PFK Series Discontinue

CKD

SM-375524-A

INSTRUCTION MANUAL

COMPRESSED AIR FLOW SENSOR

PFD Series

PFK Series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

Ver.3

CKD Corporation

PFK Series Discontinue

Safety precautions

Always read this section before starting use.

When designing and manufacturing a device using CKD products, the manufacturer is obligated to check that device safety mechanical mechanism, pneumatic control circuit, or water control circuit and the system operated by electrical control that controls the devices is secured.
It is important to select, use, handle, and maintain the product appropriately to ensure that the CKD product is used safely.
Observe warnings and precautions to ensure device safety.
Check that device safety is ensured, and manufacture a safe device.

Warning

①This product is designed and manufactured as a general industrial machine part. It must be handled by an operator having sufficient knowledge and experience in handling.

②Use this product in accordance of specifications.

Contact CKD when using the product outside the unique specifications range, when using it outdoors, and when using it under the conditions and environment below.
Do not attempt to modify or additionally machine the product.

(1) Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.
(2) Use for applications where life or assets could be adversely affected, and special safety measures are required.

③Observe corporate standards and regulations, etc., related to the safety of de-vice design and control, etc.

ISO 4414, JIS B 8370 (pneumatic system rules)
JPAS 005 (policy for pneumatic cylinder use and selection)
High Pressure Gas Maintenance Laws Occupational Safety and Sanitation Laws, and other safety rules, association standards and regulations.

④Do not handle, pipe, or remove devices before confirming safety.

(1) Inspect and service the machine and devices after confirming safety of the entire system related to this product.
(2) Note that there may be hot or charged sections even after operation is stopped.
(3) When inspecting or servicing the device, turn off the energy source (air supply or water supply), and turn off power to the facility. Discharge any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
(4) When starting or restarting a machine or device that incorporates pneumatic components, make sure that the system safety, such as pop-out prevention measures, is secured.

⑤Observe warnings and cautions on the pages below to prevent accidents.

■The Safety cautions are ranked as "DANGER", "WARNING" and "CAUTION" in this section.

DANGER: When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries, or when there is a high degree of emergency to a warning.

WARNING: When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries.

CAUTION: When a dangerous situation may occur if handling is mistaken leading to minor injuries or physical damage.

Note that some items described as "CAUTION" may lead to serious results depending on the situation.
In any case, important information that must be observed is explained.

Items Related to Design and Selection

◆ Specification check ◆

DANGER:

- Never use for flammable fluids.

WARNING:

- Use within the specification range characteristic to the product. The product is designed for use only in the compressed air system. Fracture and malfunction will be caused at pressures or temperatures outside the specification range.
- Do not use for a dealing meter.
  The product is incompatible with Measurement Law. Do not use for commercial dealings. Use it only for an industrial sensor.
- The applicable fluid is compressed air or nitrogen gas. Do not use for other fluids. Otherwise the accuracy is not guaranteed.

◆ Safe design ◆

WARNING:

- Take necessary measures so that ill effects will not be caused to persons and matters in the event of a failure of the product.

CAUTION:

- Be acquainted with characteristics of compressed air when designing pneumatic circuits.
  (1) Characteristics of air include jumping caused by compression and expansion, blowout and leakage.
  (2) Design the circuit so that compressed air inside the system is discharged.
- Check the leak current to avoid malfunctions that may be caused due to leak current.
  The leak current may give effects on a programmable logic controller or the like to cause malfunctions.
- The sensor and monitor sections of this product are independent of each other and arbitrary combination is allowed as far as the flow rate range is the same.
  (1) Combination with a difference flow rate range is not allowed.
  (2) Use the sensor and monitor sections as a set. The product does not function if either is missing.
- Though the flow sensor does not include moving parts, repetitive on/off actions of the solenoid valve will cause fine movements of net section or fixed section of the rectifying unit, possibly generating particles. To avoid particle generation, install a filter without fail on the secondary side (in the downstream) of the flow sensor.

◆ Application-specific design ◆

CAUTION:

- Because of application for compressed air, fine leaks that will not give effects on performance are allowed. If leakage must be avoided strictly, contact us.

◆ Operating environment ◆

DANGER:

- Never use in the explosive gas atmosphere. Because the product does not have an explosion-proof structure, explosion and fire may be caused.
- If the product is used for nitrogen gas, there is danger of oxygen deficiency. Follow the precautions below and take sufficient care of handling.
  (1) Use in a well-ventilated site.
  (2) During nitrogen gas use, ventilate the site.
  (3) Periodically check the nitrogen gas piping for leaks.

