 1 to 5 V or 0 to 10 V can be selected by pressing the buttons.

The default setting is 1 to 5 V.

*3: Accumulated, peak and bottom values can be reset using the external input.

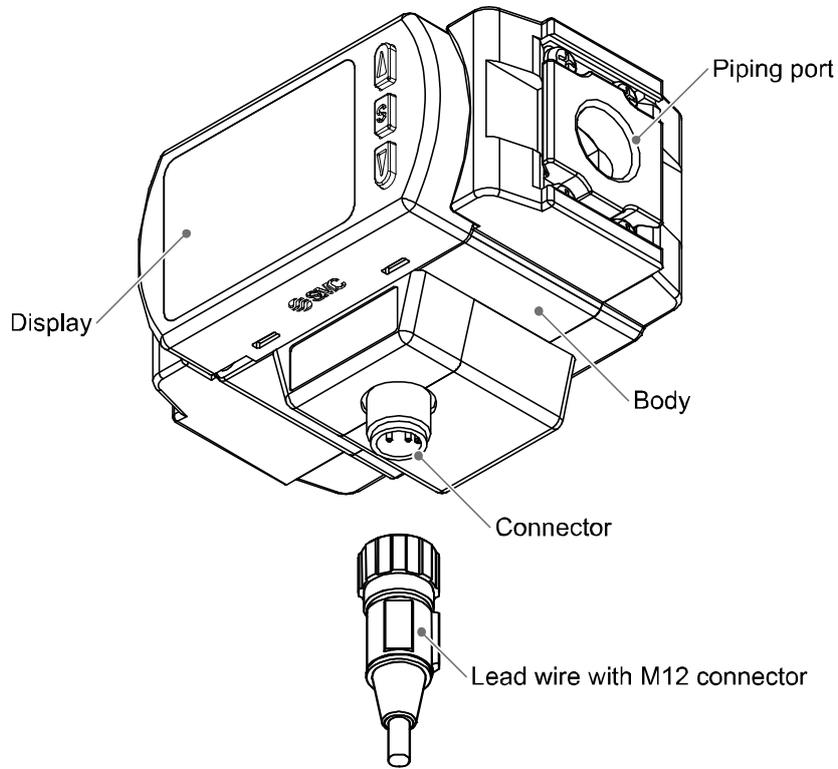
Accessories/Part numbers

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

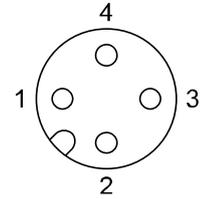
| Product number | Description | Note |
|----------------|------------------------------|--|
| ZS-37-A | Lead wire with M12 connector | Length: 3 m |
| ZS-49-A | Lead wire with M12 connector | Length: 3 m, M12 (female) - M12 (male) |

Names and Functions of Individual Parts

Body



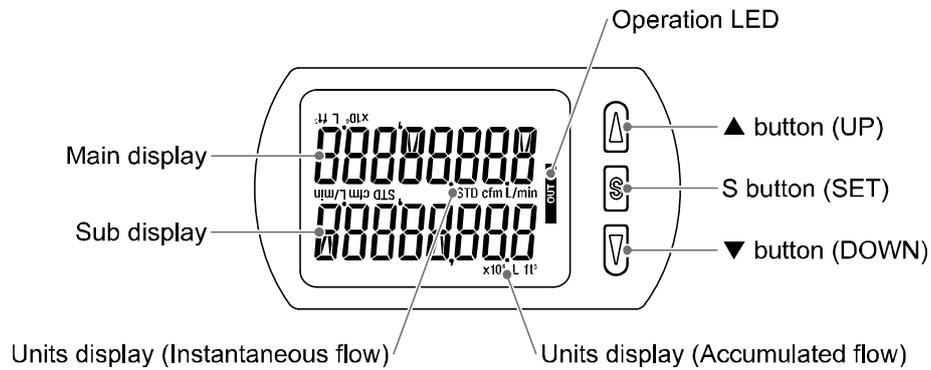
Connector pin numbers
(on the product)



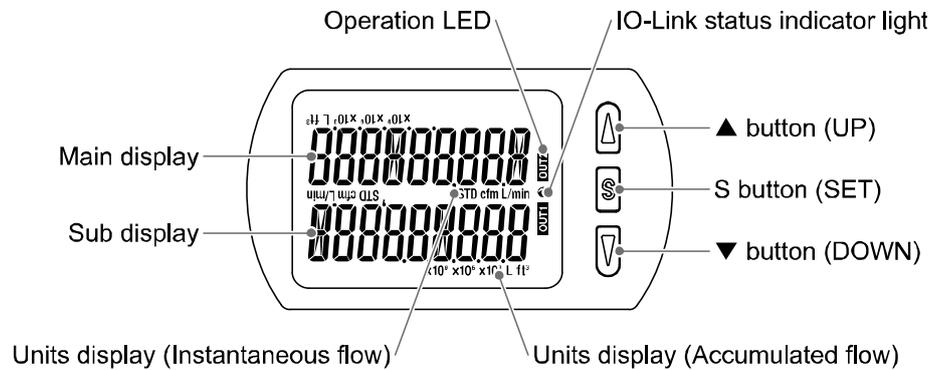
| | |
|---|-----------|
| 1 | DC(+) |
| 2 | FUNC |
| 3 | DC(-) |
| 4 | OUT (C/Q) |

| Element | Description |
|------------------------------|---|
| Display | See below |
| Connector | M12 4-pin connector for electrical connections. |
| Lead wire with M12 connector | Lead wire for power supply and outputs. |
| Piping port | For piping connections. |
| Body | The body of the product. |

Display



•IO-Link specification



| Element | Description |
|------------------------------------|--|
| Main display | Displays the instantaneous flow value and error codes. (2 colour display) |
| Operation LED | Indicates the output status of OUT. When the output is ON: Orange LED is ON. When the accumulated pulse output mode is selected, the output display will turn off. |
| Sub display | Displays the accumulated flow, set value, and peak/ bottom value when in measurement mode. |
| ▲ button (UP) | Selects the mode and the display shown on the Sub display, or increases the switch point. |
| S button (SET) | Press this button to change the mode and to set a value. |
| ▼ button (DOWN) | Selects the mode and the display shown on the Sub display, or decreases the switch point. |
| Units display (Instantaneous flow) | Indicates the flow measurement units currently selected. |
| Units display (Accumulated flow) | Indicates the flow measurement units currently selected. |
| IO-Link status indicator light | LED is ON when OUT1 is used in IO-Link mode. (LED is OFF in SIO mode) |

•IO-Link indicator light operation and display

| Communication with master | IO-Link status indicator light | Status | | | Sub screen display *1 | Content |
|---------------------------|---|--------------|------------------------|------------------------|--|--|
| |  | | | | | |
| Yes |  | IO-Link mode | Correct | Operate | Mode oPE | Normal communication status (Reading of measurement value) |
| | | | | Start up | Mode StPt | When communication starts up. |
| | | | | Preoperate | Mode PrE | |
| |  | | Abnormal | Version does not match | Er 15 V 10 | Version of master and IO-Link does not match *2 |
| No |  | Abnormal | Communication shut-off | Mode StPt | Correct communication was not received for 1 second or more. | |
| | | | | Mode PrE | | |
| | | | | Mode oPE | | |
| |  | SIO mode | | | Mode Sio | General switch output |

LCD display: "O" OFF, "●" Flashing, "●" ON

*1: "ModE - - -" is displayed when selecting the modes on the sub screen.

*2: When the product is connected to the IO-Link master with version other than "V1.1", an error is generated.

■ Definition and terminology

| | Term | Definition |
|---|---------------------------------|--|
| A | Accumulated flow | The total amount of fluid that has passed through the device. If an instantaneous flow of 100 L/min lasts for 5 minutes, the accumulated flow will be $5 \times 100 = 500$ L. |
| | Accumulated flow external reset | A function to reset the accumulated value to "0" when an external input signal is applied. |
| | Accumulated pulse output | A type of output where a pulse is generated every time a predefined accumulated flow passes. It is possible to calculate the total accumulated flow by counting the pulses. |
| | Accumulated-value hold time | A function to store the cumulative flow value in the product's internal memory at certain time intervals. Reads the memory data when power is supplied. Accumulation of data begins with the value read at the moment power is supplied. The time interval for memorizing can be selected from 2 or 5 minutes. |
| | 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 0 to 10 V or 4 to 20 mA. |
| D | Delay time | The setting time from when the flow applied to the flow switch reaches the set value, to when the ON-OFF output actually begins working. Delay time setting can prevent the output from chattering. The response time indicates when the set value is 90% in relation to the step input. |
| | Display range | Displayable range of flow. |
| | Digital filter | Function to add digital filtering to the fluctuation of flow value. Smooth the fluctuation of displayed value for sharp start up or fall of the flow. When the function is valid, digital filtering is reflected to the ON/OFF of the switch output and analogue output. The response time indicates when the set value is 90% in relation to the step input. Output chattering or flicker in the measurement mode display can be reduced by setting the digital filter. |
| F | F.S. (full span/ full scale) | This means "full span" or "full scale", and indicates varied analogue output range at rated value. For example, when analogue output is 1 to 5 V, $F.S. = 5 [V] - 1 [V] = 4 [V]$. (Reference: $1\%F.S. = 4 [V] \times 1\% = 0.04 [V]$) |
| H | Hysteresis | The difference between ON and OFF points used to prevent chattering. Hysteresis can be effective in avoiding the effects of pulsation. |
| | Hysteresis mode | Mode where the switch output will turn ON when the flow is greater than the set value, and will turn OFF when the flow falls below the set value by the amount of hysteresis or more. |
| 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. |
| | Internal voltage drop | The voltage drop across the product (and therefore not applied to the load), when the switch output is ON. The voltage drop will vary with load current, and ideally should be 0 V. |

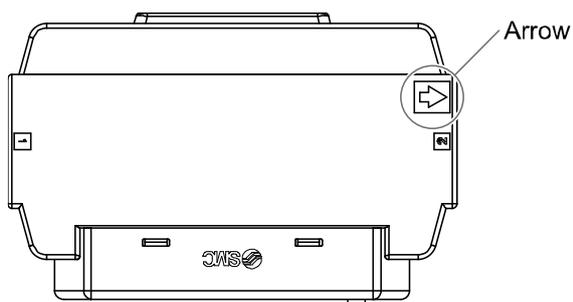
| | Terminology | Definition |
|---|-----------------------------|---|
| K | Key-lock function | Function that prevents changes to the settings of the flow switch (disables button operation). |
| N | Normal condition | The flow which is converted into the volume at 0 °C and 101.3 kPa (absolute pressure). <nor> indicates that the product is in normal condition. |
| O | Operating pressure range | The pressure range in which the product can be used. |
| | Operating temperature range | Ambient temperature range in which the product can operate. |
| | Operating humidity range | Humidity range in which the product can operate. |
| | Operating fluid temperature | Range of fluid temperature that can be measured by the product. |
| P | Pressure characteristics | Indicates the change in the display value and analogue output when the fluid pressure changes. |
| | Proof pressure | Pressure limit that if exceeded will result in mechanical and/or electrical damage to the product. |
| R | Rated flow range | The flow range within which the product will meet all published specifications. |
| | Repeatability | Reproducibility of the display or analogue output value, when the measured quantity is repeatedly increased and decreased. |
| S | Set point range | Range in which ON-OFF point (threshold) is adjustable |
| | Smallest settable increment | The resolution of set and display values. If the minimum setting unit is 2 L/min, the display will change in 2 L/min steps, e.g. 30.....32.....34 L/min. |
| | Standard condition | The flow which is converted to the volume at 20 °C and 101.3 kPa (absolute pressure). <Std> indicates that the product is standard condition. |
| | Switch output | Output type that has only 2 conditions, ON or OFF. In the ON condition an indicator LED will show, and any connected load will be powered. In the OFF condition, there will be no indicator LED and no power supplied to the load. An output showing such behavior is called switch output. |
| T | Temperature characteristics | Indicates the change in the display value and analogue output caused by ambient temperature changes. |
| U | Units selection function | A function to select display units other than the international unit (SI unit) specified in the new Japanese measurement law. The product is not equipped with this function. |
| W | Wetted part | A part that comes into physical contact with the fluid. |
| | Window comparator mode | An operating mode in which the switch output is turned on and off depending on whether the flow is inside or outside the range of two set values |

Mounting and Installation

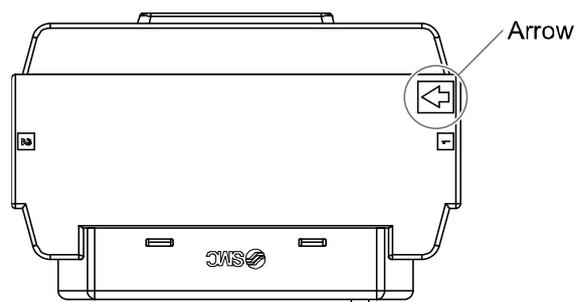
Mounting

- Avoid mounting in the direction that the display faces upward.
 - Never mount the product upside down.
 - The monitor with integrated display can be rotated.
- Rotating the display with excessive force will damage the end stop.

○ Flow direction

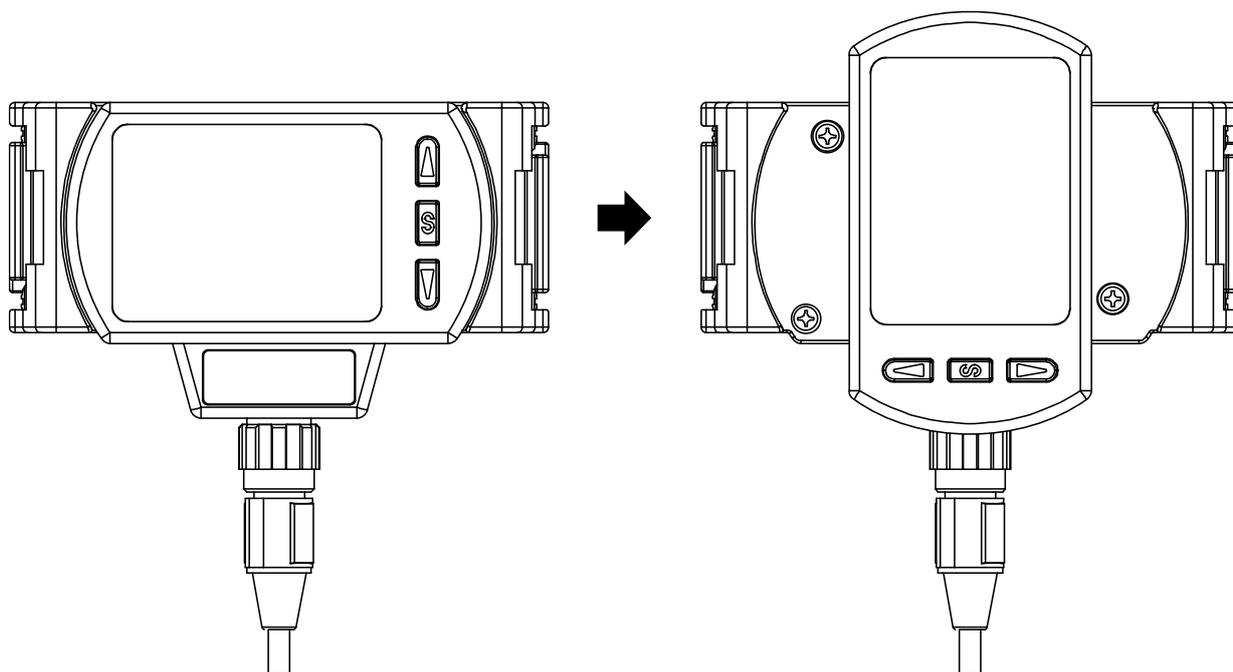


Flow direction: Left → Right



Flow direction: Right → Left

○ Rotation of the display

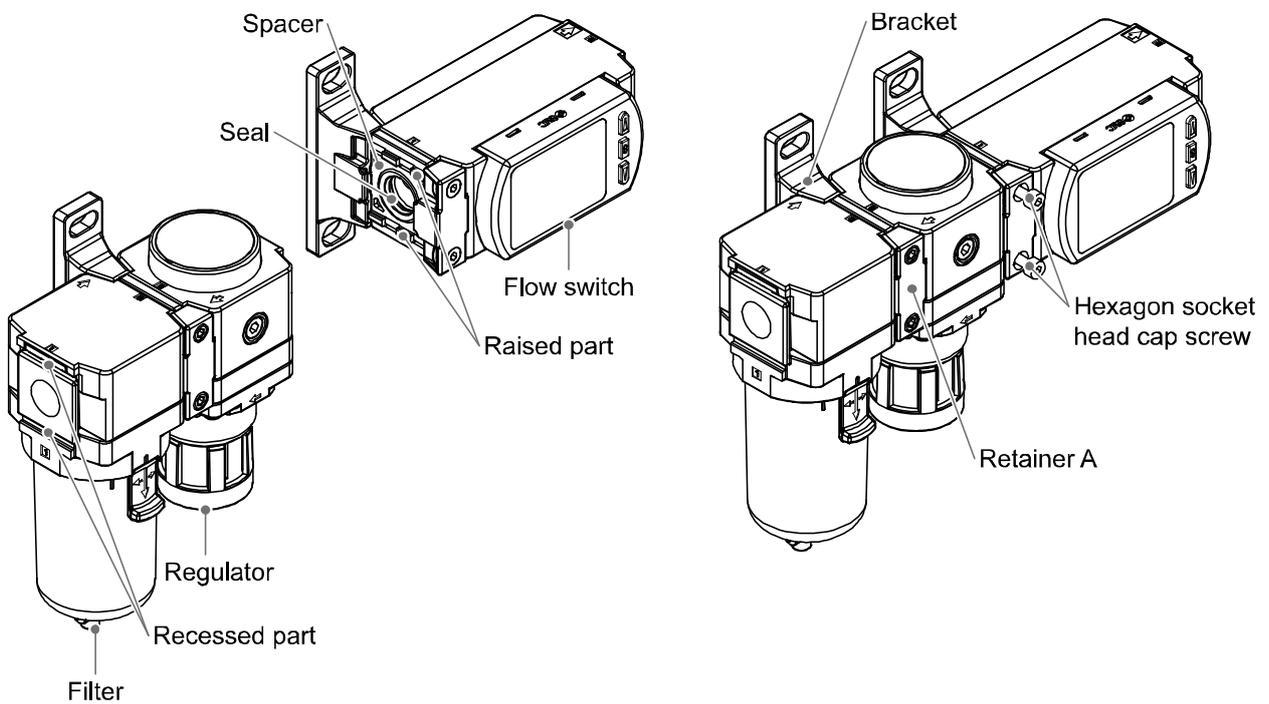


■Piping

- Fit the raised part of the spacer to the recessed part (groove for the raised part) of the product.
 - Tighten the retainer A with two hexagon socket head cap screws temporarily.
 - Tighten the two hexagon socket head cap screws with a hexagonal wrench evenly.
- Refer to the control items shown below for the tightening torque for the screws.

Control items

| Applicable model | Hexagonal wrench socket size Nominal value | Tightening torque |
|------------------|---|-------------------|
| PF3A701H | 3 | 1.2±0.05 Nm |
| PF3A702H | | |



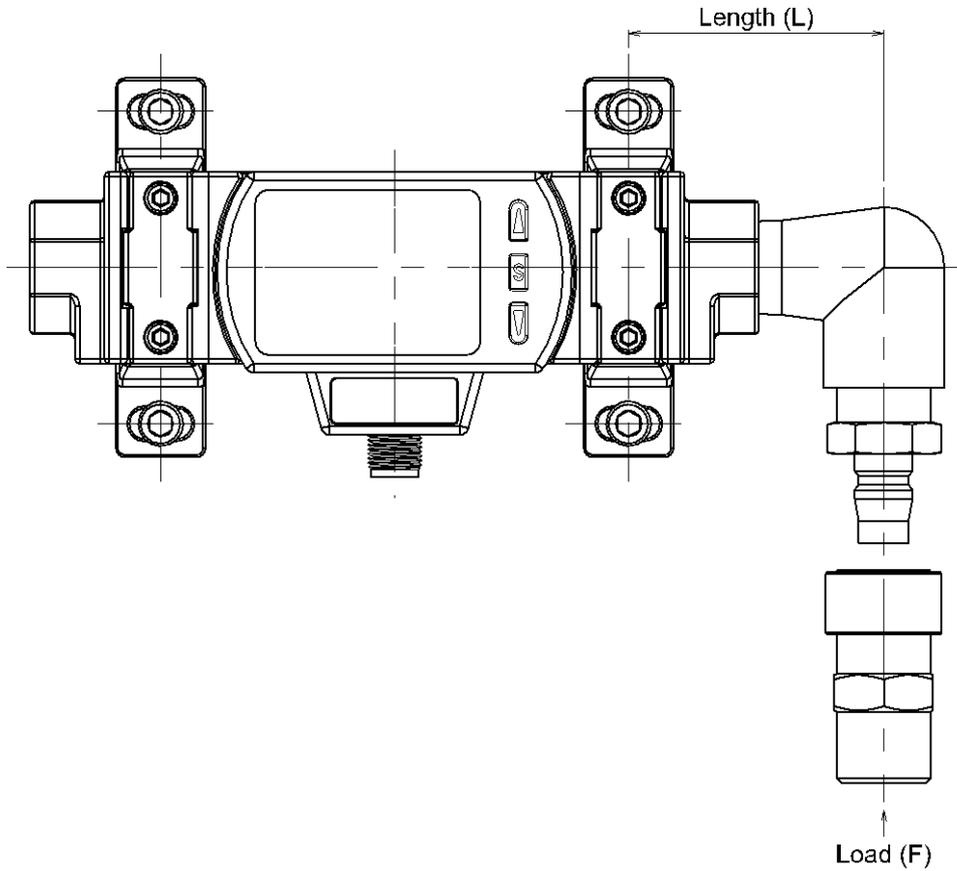
- The following options are required for coupling with modular F, R, and L combinations. They are separately prepared by the user.

| Digital flow switch | Air combination | Spacer | Spacer with bracket | Pipe adapter |
|---------------------|-----------------|--------|---------------------|--------------|
| PF3A701H | AC30#-D | Y300-D | Y300T-D | E300-#03-D |
| PF3A702H | AC40#-D | Y400-D | Y400T-D | E400-#04-D |

*: For more information about the options, refer to our website (URL <https://www.smcworld.com>).

<Caution>

•Do not apply torsion or bending moment other than the weight of the product itself. External piping needs to be supported separately as it may cause damage. If a moment applied to the equipment is unavoidable during operation, the moment should be lower than the maximum moment shown below. Non-flexible piping like steel tube is susceptible to excessive moment load or vibration. Insert flexible tubes to prevent this.



| Models | PF3A701H | PF3A702H |
|------------------------|----------|----------|
| Maximum moment (M): Nm | 16 | 19.5 |

Max. moment (M) = Length (L) x Load (F)

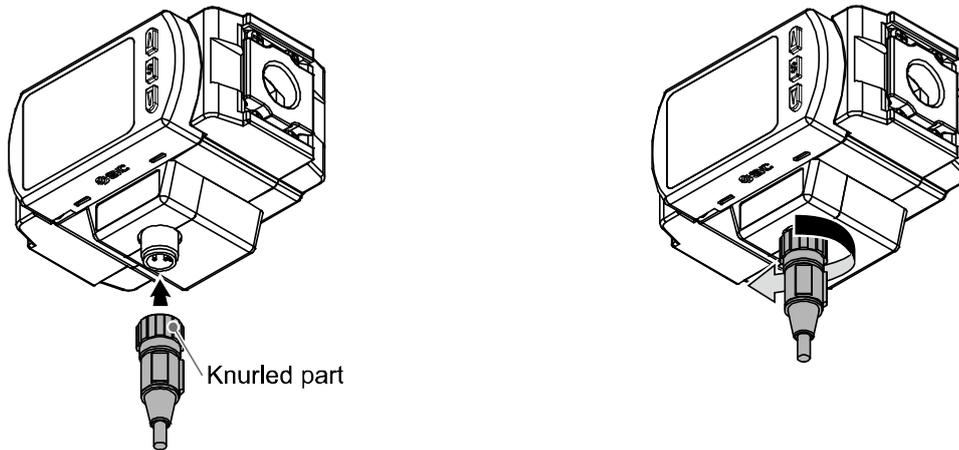
■Wiring

Connection

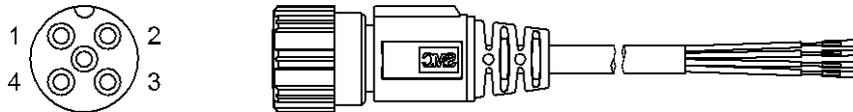
- Connections should only be made with the power supply turned off.
- Use a separate route for the product wiring and any power or high voltage wiring. If wires and cables are routed together with power or high voltage cables, malfunction may result due to noise.
- If a commercially available switching power supply is used, be sure to ground the frame ground (FG) terminal. If the product is connected to the commercially available switching power supply, switching noise will be superimposed and the product specifications will not be satisfied. In that case, insert a noise filter such as a line noise filter/ ferrite between the switching power supplies or change the switching power supply to the series power supply.

Connecting/Disconnecting

- Align the lead wire connector with the connector key groove, and insert it straight in. Turn the knurled part clockwise. Connection is complete when the knurled part is fully tightened. Check that the connection is not loose.
- To remove the connector, loosen the knurled part and pull the connector straight out.



Connector pin numbers (lead wire)



- Used as switch output device

| Pin number | Wire colour | Description | Function |
|------------|-------------|-------------|-----------------------------------|
| 1 | Brown | DC(+) | 24 VDC |
| 2 | White | FUNC | Analogue output or External input |
| 3 | Blue | DC(-) | 0 V |
| 4 | Black | OUT | Switch output |

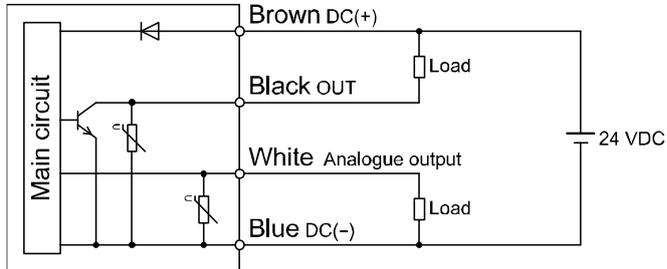
- Used as IO-Link device

| Pin number | Wire colour | Description | Function |
|------------|-------------|-------------|--|
| 1 | Brown | DC(+) | 21.6 to 30 VDC |
| 2 | White | N.C./Other | Not connected/Analogue output or External input |
| 3 | Blue | DC(-) | 0 V |
| 4 | Black | C/Q | Communication data (IO-Link)/Switch output (SIO) |

Internal circuit and wiring examples

NPN + Analogue output type

PF3A7##H-CS/DS#-##-#



Maximum applied voltage: 28 VDC

Maximum load current: 80 mA

Internal voltage drop 1 V max.

CS: Analogue output: Select 1 to 5 V or 0 to 10 V.