WARNING:

- Avoid rainwater, water and direct sunshine for the installation site.
- Do not use the product in an atmosphere where corrosion may be caused. Damage and malfunction will be caused if the product is used in such an environment.
- Contact us if the supplied air include ozone.
- Avoid using in the ozone environment.
- Use at fluid temperatures between 0 and 40°C.
  Do not use at places where the temperature is subject to abrupt changes and condensation may be generated even if ambient temperature is contained within the specification range.
- Operation beyond the maximum operating pressure will cause failure. Use within the maximum operating pressure.
- The sensor section is of a dust proof drip proof structure. Assured operation is expected even if the product is subject to water splashes during maintenance or cleaning operation. However, avoid using at places where the product is always exposed to water splashes or water or oil splashes attack the product violently.

CAUTION:

- Check that the product stands the operating environment.
  Do not use in an environment causing hazards to functions. For example, avoid using in the hot place, chemical liquid atmosphere, chemicals, vibration, moisture, water drops, coolant, gas atmosphere or similar special environment or in the environment where ozone is generated.
- Be sure to use within the ambient temperature range between 0 and 50°C.
- Avoid using at vibration beyond 49m/s^2 or impact 294m/s^2.

◆ Reserving space ◆

CAUTION:

- Reserve a space around the pneumatic devices for installation, removal and wiring and piping work.

Items Related to Installation and Adjustment

◆ Installation ◆

⚠ DANGER:

- Use at specification source voltage and output.
  If voltages exceeding the specification voltage limit are added, malfunction, sensor breakage and electric shock and fire will be caused. Do not use loads exceeding the output rating. Otherwise breakage in the output circuit and/or fire will be caused.

⚠ WARNING:

- Check the cable color and terminal number during wiring work. Wiring errors will cause breakage or failure of the sensor and malfunction. Perform wiring while referring to the instruction manual for the cable color and terminal number.
  Add a noise filter when necessary.
- Check isolation of wiring.
  Eliminate contact with other circuits, grounding fault and isolation faults between terminals. Otherwise an over-current will flow in the sensor, possibly causing failure.
- Install the product separately from high voltage cables, high voltage devices and motive devices such as motors.
- Check for chips and cable dusts when connecting at the terminal block of the monitor or sensor connectors.

⚠ CAUTION:

- Do not remove the package from pneumatic devices or dust proof cap from piping ports until it is immediately before connecting pipes.
  If the cap is removed from a piping port before connecting the pipe, foreign matters enter the pneumatic device through the piping port, possibly causing failures and malfunctions.
- Do not support pipes when installing pneumatic devices.

◆ Pre-operation check ◆

⚠ CAUTION:

- When supplying compressed air after finishing piping work, be sure to check air leaks from all connections of piping.
  Apply leak detector liquid on joints to check for air leaks. Be careful not to allow leak detector liquid to be stuck on resin parts. Otherwise resin parts may be broken, causing danger.
- Route cables separately from noise sources such as power cables. Otherwise noises may cause malfunctions.
- Do not short circuit in output transistors.
  If the load is short circuited, an over-current protection circuit is activated to prevent the output transistors from being broken, while they will be broken if being left for a long time.
- Do not use load generating surge voltages. To drive a surge generator load such as the relay and solenoid valve, use one equipped with a built-in surge suppressor element. As well, take countermeasures against surges, too, if the power supply line is connected with a surge source.

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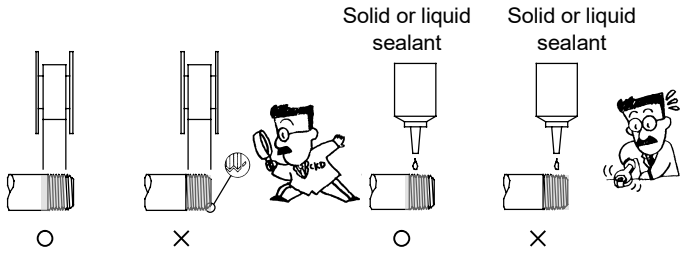
⚠ CAUTION:

- The product is designed to have no resistance against lightning surges.
  Though the product complies with CE marking, no resistance against lightning surges is designed. Take protective measures against lightning surges on the equipment side if necessary.
- Do not allow repetitive bending forces or tension applied on lead wires. Otherwise a broken wire will be caused.
- Use accessory cable (3m) for the wiring between the sensor section and monitor section. To extend the cable, contact us.