Output impedance: 1 k

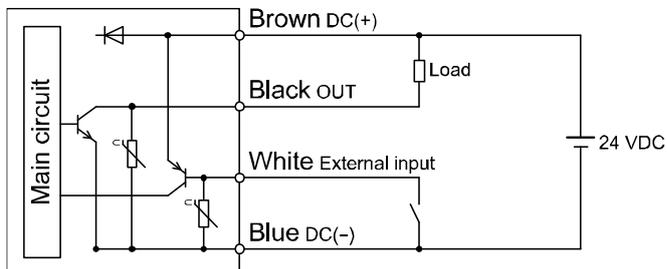
DS: Analogue output 4 to 20 mA

Max. load impedance 600 Ω

Min. load impedance: 50 Ω

NPN (1 output) + External input type

PF3A7##H-CS/DS#-##-#



Maximum applied voltage: 28 VDC

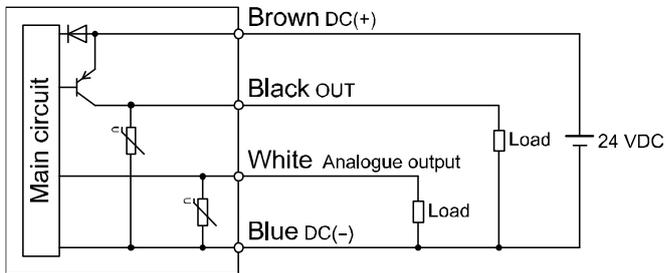
Maximum load current: 80 mA

Internal voltage drop 1 V max.

External input: Input voltage of 0.4 V max. (reed or solid state input) for 30 ms or longer

NPN + Analogue output type

PF3A7##H-ES/FS#-##-#



Maximum load current: 80 mA

Internal voltage drop 2 V max.

ES: Analogue output: Select 1 to 5 V or 0 to 10 V

Output impedance: 1 k

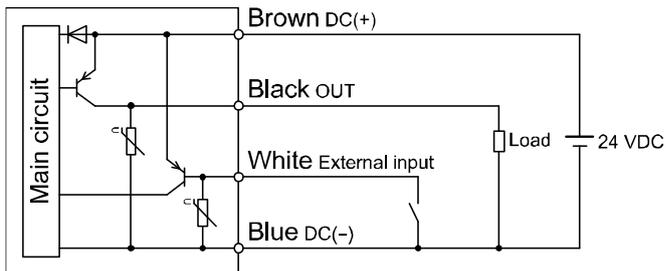
FS: Analogue output 4 to 20 mA

Max. load impedance: 600 Ω

Min. load impedance: 50 Ω

PNP (1 output) + External input type

PF3A7##H-ES/FS#-##-#



Maximum load current: 80 mA

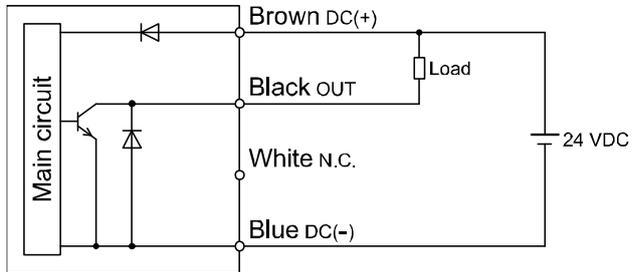
Internal voltage drop 2 V max.

External input: Input voltage of 0.4 V max. (reed or solid state input) for 30 ms or longer

IO-Link specification

NPN output type

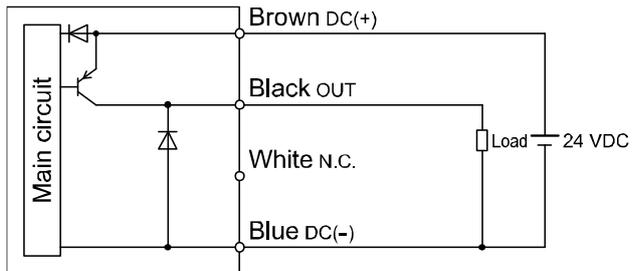
PF3A7##H-L#-##-#



Maximum applied voltage: 30 V
Maximum load current: 80 mA
Internal voltage drop 1.5 V max.

NPN output type

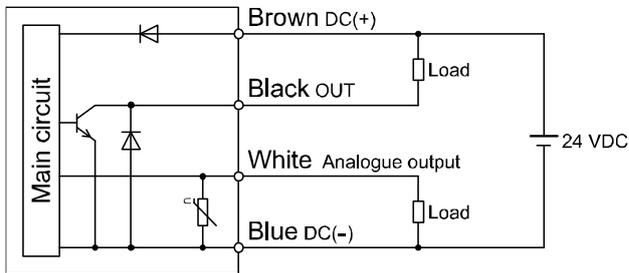
PF3A7##H-L#-##-#



Maximum load current: 80 mA
Internal voltage drop 1.5 V max.

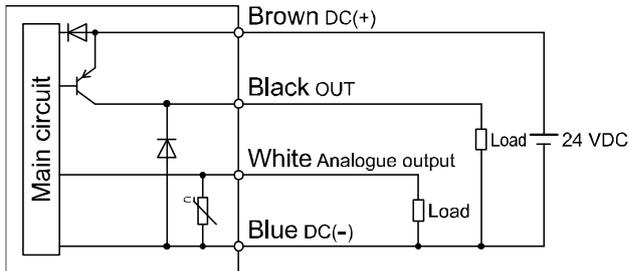
*: The output type (NPN or PNP) can be set using [F 0].

NPN + Analogue output type
PF3A7##H-L3/L4#-##-#



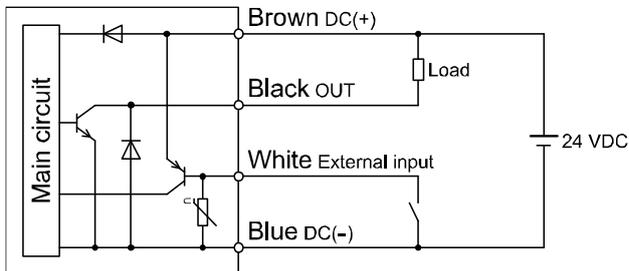
- Maximum applied voltage: 30 V
- Maximum load current: 80 mA
- Internal voltage drop 1.5 V max.
- L3: Analogue output: 1 to 5 V or 0 to 10 V
 Output impedance: 1 k Ω
- L4: Analogue output: 4 to 20 mA
 Max. load impedance: 600 Ω
 Min. load impedance: 50 Ω

PNP + Analogue output type
PF3A7##H-L3/L4#-##-#



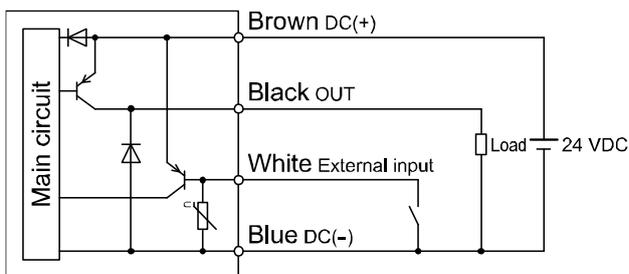
- Maximum load current: 80 mA
- Internal voltage drop 1.5 V max.
- L3: Analogue output: 1 to 5 V or 0 to 10 V
 Output impedance: 1 k Ω
- L4: Analogue output: 4 to 20 mA
 Max. load impedance: 600 Ω
 Min. load impedance: 50 Ω

NPN + External input type
PF3A7##H-L3/L4#-##-#



Maximum applied voltage: 30 V
 Maximum load current: 80 mA
 Internal voltage drop 1.5 V max.
 External input: applied voltage of 0.4 V max. (reed or solid state input) for 30 ms or longer

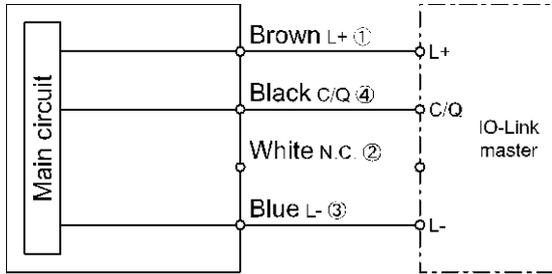
PNP + External input type
PF3A7##H-L3/L4#-##-#



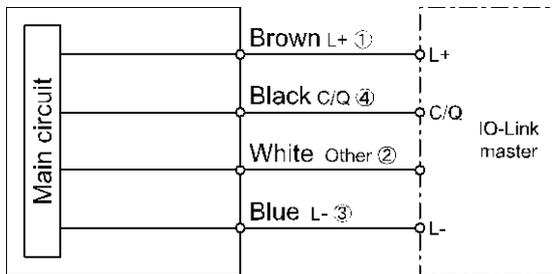
Maximum load current: 80 mA
 Internal voltage drop 2 V max.
 External input: Input voltage of 0.4 V max. (reed or solid state input) for 30 ms or longer

Used as IO-Link device

PF3A7##H-L#-##-#



PF3A7##H-L3/L4#-##-#

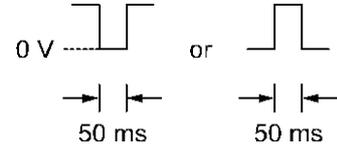
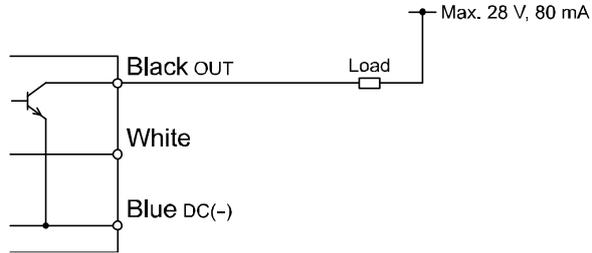


*: Numbers in the figures show the connector pin layout.

Example of wiring for accumulated pulse output

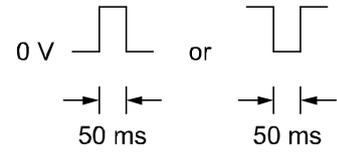
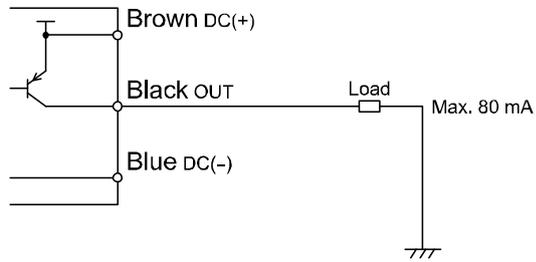
NPN output type

PF3A7##H-CS/DS/L/L3/L4#-##-#



PNP output type

PF3A7##H-ES/FS/L/L3/L4#-##-#



Change the Function Settings [Function selection mode]

Refer to the operation manual, available from the SMC website (URL <https://www.smcworld.com>) for settings below.

•Flow switch flow setting and functions

PF3A703H/PF3A706H/PF3A712H

•IO-Link function

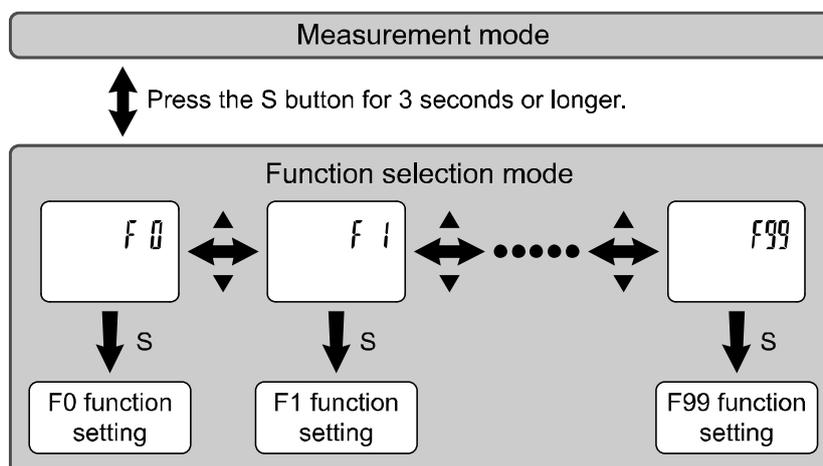
PF3A703H/PF3A706H/PF3A712H-L

■Function selection mode

In this mode, each function setting can be changed separately.

In measurement mode, press the S button for 3 seconds or longer to display [F 0].

Press the ▲ or ▼ button to select the function to be changed.



Press the S button for 2 seconds or longer to return to measurement mode.

■ Default setting

| Function (Main display) | | Default Settings (Right sub display) |
|------------------------------|--|---|
| (Main display) | (Left sub display) | |
| [F 0] | [rEF] Select display units | [Std] Standard condition |
| | [Uni] ([Unit]) Units selection function *1 | [L] L/min |
| | ([NorP]) Select NPN/PNP | ([PnP]) PNP output |
| [F 1] | [oUt] ([oUt1]) Select output mode | [HYS] Hysteresis mode |
| | [ot] ([1ot]) Select switch mode | [P] ([1_P]) Normal output |
| | [P] ([P_1]) Select input switch operation | [500] 500 L/min (PF3A701H) |
| | | [1000] 1000 L/min (PF3A702H) |
| | [H] ([H_1]) Setting of Hysteresis | [50] 50 L/min (PF3A701H) |
| | | [100] 100 L/min (PF3A702H) |
| | ([dt1]) Delay time setting | ([0.00]) 0.00 s |
| [CoL] Select display colour | [SoG] ([1SoG]) Green when ON Red when OFF (OUT1) | |
| ([F 2]) *2 | [oUt2] Select output mode | [HYS] Hysteresis mode |
| | [2ot] Select switch mode | [2_P] Normal output |
| | [P_2] Select input switch operation | [500] 500 L/min (PF3A701H) |
| | | [1000] 1000 L/min (PF3A702H) |
| | [H_2] Setting of Hysteresis | [50] 50 L/min (PF3A701H) |
| | | [100] 100 L/min (PF3A702H) |
| | [dt2] Delay time setting | [0.00] 0.00 s |
| [CoL] Select display colour | [1SoG] Green when ON Red when OFF (OUT1) | |
| [F 3] | [FIL] Select digital filter | [1.0] 1 second |
| [F 5] | [FnC] ([FUnC]) Select FUNC (switching analogue output/external input) *3 | [oUt] ([AoUt]) Analogue output |
| [F10] | [SUb] Select sub display (Line name setting *4) | [dEF] Default setting |
| [F13] | [rEv] Select Reverse display | [oFF] Reverse display OFF |
| [F14] | [CUt] Select Zero cut-off setting | [1.0] 1%F.S. cut |
| [F30] | [SAv] ([SAvE]) Accumulated value hold | [oFF] Not stored |
| [F80] | [dSP] ([diSP]) Display OFF mode | [on] Display ON |
| [F81] | [Pin] Security code | [oFF] Not used |
| [F90] | [ALL] Setting of all functions | [oFF] Not used |
| [F96] | [Sin] ([S_in]) Check of input signal | [- - -] No input signal |
| [F98] | [tES] ([tESt]) Setting of output check | [n] Normal output |
| [F99] | [ini] Reset to the default settings | [oFF] Not used |

*1: Setting is only possible for models with the units selection function.

*2: [F 2] The OUT2 setting can be set on the product screen, but since there is no OUT2 switch output function as an output specification, it is not possible to output the ON/OFF signal to an external device.

*3: When the 1 switch output type (output specification symbol is L) is used, [F 5] is displayed as [---] and cannot be set.
1 to 5 V or 0 to 10 V can be selected when the analogue voltage output type is used.
Analogue output free range function can be selected.

*4: When Line name is selected, a suitable line name can be input.

*5: Items in brackets are IO-Link specifications.

■ [F 0] Reference condition/Units selection function/Switch output function

Reference condition

Standard condition or normal condition can be selected.

Standard condition and normal condition are defined as follows:

- Standard condition: Displayed flow rate which is converted to volume at 20°C, 101.3 kPa (absolute pressure).
- Normal condition: Displayed flow rate which is converted to volume at 0°C, 101.3 kPa (absolute pressure).

Units selection function

With the units selection function, the selectable display units are L/min or cfm (ft³/min).

This setting is only available for models with the units selection function.

*: This function is not displayed for models without unit selection function.

*: For the product without the unit selection function, [L] is shown in the sub display on the left.

Switch output type

The switch output function can be selected (NPN or PNP output).

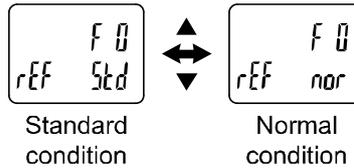
<Operation>

Display [F_0] by pressing ▲ or ▼ button in function selection mode.

Press the S button. ↓ Move on to the reference condition.

Reference condition

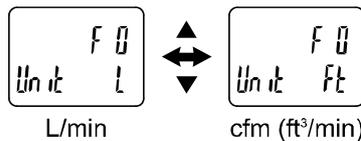
Press the ▲ or ▼ button to select the reference condition.



Press the S button to set. ↓ Move on to the units selection function.
(For units selection type)

Units selection function

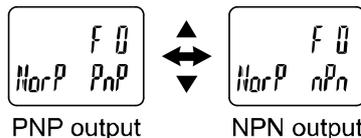
Press the ▲ or ▼ button to select the display unit.



Press the S button to set. ↓ Move on to the switch output function.
(For IO-Link type)

Switch output function

Press the ▲ or ▼ button to select the switch output function.



Press the S button to set. ↓ Return to function selection mode.

[F 0] Reference condition/Units selection function/Switch output function completed.

Flow specification when [Ft] is selected by the units selection function

| | | | | |
|------------------------------|----------------------------|------------------------|--------------------------------------|-----------------|
| Flow rate | Rated flow range | | 0.4 to 35.3 cfm | 0.8 to 70.6 cfm |
| | Setting flow range | Instantaneous flow | 0.4 to 37.1 cfm | 0.8 to 74.2 cfm |
| | | Accumulated flow | 0 to 999,999,999,999 ft ³ | |
| | Setting min. unit | Instantaneous flow | 0.1 cfm | |
| | | Accumulated flow | 1 ft ³ | |
| Accumulated pulse conversion | | 0.1, 1 ft ³ | 1, 10 ft ³ | |
| Display | Display controllable range | Instantaneous flow | 0 to 37.1 cfm | 0 to 74.2 cfm |
| | | Accumulated flow | 0 to 999,999,999,999 ft ³ | |
| | Display min. unit | Instantaneous flow | 0.1 cfm | |
| | | Accumulated flow | 1 ft ³ | |

*: Flow rate in the specification is the value at standard condition.

■[F14] Zero cut-off setting

When the flow is close to 0 L/min., the product rounds the value and zero will be displayed.

Flow value will be displayed even when the flow rate is 0 L/min. when the pressure is high or depending on the installation orientation.

Zero cut-off function makes the display zero.

The range to display zero can be changed.

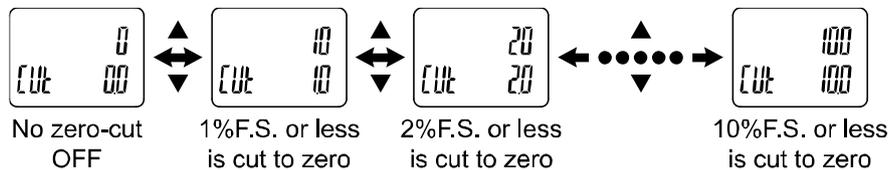
< Operation >

Display [F14] by pressing ▲ or ▼ button in function selection mode.

Press the S button. ↓ Select Zero cut-off setting.

Select zero cut-off setting

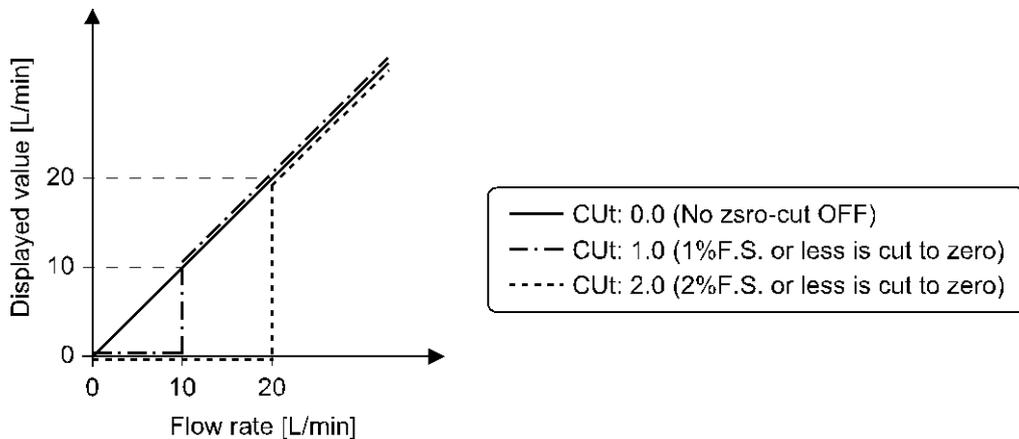
Press the ▲ or ▼ button to select the value of Zero cut-off.



*: The display above is an example of when [L] is selected for the PF3A701H (1000 L/min type) with the unit switching function.

*: If the flow rate does not reach the above value, the display will be zero.

Example: PF3A701H (1000 L/min type)



Press the S button to set. ↓ Return to function selection mode.

[F14] Zero cut-off setting completed

●Settable flow range when [L] is selected by the units selection function

| Zero cut-off set value | Zero cut-off range | Displayable flow range | |
|------------------------|--------------------|---|---|
| | | PF3A701H | PF3A702H |
| 0.0 * | 0%F.S. | 0 to 1050 L/min | 0 to 2100 L/min |
| 1.0 | 0 to 1%F.S. | 10 to 1050 L/min (Displays 0 when the value is below 10 L/min) | 20 to 2100 L/min (Displays 0 when the value is below 20 L/min) |
| 2.0 | 0 to 2%F.S. | 20 to 1050 L/min (Displays 0 when the value is below 20 L/min) | 40 to 2100 L/min (Displays 0 when the value is below 40 L/min) |
| 3.0 | 0 to 3%F.S. | 30 to 1050 L/min (Displays 0 when the value is below 30 L/min) | 60 to 2100 L/min (Displays 0 when the value is below 60 L/min) |
| 4.0 | 0 to 4%F.S. | 40 to 1050 L/min (Displays 0 when the value is below 40 L/min) | 80 to 2100 L/min (Displays 0 when the value is below 80 L/min) |
| 5.0 | 0 to 5%F.S. | 50 to 1050 L/min (Displays 0 when the value is below 50 L/min) | 100 to 2100 L/min (Displays 0 when the value is below 100 L/min) |
| 6.0 | 0 to 6%F.S. | 60 to 1050 L/min (Displays 0 when the value is below 60 L/min) | 120 to 2100 L/min (Displays 0 when the value is below 120 L/min) |
| 7.0 | 0 to 7%F.S. | 70 to 1050 L/min (Displays 0 when the value is below 70 L/min) | 140 to 2100 L/min (Displays 0 when the value is below 140 L/min) |
| 8.0 | 0 to 8%F.S. | 80 to 1050 L/min (Displays 0 when the value is below 80 L/min) | 160 to 2100 L/min (Displays 0 when the value is below 160 L/min) |
| 9.0 | 0 to 9%F.S. | 90 to 1050 L/min (Displays 0 when the value is below 90 L/min) | 180 to 2100 L/min (Displays 0 when the value is below 180 L/min) |
| 10.0 | 0 to 10%F.S. | 100 to 1050 L/min (Displays 0 when the value is below 100 L/min) | 200 to 2100 L/min (Displays 0 when the value is below 200 L/min) |

*: The zero-cut range of the accumulated value and accumulated pulse value should be 1% F.S. or more. However, please note that if the zero-cut set value is 0.0, any value below 1% F.S. will be cut.

*: When setting the flow value and hysteresis within zero cut-off settable range, the on-off point varies depending on the settable range. For details, please refer to switch output (OUT) value and hysteresis are set within Zero cut-off range (page 34).

●Flow specification when [Ft] is selected by the units selection function.

| Zero cut-off set value | Zero cut-off range | Set point range | |
|------------------------|--------------------|---|---|
| | | PF3A703H | PF3A706H |
| 0.0 * | 0%F.S. | 0 to 37.1 cfm | 0 to 74.2 cfm |
| 1.0 | 0 to 1%F.S. | 0.4 to 37.1 cfm (Displays 0 when the value is below 0.4 cfm) | 0.8 to 74.2 cfm (Displays 0 when the value is below 0.8 cfm) |
| 2.0 | 0 to 2%F.S. | 0.8 to 37.1 cfm (Displays 0 when the value is below 0.8 cfm) | 1.5 to 74.2 cfm (Displays 0 when the value is below 1.5 cfm) |
| 3.0 | 0 to 3%F.S. | 1.1 to 37.1 cfm (Displays 0 when the value is below 1.1 cfm) | 2.2 to 74.2 cfm (Displays 0 when the value is below 2.2 cfm) |
| 4.0 | 0 to 4%F.S. | 1.5 to 37.1 cfm (Displays 0 when the value is below 1.5 cfm) | 2.9 to 74.2 cfm (Displays 0 when the value is below 2.9 cfm) |
| 5.0 | 0 to 5%F.S. | 1.8 to 37.1 cfm (Displays 0 when the value is below 1.8 cfm) | 3.6 to 74.2 cfm (Displays 0 when the value is below 3.6 cfm) |
| 6.0 | 0 to 6%F.S. | 2.2 to 37.1 cfm (Displays 0 when the value is below 2.2 cfm) | 4.3 to 74.2 cfm (Displays 0 when the value is below 4.3 cfm) |
| 7.0 | 0 to 7%F.S. | 2.5 to 37.1 cfm (Displays 0 when the value is below 2.5 cfm) | 5.0 to 74.2 cfm (Displays 0 when the value is below 5.0 cfm) |
| 8.0 | 0 to 8%F.S. | 2.9 to 37.1 cfm (Displays 0 when the value is below 2.9 cfm) | 5.7 to 74.2 cfm (Displays 0 when the value is below 5.7 cfm) |
| 9.0 | 0 to 9%F.S. | 3.2 to 37.1 cfm (Displays 0 when the value is below 3.2 cfm) | 6.4 to 74.2 cfm (Displays 0 when the value is below 6.4 cfm) |
| 10.0 | 0 to 10%F.S. | 3.6 to 37.1 cfm (Displays 0 when the value is below 3.6 cfm) | 7.1 to 74.2 cfm (Displays 0 when the value is below 7.1 cfm) |

*: The zero-cut range of the accumulated value and accumulated pulse value should be 1% F.S. or more. However, please note that if the zero-cut set value is 0.0, any value below 1% F.S. will be cut.

*: When setting the flow value and hysteresis within zero cut-off settable range, the on-off point varies depending on the settable range. For details, please refer to switch output (OUT) value and hysteresis are set within Zero cut-off range (page 34).