◆ Piping ◆

⚠ CAUTION:

- Wind seal tape from a point 2mm or more inside from the thread edge of the pipe in the opposite direction to the thread direction.
  (1) If the seal tape extends beyond the thread part of the pipe, the screwing force will cut the seal tape and the fraction tape will remain inside the product, possibly causing failures.



  (2) When using a liquid sealant, be careful to not allow adhesion on resin parts. Otherwise resin parts may be broken, possibly causing danger.

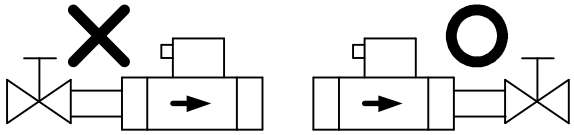
- Take measures to prevent pipes connected with pneumatic devices from being disconnected due to vibration, looseness or pulling phenomenon.
  A dropping pipe will cause danger.
- When using nylon tube or urethane tube as a piping material, be careful of the following.
  (1) Use nonflammable or metallic steel pipe in the atmosphere of scattering spatters.
  (2) When using a standard push-in joint for a spiral tube, fix the root of the tube with hose band. Otherwise rotation will be caused, reducing the holding performance.
- Route pipes so that joints will not be disconnected due to movement, vibration or tensile force of equipment.
- When performing piping, flush the inside before connecting to pneumatic devices without fail.
  It is important to prevent foreign matters in pipes from entering pneumatic devices.

⚠ CAUTION:

- When connecting pipes, tighten to the correct torque.
  (1) Prevention of air leaks and thread breakage is the purpose.
  (2) To avoid damage on the thread, tighten by hand first, then use a tool.

Connecting screw	Recommended tightening torque [Nm]
Rc3/8	22 to 24
Rc1/2	28 to 30
Rc3/4	31 to 33
Rc1	36 to 38
Rc11/2	48 to 50
Rc2	54 to 56

- To adjust the flow rate with a throttle valve (such as the globe valve or ball valve), install the throttle valve in the secondary circuit (downstream) of the sensor. Otherwise uneven flow (disturbances in flow) will cause errors.



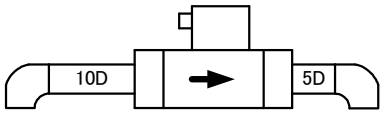
- Do not install a pressure reducing valve (regulator) immediately before the sensor. Otherwise uneven flow will cause errors.
  (1) To install a pressure reducing valve in the primary circuit, install a straight pipe of 10D or over.
  * "D" indicate the inside diameter of the piping material.
  (2) Choose a pressure reducing valve having a flow rate characteristic larger than the maximum flow rate of the sensor with a good margin.

- Route pipes so that the fluid direction matches the direction specified on the sensor. Reverse connection will cause larger indications.

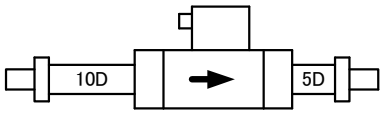
- When routing pipes, do not allow forces to be added on resin parts.

⚠ CAUTION:

- When using an elbow or bushing in piping, it is recommended to install a direct pipe of 10D or over (in case of primary circuit) or 5D or over (in case of secondary circuit).
  (1) Be sure to install a direct pipe for the PFD-163 Series.
  (2) The difference of bores changed with a bushing may not be two or more sizes.



In case of elbow

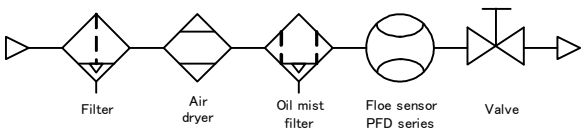


In case of bushing

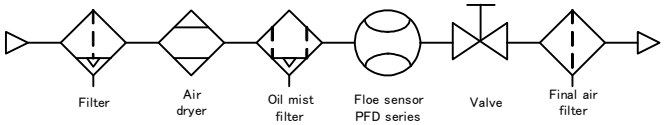
◆ Pneumatic pressure source ◆

⚠ CAUTION:

- Install a pneumatic filter immediately before the circuit equipped with a pneumatic device.
- After piping and connection work is finished and compressed air is to be supplied, do not add a high pressure abruptly. Otherwise joints will be disconnected and piping tubes will jump, resulting in injuries.
- Quality of compressed air
  (1) Use our clean air system components suitable for your application.
  (2) Use compressed air free from oxidized oil content of the air compressor, tar, carbon or other materials.
  (3) Use compressed air free from solid foreign matters.
  (4) Install a filter, air dryer and oil mist filter in the primary circuit (upstream) of the sensor. The rectifying unit (wire net) of the sensor rectifies the flow inside piping. It is not designed to remove foreign matters. Install a filter separately without fail.