- When the set value and hysteresis of the switch output (OUT1/2) is set within the zero-cut range. The operating point of the switch output will be changed, depending on the zero-cut setting value. However, please note that the set value and hysteresis of the switch output will not be changed. To maintain the on-off point, set the value and hysteresis without the zero cut-off range.

<Example: PF3A701H (1000 L/min type)>

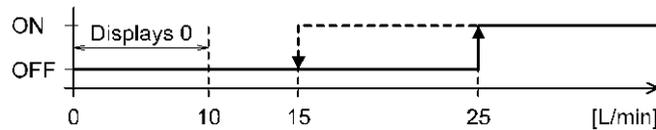
Common setting

| | |
|------------------|-----------------|
| Output mode | Hysteresis mode |
| Switch operation | Normal output |
| Set value (P) | 25 |
| Hysteresis (H) | 10 |

Initial setting

Zero cut-off setting CUt: 1.0 (displays 0 for a value below 10 L/min)

| | |
|------------------|------------------|
| Switch ON point | 25 L/min or more |
| Switch OFF point | Below 15 L/min |

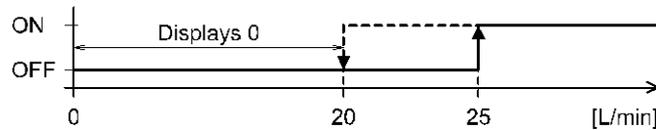


Change the zero cut-off setting
The set value (P) and hysteresis (H)
cannot be changed.

~Condition when the operating point of hysteresis (H) is changed~

•The zero-cut setting CUt: 1.0 will be changed to CUt: 2.0. (0 will be displayed for a value below 20 L/min)

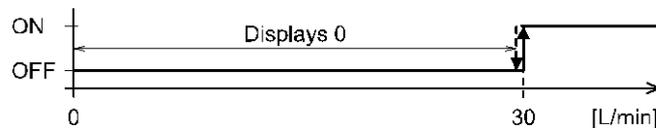
| | |
|------------------|---------------------------------|
| Switch ON point | 25 L/min or more |
| Switch OFF point | Below 20 L/min (0 is displayed) |



~Condition when the operating point of the set point (P) and hysteresis (H) is changed~

•The zero-cut setting CUt: 1.0 will be changed to CUt: 3.0. (0 will be displayed for a value below 30 L/min)

| | |
|------------------|---------------------------------|
| Switch ON point | 30 L/min or more |
| Switch OFF point | Below 30 L/min (0 is displayed) |



IO-Link Specifications

■ Outline of IO-Link functions

○ Communication function

This product can check the temperature measurement value, diagnostic information and switch output status using cyclic data communication via the IO-Link system.

○ Product status monitoring function

This function monitors the product status via the IO-Link.

- Several errors (e.g. internal hardware errors) can be monitored.
- Detects multiple warning conditions (flow rate error, Internal failure, etc.).

○ Data storage function

The Data storage function stores the IO-Link device parameter settings to the IO-Link master.

With the IO-Link data storage function, the IO-Link device can be replaced easily without re-setting the equipment construction or setting parameters

When the device parameter is set and downloaded to the device using the IO-Link setting tool, the parameter will be uploaded to the data storage in the master by the system command after download (backup instruction by the communication command).

When the device is replaced with the same type of IO-Link device due to failure, the parameter settings stored in the master are downloaded automatically, device can be operated with the parameter settings of the previous device.

Device parameter setting is applicable to 3 types of back-up levels of the master setting ("Inactive", "back-up/Restore", "Restore").

"Back-up" implies the activation of upload and "restore" implies download.

■ Communication specifications

| | |
|-------------------------------|---|
| IO-Link type | Device |
| IO-Link version | V1.1 |
| Communication speed | COM2 (38.4 kbps) |
| Min. cycle time | 3.3 ms |
| Process data length | Input Data: 6 byte, Output Data: 0 byte |
| On request data communication | Available |
| Data storage function | Available |
| Event function | Available |

■ Process data

Process data is the data which is exchanged periodically between the master and device.
This product process data consists of switch output status, error diagnostics, fixed output and flow measurement value.

(Refer to the table below.)

| Bit offset | Item | Notes |
|------------|-------------------------|--|
| 0 | OUT1 output | 0: OFF 1: ON |
| 1 | OUT2 output | 0: OFF 1: ON |
| 8 | Measurement diagnostics | 0: Within range 1: Out of range (HHH) |
| 14 | Fixed output | 0: Normal output 1: Fixed output (Setting of output check) |
| 15 | Error Diagnosis | 0: Error not generated 1: Error generated |
| 16 to 31 | Flow measurement value | With sign: 16 bit |

| Bit offset | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|------------|-----------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Item | Flow measurement value (PD) | | | | | | | | | | | | | | | |

| Bit offset | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-----------------|--------------|-------------|----|----|----|----------------|-------------|---|---|---|------|---------------|---|---|---|
| Item | Error diagnosis | Fixed output | Reservation | | | | Flow diagnosis | Reservation | | | | OUT2 | OUT1 | | | |
| | | | | | | | | | | | | | Switch output | | | |

•The process data of this product is Big-Endian type.

When the transmission method of the upper communication is Little-Endian, the byte order will be changed.

Refer to the table below for the Endian type of the major upper communication.

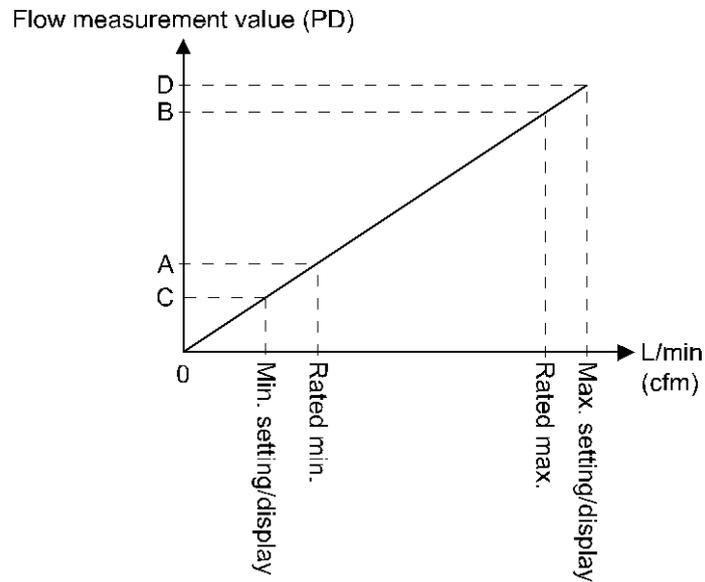
| | |
|--------------------|---|
| Endian type | Upper communication protocol |
| Big-Endian type | Such as PROFIBUS and PROFINET |
| Little-Endian type | Such as EtherNET/IP, EtherCAT and CC-Link IE Field. |

○Unit specification and flow measurement value (PD)

| Series | Unit | Flow range | Flow value | | PD value | | | | | |
|---------|-------|------------|------------------|------|------------------------|------|----|------|----|------|
| | | | Rated flow range | | Display/settable range | | | | | |
| | | | Min. | Max. | Min. | Max. | A | B | C | D |
| PF3A7#H | L/min | 1,000 L | 10 | 1000 | 10 | 1050 | 40 | 4000 | 40 | 4200 |
| | | 2,000 L | 20 | 2000 | 20 | 2100 | 40 | 4000 | 40 | 4200 |
| | cfm | 1,000 L | 0.4 | 35.3 | 0.4 | 37.1 | 40 | 4000 | 40 | 4200 |
| | | 2,000 L | 0.8 | 70.6 | 0.8 | 74.2 | 40 | 4000 | 40 | 4200 |

*: The flow ranges and relationship between the fluid and PD are shown in the figures below.

●Relationship between flow rate and PD



○ Conversion formula of the process data and flow measurement value

(1) Conversion formula from the process data to the flow measurement value:

$$Pr = a \times (PD) + b$$

(2) Conversion formula from the flow gauge measurement value to the process data:

$$(PD) = (Pr - b) / a$$

Pr: Flow measurement value and pressure set value

PD: Flow measurement value (process data)

a: Inclination

b: Intercept

[Inclination and intercept to the unit specification]

| Series | Unit | Flow range | Inclination a | Intercept b |
|---------|-------|------------|---------------|-------------|
| PF3A7#H | L/min | 1000 L | 0.25 | 0 |
| | | 2000 L | 0.50 | 0 |
| | cfm | 1000 L | 0.0088275 | 0 |
| | | 2000 L | 0.0176575 | 0 |

[Calculation example]

(1) Conversion from the process data to the flow measurement value

(For PF3A701H series, unit L/min, flow range 1000 L and PD = 2800)

$$\begin{aligned} Pr &= a \times (PD) + b \\ &= 0.25 \times 2800 + 0 \\ &= 700 \text{ [L/min]} \end{aligned}$$

(2) Conversion from the flow measurement value to the process data

(For PF3A702H series, unit L/min, flow range 2000 L and Pr = 1750 [L/min])

$$\begin{aligned} (PD) &= (Pr - b) / a \\ &= [1750 - 0] / 0.50 \\ &= 3500 \end{aligned}$$

■ IO-Link parameter setting

○ IODD file

IODD (I/O Device Description) is a definition file which provides all properties and parameters required for establishing functions and communication of the device.

IODD includes the main IODD file and a set of image files such as vendor logo, device picture and device icon.

The IODD file is shown below.

| Product No. | IODD file * |
|-------------------|--|
| PF3A7*H-*-L*-*-** | SMC-PF3A7*H-*-L*-*-**--yyymmdd-IODD1.1 |

: "" indicates the product No., and the product No. applicable to each IODD file input.

*: "yyymmdd" indicates the file preparation date. yyyy is the year, mm is the month and dd is the date.

The IODD file can be downloaded from the SMC website (URL <https://www.smcworld.com>).

○ Service data

The tables below indicate the parameters which can be read or written by simple access parameter (direct parameters page) and ISDU parameters which are applicable to various parameters and commands.

● Direct parameters page 1

| DPP1 address | Access | Parameter name | Initial value (dec) | Content |
|--------------|--------------|---------------------|---------------------|---------------------|
| 0x07 | R | Vendor ID | 0x0083 (131) | "SMC Corporation" |
| 0x08 | | | | |
| 0x09 | R | Device ID | 0X018A (394) | PF3A701H-xx-Lx-xxx |
| 0x0A | | | 0X018B (395) | PF3A701H-xx-L3x-xxx |
| | | | 0X018C (396) | PF3A701H-xx-L4x-xxx |
| | | | 0X018D (397) | PF3A702H-xx-Lx-xxx |
| 0x0B | 0X018E (398) | PF3A702H-xx-L3x-xxx | | |
| | 0X018F (399) | PF3A702H-xx-L4x-xxx | | |

●ISDU parameters

| Index (dec) | Sub index | Access *1 | Parameters | Initial value | Remarks |
|----------------|-----------|-----------|---------------------------------|------------------------------|--|
| 0x0002 (2) | 0 | W | System command | - | Refer to "System command" on page 40. |
| 0x000C (12) | 0 | R/W | Device access lock | 0x0000 | Refer to "Device access lock parameter" on page 41. |
| 0x0010 (16) | 0 | R | Vendor name | SMC Corporation | |
| 0x0011 (17) | 0 | R | Vendor text | www.smcworld.com | |
| 0x0012 (18) | 0 | R | Product name | Example: PF3A701H-Lx-xx-x | |
| 0x0013 (19) | 0 | R | Product ID | Example: PF3A701H-Lx-xx-x | |
| 0x0014 (20) | 0 | R | Product text | Flow sensor | |
| 0x0015 (21) | 0 | R | Serial number | Example: "xxxxxxxx" | •Initial value is indicated as 8-digit. •16 octets fixed character string |
| 0x0016 (22) | 0 | R | Hardware version | HW-Vx.y | x: Large revision number y: Small revision number |
| 0x0017 (23) | 0 | R | Software version | FW-Vx.y | x: Large revision number y: Small revision number |
| 0x0024 (36) | 0 | R | Device status parameter | - | Refer to "Device state parameters" on page 41. |
| 0x0025 (37) | 0 | R | Device detailed state parameter | - | Refer to "Device detailed state parameter" on page 42. |
| 0x0028 (40) | 0 | R | Process data input | - | The latest value of process data can be read. |

*1: R: Read, W: Write

●System command (index 2)

In the ISDU index 0x002 SystemCommand (system command), the command shown in the table below will be issued.

The button of each system command is displayed on the IO-Link setting tool (excluding "ParamDownloadStore").

Click the button to send the system command to the product.

Writable commands are shown below.

Data type: 8 bit UInteger

| Value | Function definition | Description |
|-------|------------------------|---|
| 128 | Device Reset | Restarts the device |
| 129 | Application Reset | Reset of the peak/bottom value (flow rate/temperature) Reset of the accumulated flow value |
| 130 | Restore Factory Reset | Initialize the set value to the default value |
| 170 | Flow peak bottom Reset | Reset of peak/bottom value (flow rate) |
| 190 | Integrated flow Reset | Reset of the accumulated flow value |

- Device access lock parameter (index 12)

The contents are as follows.

Data type: 16 bit Record

| Value | Contents |
|-------|---|
| 0 | Key lock release, DS unlock (Initial value) |
| 2 | Key lock release, DS lock |
| 8 | Key lock, DS unlock |
| 10 | Key lock, DS lock |

[Key lock]

This function prevents the user from physically changing the setting of the flow switch (button operation is not accepted).

Even when key lock function is activated, settings can be changed by IO-Link communication.

Restoration by data storage (overwriting parameter data) can be performed.

[Lock data storage (DS lock)]

Locking "Data storage" will invalidate the data storage function of the flow switch.

In this case, access will be denied for backup and restoration of data storage.

- Device state parameters (index 36)

Readable device states are as follows.

Data type: 8 bit UInteger

| Value | State definition | Description |
|-------|---------------------------------|---|
| 0 | Normal operation | - |
| 1 | Maintenance inspection required | Not available |
| 2 | Outside specification range | Outside the flow measurement range |
| 3 | Function check | Not available |
| 4 | Failure | Internal failure of digital flow switch |

- Device detail status parameters (index 37)

Detailed event contents of readable device status are as follows.

| Array | Event content | Event classification | | Event code |
|-------|--|----------------------|-------|------------|
| | | Definition | Value | |
| 1 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D02 |
| 2 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D03 |
| 3 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D04 |
| 4 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D05 |
| 5 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D01 |
| 6 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D06 |
| 7 | Internal failure of digital flow switch | Error | 0xF4 | 0x8D08 |
| 8 | Flow sensor error | Error | 0xF4 | 0x8CD0 |
| 9 | Temperature sensor error | Error | 0xF4 | 0x8CD1 |
| 10 | Outside the accumulated flow value measurement | warning | 0xE4 | 0x8D80 |
| 11 | Outside the instantaneous flow measurement | warning | 0xE4 | 0x8C10 |
| 12 | Test event A | warning | 0xE4 | 0x8CA0 |
| 13 | Test event B | warning | 0xE4 | 0x8CA1 |
| 14 | Data storage upload request | notification | 0x54 | 0xFF91 |

●Product individual parameters

| Index | | Sub index | Access *1 | Parameter | Data type *2 | Initial value | Data storage *3 | Set value *4 | Remarks |
|-------|--------|-----------|-----------|---|--------------|---------------|-----------------|--|--|
| dec | hex | | | | | | | | |
| 1000 | 0x03E8 | 0 | R/W | Unit (Selection of display unit) | U8 | 0 | Y | 0: L/min (L) 1: cfm (ft ³) | When the unit selection function is not included, a read/write to an un-selectable item is rejected. |
| 1010 | 0x03F2 | 0 | R/W | CoL (Selection of display colour) | U8 | 2 | Y | 0: rEd (Constantly red) 1: Grn (Constantly green) 2: 1SoG (OUT1 turns green at ON) 3: 1Sor (OUT1 turns red at ON) 4: 2SoG (OUT2 turns green at ON) 5: 2Sor (OUT2 turns red at ON) | Setting of display colour |
| 1020 | 0x03FC | 0 | R/W | NorP (Selection of switch output PNP/NPN) | U8 | 1 | Y | 0: NPN 1: PNP | Setting the switch output |
| 1030 | 0x0406 | 0 | R/W | Change by FUNC | U8 | 0 | Y | 0: Aout (Analogue output) 1: in (Exterior input) | FUNC terminal function setting |
| 1070 | 0x042E | 0 | R/W | Reference condition | U8 | 0 | Y | 0: std (Standard condition) 1: nor (Normal condition) | |
| 1210 | 0x04BA | 1 | R/W | oUt1 (Selection of output mode) | U8 | 0 | Y | 0: HYS (Hysteresis) 1: Wind (Window comparator) 2: AC (Accumulated output) 3: PLS (Accumulated pulse) 4: Err (Error output) 5: oFF (Output OFF) | |
| | | 2 | R/W | 1ot (Selection of output type) | U8 | 0 | Y | 0: 1_P (Normal output) 1: 1_n (Reverse output) | Setting of OUT1 output normal and reserved output |
| 1220 | 0x04C4 | 1 | R/W | P_1 (n_1) (Selection of output set value) | S16 | 2000 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT1 output set value (Hysteresis) |
| | | 2 | R/W | H_1 (Setting of OUT1 hysteresis) | U16 | 200 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT1 hysteresis (Hysteresis) |
| | | 3 | R/W | P1L (n1L) (Lower limit of window comparator) | S16 | 1200 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT1 output set value (Lower limit of window comparator) |
| | | 4 | R/W | P1H (n1H) (Upper limit of window comparator) | S16 | 2400 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT1 output set value (Upper limit of window comparator) |
| | | 5 | R/W | WH1 (Window comparator hysteresis) | U16 | 400 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT1 hysteresis (Window comparator) |
| | | 6 | R/W | dt1 (Delay time) | U16 | 0 | Y | Settable values 0x0000 to 0x1770 (0 to 6000) | Setting of OUT1 delay time 10 ms increment |

●Product individual parameters (continued)

| Index | | Sub index | Access *1 | Parameter | Data type *2 | Initial value | Data storage *3 | Set value *4 | Remarks | | | | | | | |
|-------|--------|-----------|-----------|------------------------------------|--|---------------|-----------------|--|---|--|--|-----|------|---|---|--|
| dec | hex | | | | | | | | | | | | | | | |
| 1410 | 0x0582 | 1 | R/W | oUt2 (Selection of output mode) | U8 | 0 | Y | 0: HYS (Hysteresis) 1: Wind (Window comparator) 2: AC (Accumulated output) 3: PLS (Accumulated pulse) 4: Err (Error output) 5: oFF (Output OFF) | | | | | | | | |
| | | 2 | R/W | | | | | | | 2ot (Selection of output type) | U8 | 0 | Y | 0: 2_P (Normal output) 1: 2_n (Reverse output) | Setting of OUT2 output normal and reserved output | |
| 1420 | 0x058C | 1 | R/W | OUT2 setting | P_2 (n_2) (Selection of output set value) | S16 | 2000 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT2 output set value (Hysteresis) | | | | | | |
| | | 2 | R/W | | | | | | | | H_2 (Setting of OUT2 hysteresis) | U16 | 200 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT2 hysteresis (Hysteresis) |
| | | 3 | R/W | | | | | | | | P2L (n2L) (Lower limit of window comparator) | S16 | 1200 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT2 output set value (Lower limit of window comparator) |
| | | 4 | R/W | | | | | | | | P2H (n2H) (Upper limit of window comparator) | S16 | 2400 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT2 output set value (Upper limit of window comparator) |
| | | 5 | R/W | | | | | | | | WH2 (Window comparator hysteresis) | U16 | 400 | Y | Setting range Refer to "Settable range list". (Page 47) | Setting of OUT2 hysteresis (Window comparator) |
| | | 6 | R/W | | | | | | | | dt2 (Delay time) | U16 | 0 | Y | Settable values 0x0000 to 0x1770 (0 to 6000) | Setting of OUT2 delay time 10 ms increment |
| 1300 | 0x0514 | 1 | R/W | OUT1 accumulated flow setting | AC1_L (OUT1 set value (L)) | S16 | 0 | Y | Setting range 0x0000 to 0x270F (0 to 9999) | Setting of OUT1 set value Unit specification (Unit): When "L" is selected | | | | | | |
| | | 2 | R/W | | | | | | | | AC1_L (OUT1 index (L)) | S16 | 0 | Y | Setting range 0x0000 to 0x0008 (0 to 8) | Setting of OUT1 index value Unit specification (Unit): When "L" is selected |
| 1310 | 0x051E | 1 | R/W | OUT1 accumulated flow setting | AC1_Ft ³ (OUT1 set value (Ft ³)) | S16 | 0 | Y | Setting range 0x0000 to 0x270F (0 to 9999) | Setting of OUT1 set value Unit specification (Unit): When "Ft ³ " is selected | | | | | | |
| | | 2 | R/W | | | | | | | | AC1_Ft ³ (OUT1 index (Ft ³)) | S16 | 0 | Y | Setting range 0x0000 to 0x0008 (0 to 8) | Setting of OUT1 index value Unit specification (Unit): When "Ft ³ " is selected |
| 1500 | 0x05DC | 1 | R/W | OUT2 accumulated flow setting | AC2_L (OUT2 set value (L)) | S16 | 0 | Y | Setting range 0x0000 to 0x270F (0 to 9999) | Setting of OUT2 set value Unit specification (Unit): When "L" is selected | | | | | | |
| | | 2 | R/W | | | | | | | | AC2_L (OUT2 index (L)) | S16 | 0 | Y | Setting range 0x0000 to 0x0008 (0 to 8) | Setting of OUT2 index value Unit specification (Unit): When "L" is selected |
| 1510 | 0x05E6 | 1 | R/W | OUT2 accumulated flow setting | AC2_Ft ³ (OUT2 set value (Ft ³)) | S16 | 0 | Y | Setting range 0x0000 to 0x270F (0 to 9999) | Setting of OUT2 set value Unit specification (Unit): When "Ft ³ " is selected | | | | | | |
| | | 2 | R/W | | | | | | | | AC2_Ft ³ (OUT2 index (Ft ³)) | S16 | 0 | Y | Setting range 0x0000 to 0x0008 (0 to 8) | Setting of OUT2 index value Unit specification (Unit): When "Ft ³ " is selected |

●Product individual parameters (continued)

| Index | | Sub index | Access *1 | Parameter | Data type *2 | Initial value | Data storage *3 | Set value *4 | Remarks |
|-------|--------|-----------|-----------|--|---------------------|---------------|-----------------|---|--|
| dec | hex | | | | | | | | |
| 1320 | 0x0528 | 0 | R/W | OUT1 accumulated pulse converted value PLS1_L | U8 | 0 | Y | 0: 100 (L/pulse) 1: 1000 (L/pulse) | Accumulated pulse converted value setting |
| 1330 | 0x0532 | 0 | R/W | | PLS1_F ³ | U8 | 0 | Y | |
| 1520 | 0x05F0 | 0 | R/W | OUT2 accumulated pulse converted value PLS1_L | U8 | 0 | Y | 0: 100 (L/pulse) 1: 1000 (L/pulse) | |
| 1530 | 0x05FA | 0 | R/W | | PLS1_F ³ | U8 | 0 | Y | |
| 1600 | 0x0640 | 0 | R/W | AC (Setting of the accumulated flow output direction) | U8 | 0 | Y | 0: Add (Addition) 1: dEC1 (Subtraction OUT1) 2: dEC2 (Subtraction OUT2) | Setting of the accumulated flow output direction |
| 1800 | 0x0708 | 0 | R/W | FiL (Digital filter) | U8 | 0 | Y | 0: 1.0 sec 1: 2.0 sec 2: 5.0 sec | Set digital filter |
| 2000 | 0x07D0 | 1 | R/W | Sub (Setting of lower level display) | U8 | 0 | Y | 0: dEF (Default) 1: LinE (Line name) 2: oFF (Display is OFF) | Setting of the lower level display |
| | | 2 | R/W | dEF [Selection of display items during dEF setting] | U8 | 20 | Y | Refer to "Selection of display items" when dEF is set". (Page 48) | [Setting of display items of lower display during dEF setting] |
| 2020 | 0x07E4 | 0 | R/W | rEv (Reserved Display setting) | U8 | 0 | Y | 0: oFF (Normal display) 1: on (Reversed display) | Reserved Display setting |
| 2030 | 0x07EE | 0 | R/W | Cut (Zero cut-off setting) | U8 | 0 | Y | Setting range 0x0000 to 0x000A (0 to 10) | 1.0% increments |
| 2040 | 0x07F8 | 0 | R/W | in (External input setting) | U8 | 0 | Y | 0: rAC (Reset accumulation) 1: rPb (Reset peak/bottom) | External input setting |
| 2100 | 0x0834 | 0 | R/W | AoUt (Setting of analogue output) | U8 | 0 | Y | 0: 1 to 5 V 1: 0 to 10 V | Setting of analogue output (Voltage output type only) |
| 2110 | 0x083E | 1 | R/W | FrEE (Setting of free range mode) | U8 | 0 | Y | 0: oFF (Unused) 1: on (Used) | Setting of free range mode |
| | | 2 | R/W | F_H (Set value of free range) | S16 | 4000 | Y | Setting range 0x0190 to 0x1068 (400 to 4200) | Set value of free range Rated value 10% to 105% |
| 2200 | 0x0898 | 0 | R/W | SAVE (Accumulated flow value hold setting) | U8 | 0 | Y | 0: oFF (Not held) 1: 2.0 min 2: 5.0 min | |
| 2400 | 0x0960 | 0 | R/W | diSP (Display OFF setting) | U8 | 0 | Y | 0: on 1: oFF | |

●Product individual parameters (continued)

| Index | | Sub index | Access *1 | Parameter | | Data type *2 | Initial value | Data storage *3 | Set value *4 | Remarks |
|-------|--------|-----------|-----------|-------------------------------|-----------------------------------|--------------|---------------|------------------------------|---|---|
| dec | hex | | | | | | | | | |
| 2410 | 0x096A | 1 | R/W | Security code | Pin (Security code Used/Not used) | U8 | 0 | Y | 0: oFF (Unused) 1: on (Used) | |
| | | 2 | R/W | | PinCode (Security code setting) | U16 | 0 | Y | Setting range 0x0000 to 0x03E7 (0 to 999) | |
| 2420 | 0x0974 | 1 | R/W | Lower level screen | Line name 1st letter | U8 | 0 | Y | Refer to "Line name: communication data". (Page 49) | 11 seg |
| | | 2 | R/W | | Line name 2nd letter | U8 | 0 | Y | | 7seg |
| | | 3 | R/W | | Line name 3rd letter | U8 | 0 | Y | | 7seg |
| | | 4 | R/W | | Line name 4th letter | U8 | 0 | Y | | 7seg |
| | | 5 | R/W | | Line name 5th letter | U8 | 0 | Y | | 7seg |
| | | 6 | R/W | | Line name 6th letter | U8 | 0 | Y | | 11seg |
| | | 7 | R/W | | Line name 7th letter | U8 | 0 | Y | | 7seg |
| | | 8 | R/W | | Line name 8th letter | U8 | 0 | Y | | 7seg |
| | | 9 | R/W | | Line name 9th letter | U8 | 0 | Y | | 7seg |
| 7000 | 0x1B58 | 0 | W | Communication OUT output test | Communication OUT output test | U8 | - | N | 0: Normal output 1: Fixed output | The PD becomes 1 when a fixed output has been received |
| 7010 | 0x1B62 | 0 | W | | Toggle output command | U8 | - | N | Refer to table "Toggle output command". (Page 47) | |
| 7100 | 0x1BBC | 0 | R | Analogue output value | | U16 | - | N | 0x0000 to 0x0BB8 (0 to 3000) | Analogue output type only |
| 8000 | 0x1F40 | 0 | R | Measurement related | Inclination of flow rate PD a | F32 | - | N | Refer to "Inclination and intercept to the unit specification" (Page 38) | |
| 8010 | 0x1F4A | 0 | R | | Flow rate PD intercept b | F32 | - | N | Refer to "Inclination and intercept to the unit specification" (Page 38) | |
| 8020 | 0x1F54 | 0 | R | | Flow peak value | S16 | - | N | 0x0000 to 0x1068 (0 to 4200) | |
| 8030 | 0x1F5E | 0 | R | | Flow bottom value | S16 | - | N | 0x0000 to 0x1068 (0 to 4200) | |
| 8040 | 0x1F68 | 1 | R | | Accumulated mantissa | S16 | - | N | 0x0000 to 0x270F (0 to 9999) | Accumulated mantissa x accumulated index = current accumulated flow (0 to 8) |
| | | 2 | R | Accumulated index | S16 | - | N | 0x0000 to 0x0008 (0 to 8) | | |

*1: "R" means Read and "W" means Write.