・If ultra-clean air is necessary



Items Related to Operation and Maintenance

◆ During operation ◆

⚠ WARNING:

- If the valve leading to the sensor is opened quickly, several ten folds of the rated flow will occur, causing breakage of the platinum thin film sensor and rectifying unit, possibly resulting in an outflow to the secondary circuit. When opening the valve leading to the sensor, open slowly while observing the monitor so that the rated flow will not be exceeded.

⚠ CAUTION:

- If a fault is found during operation, turn the power off immediately and stop operating, and contact the sales shop.
- For ten seconds after the power is turned on, the hardware is checked and internal configuration is arranged. In this interval, correct indication or output is not obtained. If an interlock circuit of a control unit is built in relation to an alarm output, a faulty stop may be caused. To avoid this, mask the output in the interval.
- When changing output settings, the control unit may generate unintended actions. Stop the equipment before changing.
- To use the product for an interlock circuit, design multiplexed interlock circuits to be ready for failures and periodically inspect to check for correct operation.

◆ Maintenance and inspection ◆

⚠ CAUTION:

- When performing maintenance, turn the power off in advance and stop compressed air supply, and check that there is no residual pressure.
  This is necessary for safety assurance.
- Perform periodic inspection at least once every year and check for correct operation.
- To avoid failures, do not disassemble or remodel.

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PFD series

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Revision June 9, 2016
Nov.1st, 2006

1. Installation and Wiring Method

1.1 Piping Method

(1) Route pipes so that the fluid direction matches the direction specified on the sensor.

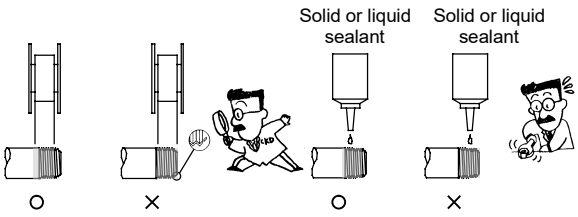
(2) When performing piping, flush the inside before connecting to pneumatic devices without fail.

(3) Do not support pipes when installing pneumatic devices. When routing pipes, do not allow forces to be added on resin parts.

(4) Refer to the following torque when connecting pipes.

Connecting screw	Recommended tightening torque [Nm]
Rc3/8	22 to 24
Rc1/2	28 to 30
Rc3/4	31 to 33
Rc1	36 to 38
Rc11/2	48 to 50
Rc2	54 to 56

(5) Wind seal tape from a point 2mm or more inside from the thread edge of the pipe in the opposite direction to the thread direction.

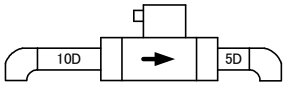


When using a liquid sealant, be careful to not allow adhesion on resin parts.

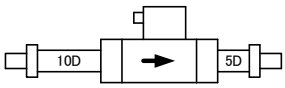
(6) After finishing connections of pipes, do not supply compressed air quickly at a high pressure, but check for air leaks from all piping joints.
When opening the valve leading to the sensor, open slowly while observing the monitor so that the rated flow will not be exceeded.

⚠ CAUTION:

- It is important to prevent foreign matters in pipes from entering pneumatic devices.
- Do not remove the package from pneumatic devices or dust proof cap from piping ports until it is immediately before connecting pipes.
- When using an elbow or bushing in piping, it is recommended to install a direct pipe of 10D or over (in case of primary circuit) or 5D or over (in case of secondary circuit).

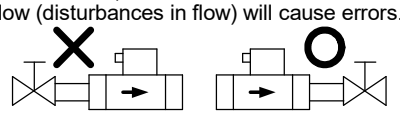


In case of elbow



In case of bushing

- Be sure to install a direct pipe for the PFD-163 Series.
- The difference of bores changed with a bushing may not be two or more sizes.
  Prevention of air leaks and thread breakage is the purpose.
- To avoid damage on the thread, tighten by hand first, then use a tool.
- Take measures to prevent pipes connected with pneumatic devices from being disconnected due to vibration, looseness or pulling phenomenon.
- A dropping pipe will cause danger.
- When using nylon tube or urethane tube as a piping material, be careful of the following.
  - Use nonflammable or metallic steel pipe in the atmosphere of scattering spatters.
  - When using a standard push-in joint for a spiral tube, fix the root of the tube with hose band. Otherwise rotation will be caused, reducing the holding performance.
- Route pipes so that joints will not be disconnected due to movement, vibration or tensile force of equipment.
- To adjust the flow rate with a throttle valve (such as the globe valve or ball valve), install the throttle valve in the secondary circuit (downstream) of the sensor. Otherwise uneven flow (disturbances in flow) will cause errors.