*2: Refer to the table below for the symbol.

| Symbol | Data type (IO-Link standard) | Data length Bit [byte] | Description |
|--------|---------------------------------|---------------------------|-----------------------|
| U8 | UIntegerT | 8[1] | Unsigned integer |
| U16 | | 16[2] | |
| S16 | IntegerT | 16[2] | Signed integer |
| F32 | Float32T | 32[4] | Floating point number |

*3: "Y" indicates that the parameter setting data is saved to the master, and "N" indicates that the parameter is not saved.

*4: Read/write to un-selectable items will be rejected depending on the product No.

[Set range list]

| Item | Setting range (PD) |
|----------------------|----------------------------------|
| P_1/P_2 (n_1/n_2) | 0x0028 to 0x1068 (40 to 4200) |
| H_1/H_2 | 0x0000 to 0x1040 (0 to 4160) |
| P1L/P2L (n1L/n2L) | 0x0028 to 0x1068 (40 to 4200) |
| P1H/P2H (n1H/n2H) | 0x0028 to 0x1068 (40 to 4200) |
| WH1/WH2 | 0x0000 to 0x0820 (0 to 2080) |

[Toggle output command]

| Item | Value | Notes |
|-----------------|-------|--|
| Measured value | 0 | |
| OUT output bit | OUT1 | Connected with hardware output (Not connected as OUT2 does not have the hardware) |
| | OUT2 | |
| Analogue output | 80 | |
| Diagnosis bit | 224 | |
| Error bit | 255 | |

[dEF selection of display items during standard setting]

| Value | Setting content | | Supplemental information |
|-------|---|--------------------------------|---|
| 0 | OUT1 | HYS mode set value | When the value which does not match the OUT* output mode setting is written, acknowledgment is sent |
| 1 | | HYS mode hysteresis | |
| 2 | | Wind mode lower side set value | |
| 3 | | Wind mode upper side set value | |
| 4 | | Wind mode hysteresis | |
| 5 | | Accumulated output mode | |
| 6 | | Accumulated pluse output mode | |
| 7 | | Err mode | |
| 8 | | oFF mode | |
| 9 | OUT2 | HYS mode set value | |
| 10 | | HYS mode hysteresis | |
| 11 | | Wind mode lower side set value | |
| 12 | | Wind mode upper side set value | |
| 13 | | Wind mode hysteresis | |
| 14 | | Accumulated output mode | |
| 15 | | Accumulated pluse output mode | |
| 16 | | Err mode | |
| 17 | | oFF mode | |
| 18 | Flow bottom value | | |
| 19 | Flow peak value | | |
| 20 | Accumulated flow value | | |
| 21 | Switch output mode/communication mode display | | SIO mode/SDCI mode (Refer to page 13) |
| 22 | Option display | | Line name, not displayed |

[Line name communication data]

| Value (16 hex number) | | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
|--------------------------|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Display letter | 7seg | 8 | 6 | 0 | 8 | 8 | 8 | 0 | 8 | 1 | 0 | 8 | 0 | 0 | 0 | 0 | 0 |
| | 11seg | 8 | 6 | 0 | 8 | 8 | 8 | 0 | 8 | 1 | 0 | 8 | 0 | 0 | 0 | 0 | 0 |
| Value (16 hex number) | | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 1A | 1B | 1C | 1D | 1E | 1F |
| Display letter | 7seg | / | 7 | 5 | 8 | 0 | 0 | 0 | / | 8 | / | 0 | 0 | 2 | 3 | 4 | 5 |
| | 11seg | 8 | 7 | 5 | 8 | 0 | 0 | 0 | 8 | 8 | 3 | 0 | 0 | 2 | 3 | 4 | 5 |
| Value (16 hex number) | | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 2A | 2B | 2C | 2D | 2E | 2F |
| Display letter | 7seg | 8 | 0 | 8 | 9 | 1 | 1 | 1 | / | / | / | / | / | / | / | / | 1 |
| | 11seg | 8 | 0 | 8 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Specifications

| Models | | PF3A701H | PF3A702H | |
|---------------------------|---|---|------------------------|------------------|
| Fluid | Applicable fluid *1 | Air, N ₂ | | |
| | Operating fluid temperature | 0 to 50 °C | | |
| Flow specifications | Detection method | Heating type sensor (branch flow type) | | |
| | Rated flow range | 10 to 1000 L/min | 20 to 2000 L/min | |
| | Set point range | Instantaneous flow | 10 to 1050 L/min | 20 to 2100 L/min |
| | | Accumulated flow | 0 to 999,999,999,990 L | |
| | Minimum resolution | Instantaneous flow | 1 L/min | 2 L/min |
| | | Accumulated flow | 10 L | |
| | Accumulated volume per pulse (Pulse width = 50 msec.) | Select from 10 L/pulse and 100 L/pulse | | |
| | Accumulated value hold *2 | 2 minutes or 5 minutes | | |
| Pressure specifications | Rated pressure range | 0 to 1.0 MPa | | |
| | Proof pressure | 1.5 MPa | | |
| | Pressure loss | Refer to the pressure loss graph | | |
| | Pressure Characteristics *3 | ±5.0%F.S. (0 to 1.0 MPa, 0.5 MPa standard) | | |
| Electrical specifications | Power supply voltage | 24 VDC ±10% | | |
| | Current consumption | 150 mA or less | | |
| | Protection | Polarity protection | | |
| Accuracy | Display accuracy *4 | ±3.0%F.S. | | |
| | Analogue output accuracy *4 | ±3.0%F.S. | | |
| | Repeatability | ±1.0%F.S. | | |
| | Temperature characteristics | ±5.0%F.S. (Ambient temp. 0 to 50 °C, 25 °C standard) | | |
| | Impact when modular devices are connected *5 | ±5.0% | | |
| Switch output | Output type | NPN open collector, PNP open collector | | |
| | Output mode | Selects one of the output (hysteresis or window comparator mode), the output for the accumulated flow and the accumulated pulse output. | | |
| | Switch operation | Normal or reversed output | | |
| | Maximum load current | 80 mA | | |
| | Maximum applied voltage (Only NPN) | 28 VDC | | |
| | Internal voltage drop (Residual voltage) | NPN output type: 1 V or less (at load current of 80 mA) PNP output type: 2 V or less (at load current of 80 mA) | | |
| | Response time *8 | Select from 1 s, 2 s, 5 s. | | |
| | Hysteresis *7 | Variable | | |
| | Protection | Over current protection | | |

| Models | | PF3A701H | PF3A702H | |
|---------------------------------|--------------------------|---|--|---|
| Analogue output *9 | Output type | | Voltage output: 1 to 5 V (0 to 10 V can also be selected *9), Current output: 4 to 20 mA | |
| | Impedance | Output voltage | Output impedance approx. 1 k Ω | |
| | | Current output | Max. load impedance 600 Ω Min. load impedance 50 Ω | |
| | Response time *11 | | Linked with the response time of the switch output | |
| Ext. input *12 | Input type | | Input with no voltage: 0.4 V or less | |
| | Input mode | | Select from the Reset of Accumulated Value, Reset Peak and Reset Bottom values | |
| | Time for input | | 30 ms or more | |
| Display | Reference condition *13 | | Normal or Standard condition | |
| | Unit *14 | Instantaneous flow | L/min, cfm (ft ³ /min) | |
| | | Accumulated flow | L, ft ³ | |
| | Display range *15 | Instantaneous flow | 0 to 1050 L/min (Displays 0 when the value is below 10 L/min.) | 0 to 2100 L/min (Displays 0 when the value is below 20 L/min.) |
| | | Accumulated flow *16 | 0 to 999,999,999,990 L | |
| | Minimum display unit | Instantaneous flow | 1 L/min | 2 L/min |
| | | Accumulated flow | 10 L | |
| | Display | | Display method: LCD Number of displays: 2 (main display and sub display) Colour (main display): Red and green Display colour (sub display): Orange Display (main display): 5 digits, 7 segment Display (sub display): 6 digits, 7 segment | |
| | Operation LED | | OUT LED: Red is ON when output is ON | |
| | Environmental resistance | Protection | | IP65 |
| Withstand voltage | | 1000 V AC for 1 minute between terminals and housing | | |
| Insulation resistance | | 50 M Ω between terminals and housing (with 500 VDC megger) | | |
| Operating temperature range | | Operation: 0 to 50 °C, Storage: -10 to 60 °C (No condensation or freezing) | | |
| Operating humidity range | | Operation, Storage: 35 to 85%RH (No condensation) | | |
| Standards | | CE marked (EMC directive, RoHS directive) | | |
| Piping | Piping specification | Modular (Body size: 30) | Modular (Body size: 40) | |
| Materials in contact with fluid | | SUS304, Aluminum alloy, PPS, HNBR (Sensor: Pt, Au, Ni, Fe, lead glass (not RoHS compliant), Al ₂ O ₃) | | |
| Lead wire with connector | | 3 m | | |
| Weight | Body | 350 g | 400 g | |
| | Lead wire with connector | +90 g | | |

IO-Link specification

| Models | | | PF3A701H | PF3A702H |
|-------------------------------|--|------------------------------|---|----------|
| Electrical specifications | Power supply voltage | Used as switch output device | 24 VDC, $\pm 10\%$ | |
| | | Used as IO-Link device | 21.6 to 30 VDC | |
| Switch output | Output type | | Select from NPN or PNP open collector output | |
| | Output mode | | Selects one of the output (hysteresis or window comparator mode), the output for the accumulated flow, the accumulated pulse output, error output and switch OFF. | |
| | Maximum applied voltage (Only NPN) | | 30 VDC | |
| | Internal voltage drop (Residual voltage) | | 1.5 V or less (at load current of 80 mA) | |
| | Response time ^{*7} | | 3.3 ms or less Variable at 0 to 60 s/0.01 step | |
| Analogue output ^{*9} | Response time ^{*11} | | Output with digital filter setting | |
| Display | Display | | Display method: LCD Number of displays: 2 (main display and sub display) Colour (main display): Red and green Display colour (sub display): Orange Display (main display and sub display): 9 digits (7 segment 7digits, 11 segment 2 digits) | |
| | Digital filter ^{*17} | | Select from 1 s/2 s/5 s | |

- *1: The air quality class is according to JIS B 8392-1:2012 [4:6:-] and ISO8573-1:2010 [4:6:-].
- *2: When using the accumulated value hold function, calculate the product life from the operating conditions, and use the product within its life. Maximum updating time of accumulated value is 1.5 million times.
If the product is energized for 24 hours per day, the product life will be as follows:
•Data memorized every 5 minutes --- 5 minutes x 1.5 million times = 7.5 million minutes = 14.3 years
•Data memorized every 2 minutes --- 2 minutes x 1.5 million times = 3 million minutes = 5.7 years
If the Accumulated Flow External Reset is repeatedly used, the product life will be shorter than calculated life.
- *3: Do not release the OUT side piping port of the product directly to the atmosphere without connecting piping. If the product is used with the piping port released to atmosphere, accuracy may vary.
- *4: When pipe bore sizes 3/8 (PF3A701H) and 1/2 (PF3A702H) are connected.
- *5: These values are for modular products with a pipe bore size of 3/8 (PF3A701H), 1/2 (PF3A702H), and supply pressure of 0.5 MPa.
- *6: The time from when the flow is changed by a step input (when the flow rate changes from 0 to the maximum flow instantaneously) until the switch output, turns ON (or OFF) when set at 90% of the rated flow rate.
- *7: The time can be set from when the instantaneous flow reaches the set value, to when the switch output actually begins working.
- *8: If the applied voltage fluctuates around the set value, the width for setting more than the fluctuating width needs to be set. Otherwise, chattering will occur.
- *9: Analogue output or external input can be selected by pressing the buttons. Refer to the graph for analogue output.
- *10: When selecting 0 to 10V, refer to the analogue output graph for the allowable load current.
- *11: The time from when the flow is changed as a step input (when the flow rate changes from 0 to the maximum flow instantaneously) until the analogue output reaches 90% of the rated flow rate.
- *12: Analogue output or external input can be selected by pressing the buttons.
- *13: The flow rate given in the specification is the value at standard condition (STD).
- *14: Setting is only possible for models with the unit selection function.
- *15: Displayable range change based on the setting of zero cut-off function.
- *16: The first and next 6 digits (12 digits in total) for accumulated flow rate are displayed. When upper digits are displayed, "x10⁶" lights up in other window.
For IO-Link type, upper 6 digits are displayed and x10³ or x10⁶ or x10⁹ turns on for accumulated flow rate.
- *17: Set the time for digital filter to the sensor input. The response time indicates when the set value is 90% in relation to the step input.
- *18: Any products with tiny scratches, smears, or display colour variation or brightness which does not affect the performance are verified as conforming products.