- Do not install a pressure reducing valve (regulator) immediately before the sensor. Otherwise uneven flow will cause errors.
- To install a pressure reducing valve in the primary circuit, install a straight pipe of 10D or over.
- "D" indicate the inside diameter of the piping material.
- Choose a pressure reducing valve having a flow rate characteristic larger than the maximum flow rate of the sensor with a good margin.
- When supplying compressed air after finishing piping work, be sure to check air leaks from all connections of piping.
  Apply leak detector liquid on joints to check for air leaks. Be careful not to allow leak detector liquid to be stuck on resin parts. Otherwise resin parts may be broken, causing danger.

1.2 Sensor Section and Monitor Section Wiring Method

- Be sure to refer to operating precautions before performing wiring.

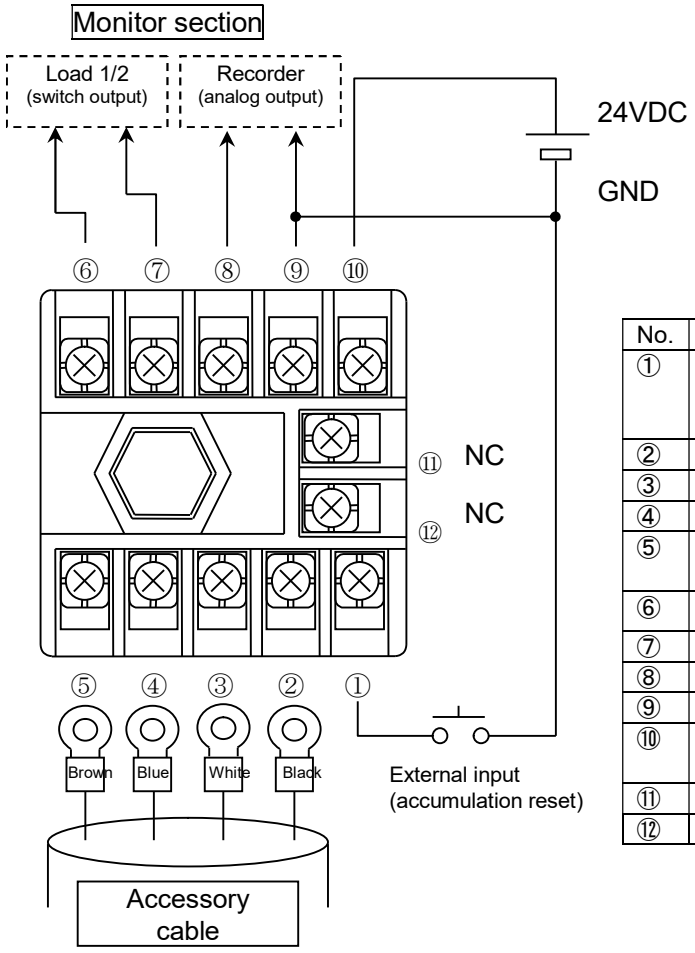
■■ PFD Series ■■

⚠ CAUTION:

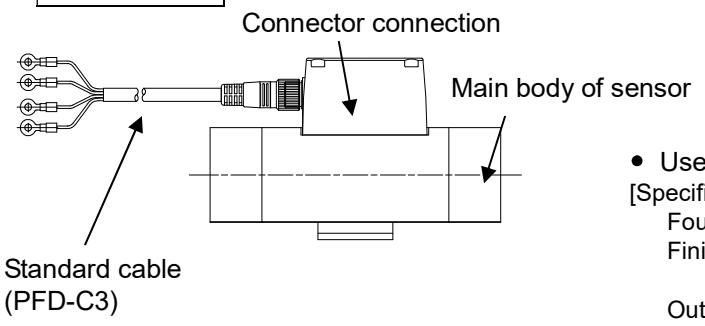
- Turn the power off before performing wiring.

⚠ CAUTION:

- Route cables separately from noise sources such as power cables. Otherwise noises may cause malfunctions.
- Do not allow repetitive bending forces or tension applied on lead wires. Otherwise a broken wire will be caused.
- Use accessory cable (3m) for the wiring between the sensor section and monitor section. To extend the cable, contact us.