Communication specification (During IO-Link mode)

| | |
|-------------------------------|---|
| IO-Link type | Device |
| IO-Link version | V1.1 |
| Communication speed | COM2 (38.4 kbps) |
| Configuration file | IODD file *1 |
| Min. cycle time | 3.3 ms |
| Process data length | Input Data: 4 byte, Output Data: 0 byte |
| On request data communication | Available |
| Data storage function | Available |
| Event function | Available |
| Vendor ID | 131 (0x0083) |
| Device ID *2 | Refer to direct parameters page 1 (page 39) |

*1: The configuration file can be downloaded from the SMC website. (URL <https://www.smcworld.com>)

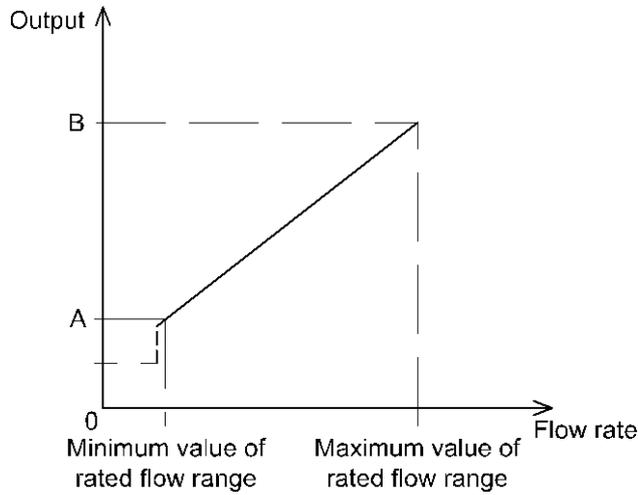
*2: The Device ID varies depending on the output specification of the product.

Cable specification for M12 connector and lead wire (ZS-37-A, ZS-49-A)

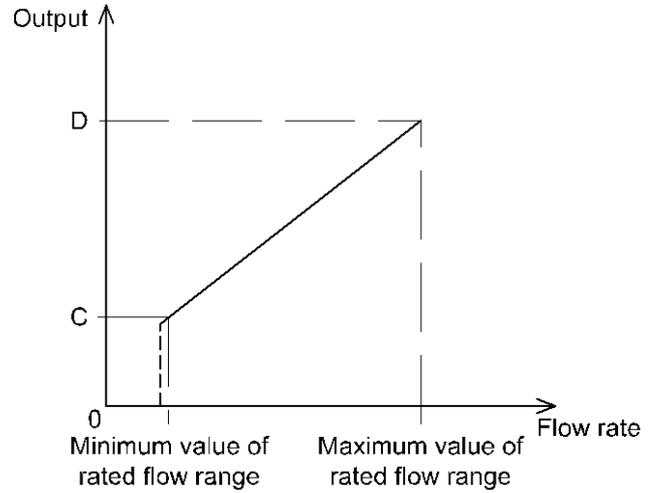
| Item | | Specifications |
|-----------|-----------------------|---------------------------|
| Conductor | Nominal cross section | AWG23 |
| | O.D. | Approx. 1.1 mm |
| Insulator | Colours | Brown, blue, black, white |
| | Finish O.D. | ø4 |

■ Characteristics data

● Flow rate/Analogue output



| | 0 L/min | A *2 | B |
|------------------------------|---------|---------|-------|
| Voltage output (1 to 5 V) *1 | 1 V | 1.04 V | 5 V |
| Current output *1 | 4 mA | 4.16 mA | 20 mA |



| | 0 L/min | C *2 | D |
|-----------------------------------|---------|-------|------|
| Voltage output (0 to 10 V) *1, *3 | 0 V | 0.1 V | 10 V |

| Models | Minimum value of rated flow range *4 | Maximum value of rated flow range |
|----------|--------------------------------------|-----------------------------------|
| PF3A701H | 10 L/min | 1000 L/min |
| PF3A702H | 20 L/min | 2000 L/min |

*1: Analogue output accuracy is within $\pm 3\%$ F.S.

*2: A and C change based on the setting of zero cut-off function.

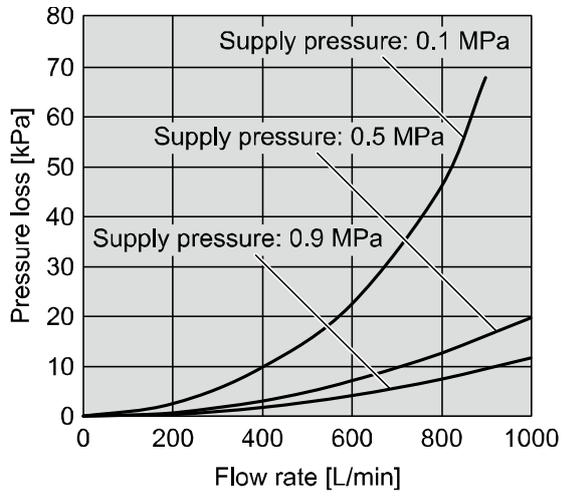
*3: Set the current to the analogue output from the connected equipment to 20 μ A or less when selecting 0 to 10 V.

When 20 μ A or more current flows, it is possible that the accuracy is not satisfied in the area at 0.5 V or lower.

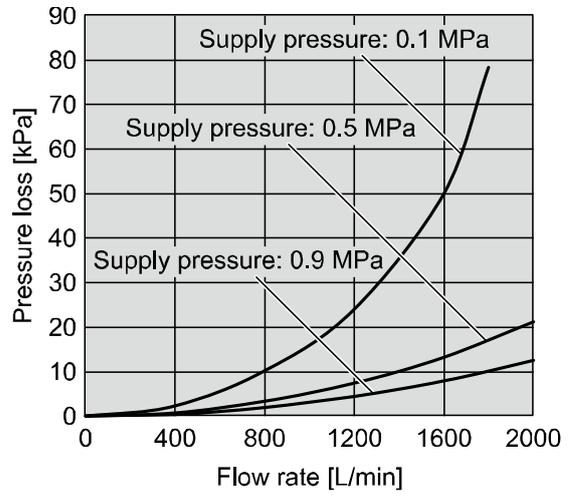
*4: The minimum value of the rated flow range changes based on the setting of zero cut-off function.

● Pressure loss (reference value)

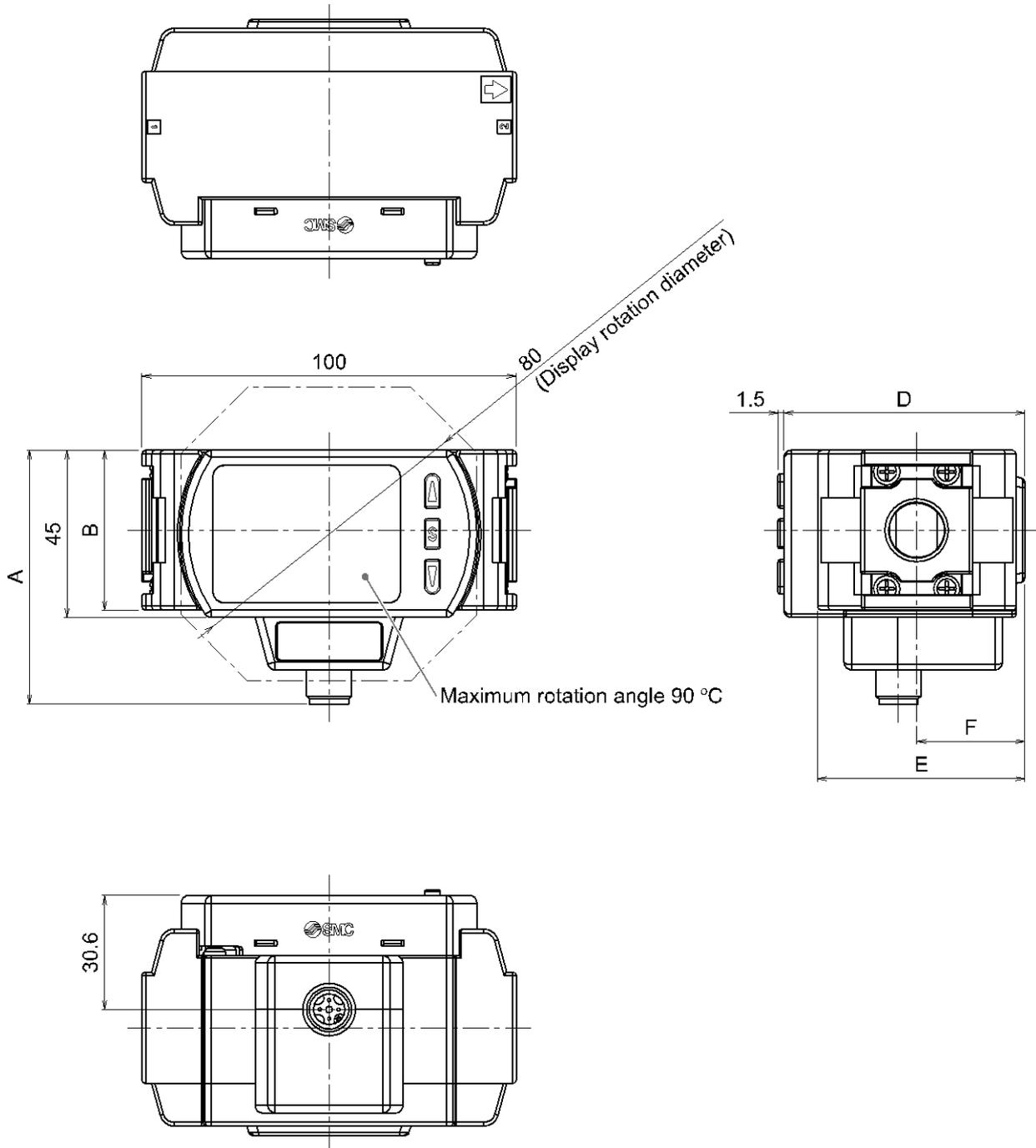
● PF3A701H (For 1000 L/min)



● PF3A702H (For 2000 L/min)

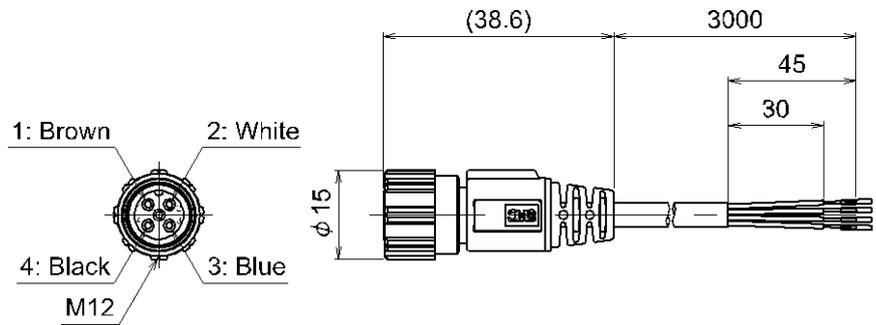


■Dimensions



| Models | Symbol | A | B | D | E | F |
|----------|--------|------|----|------|------|------|
| PF3A701H | | 68.3 | 43 | 64.4 | 55.4 | 28.9 |
| PF3A702H | | 72.3 | 51 | 73 | 71 | 35.5 |

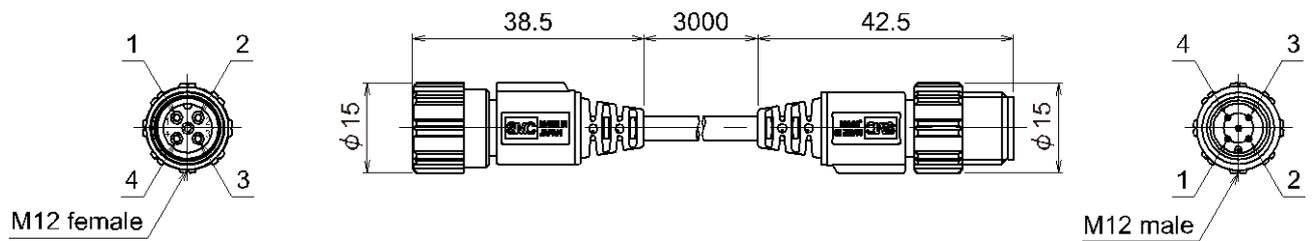
Lead wire with M12 connector (ZS-37-A)



| Pin number | Description | Colour |
|------------|-------------|--------|
| 1 | DC(+) | Brown |
| 2 | FUNC | White |
| 3 | DC(-) | Blue |
| 4 | OUT | Black |

*: 4-wire lead wire with M12 connector for PF3A series.

Lead wire with M12 connector (ZS-49-A)



| M12 female Pin number | Description | M12 male Pin number |
|--------------------------|-------------|------------------------|
| 1 | L+ | 1 |
| 2 | N.C. or DO | 2 |
| 3 | L- | 3 |
| 4 | C/Q | 4 |

Revision history

A: Contents revised in several places
[December 2020]

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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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