No.	Function	
①	Accumulation reset	Connect this terminal with the GND terminal ⑨ to reset the cumulative flow rate.
②	Sensor signal 2	Connect accessory cable [BLACK].
③	Sensor signal 1	Connect accessory cable [WHITE].
④	Sensor GND	Connect accessory cable [BLUE].
⑤	Sensor power supply	Connect accessory cable [BROWN].
⑥	OUT1	NPN/PNP transistor output
⑦	OUT2	NPN/PNP transistor output
⑧	Analog output	Voltage/Current output
⑨	Power GND	Connect 0VDC of the power supply.
⑩	Power 24VDC	Connect 24VDC of the power supply.
⑪	N C	Leave the terminal unconnected.
⑫	N C	Leave the terminal unconnected.



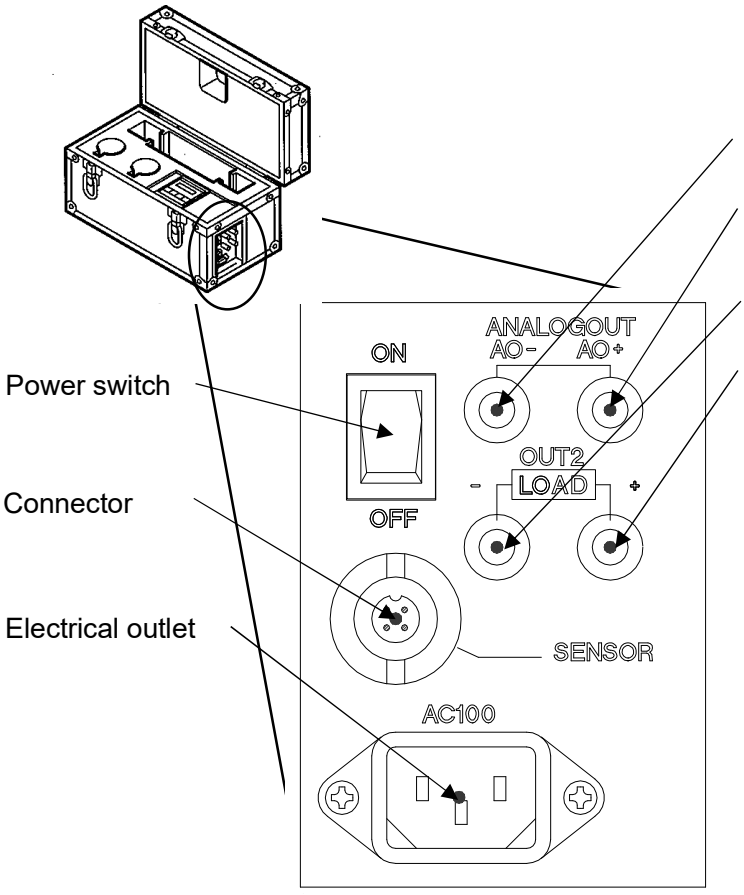
- Use accessory cable for wiring.

[Specifications]
Four-conductor DC cable with connectors
Finish external shape: Ø6.
Conductor wire size 0.5mm^2
Outside diameter of insulator: Ø1.72

■■ PFK Series ■■

CAUTION:
- Turn the power off before performing wiring.
- The switch output of PFK Series is only one point: OUT2.
- To extend the cable, contact us.

Monitor section

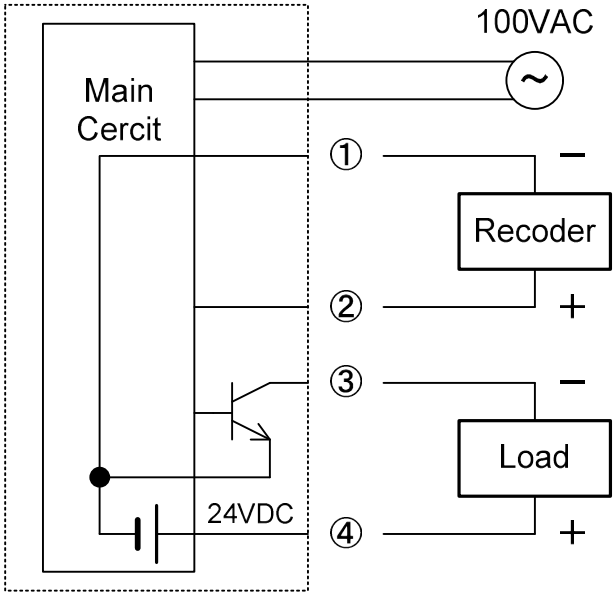


Banana Socket ① : Analog output (-)

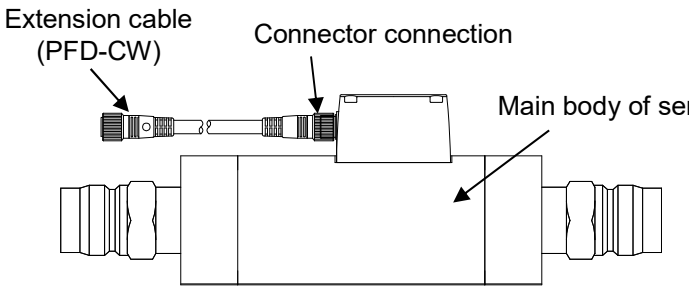
Banana Socket ② : Analog output (+)

Banana Socket ③ : Switch output2 (-)

Banana Socket ④ : Switch output2 (+)



Sensor section



- Use accessory cable for wiring.

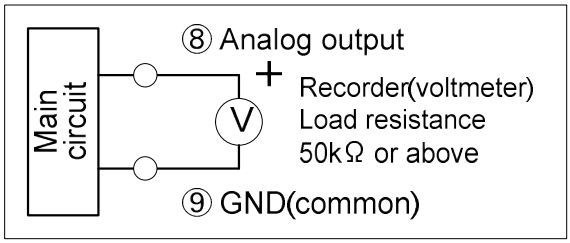
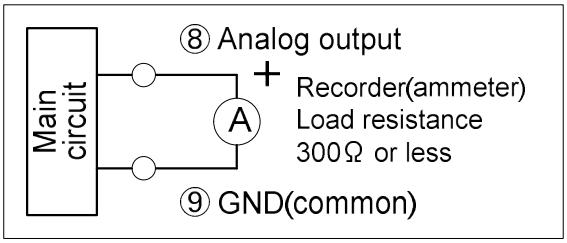
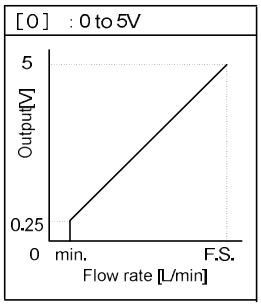
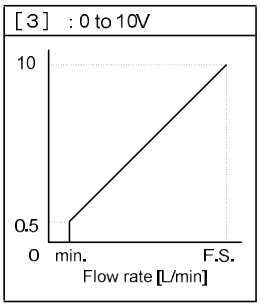
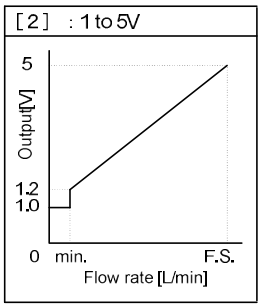
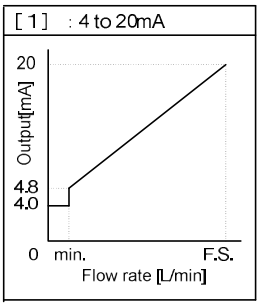
[Specifications]
Four-conductor DC cable with connectors
Finish external shape: Ø6.
Conductor wire size 0.5mm^2
Outside diameter of insulator: Ø1.72

1.3 Electric Wiring

⚠CAUTION:

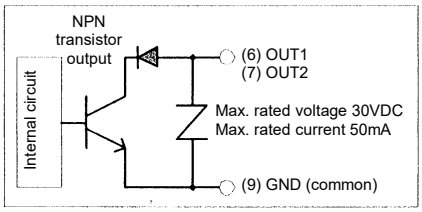
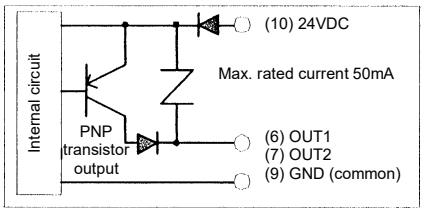
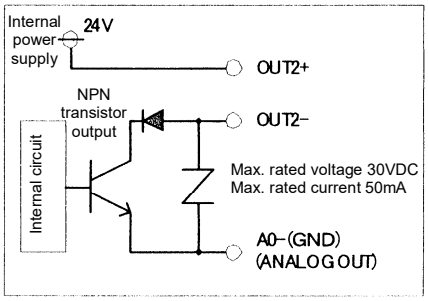
- Do not short circuit in output transistors.
  If the load is short circuited, an over-current protection circuit is activated to prevent the output transistors from being broken, while they will be broken if being left for a long time.
- Do not use load generating surge voltages. To drive a surge generator load such as the relay and solenoid valve, use one equipped with a built-in surge suppressor element. As well, take countermeasures against surges, too, if the power supply line is connected with a surge source.
- The product is designed to have no resistance against lightning surges.
  Though the product complies with CE marking, no resistance against lightning surges is designed. Take protective measures against lightning surges on the equipment side if necessary.
- If a fault is found during operation, turn the power off immediately and stop operating, and contact the sales shop.
- For ten seconds after the power is turned on, the hardware is checked and internal configuration is arranged. In this interval, correct indication or output is not obtained. If an interlock circuit of a control unit is built in relation to an alarm output, a faulty stop may be caused. To avoid this, mask the output in the interval.
- When changing output settings, the control unit may generate unintended actions. Stop the equipment before changing.
- To use the product for an interlock circuit, design multiplexed interlock circuits to be ready for failures and periodically inspect to check for correct operation.

<Analog output>

	◆ In case of voltage output type Model symbol : [0], [2] and [3] *1	◆ In case of current output type Model symbol : [1] *1
Wiring method		
Analog output characteristics	  	 Model number / min / F.S. PFD(K)-501 / 25 / 500 PFD(K)-102 / 50 / 1000 PFD(K)-202 / 100 / 2000 PFD(K)-402 / 200 / 4000 PFD(K)-802 / 400 / 8000 PFD-163 / 800 / 16000 [L/min(normal)]

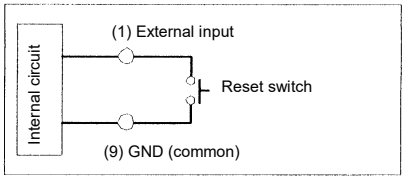
*1 : For the model number, refer to pages 33 and 34.

<Switch output/Accumulation pulse output>

	◆ In case of NPN transistor output [Model symbol: [N] *1	◆ In case of PNP transistor output Model symbol: [P] *1
PFD Series		
PFK Series		

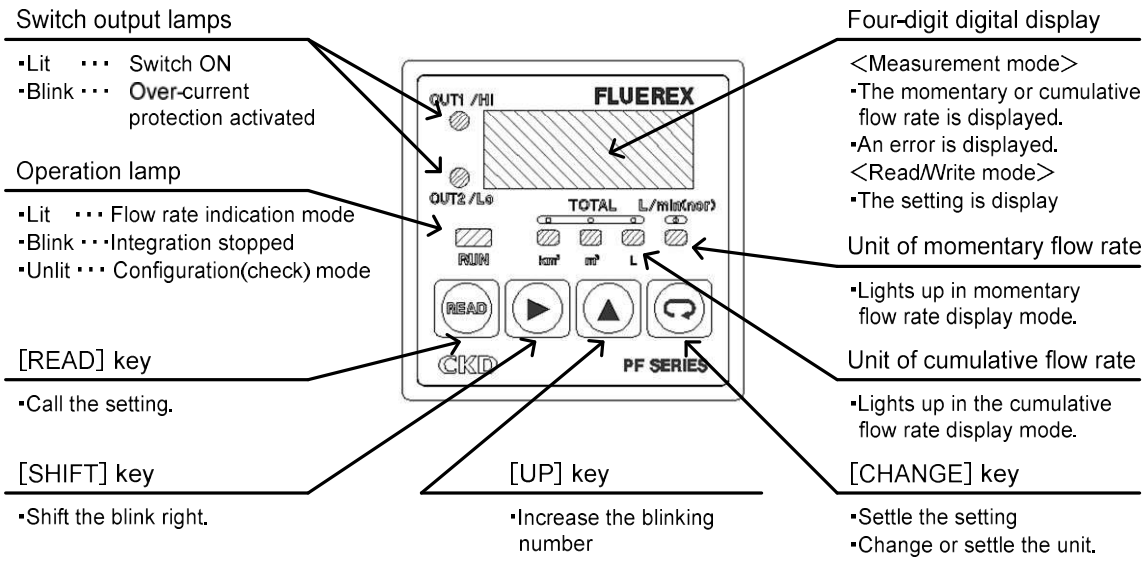
*1: For the model number, refer to pages 33 and 34.

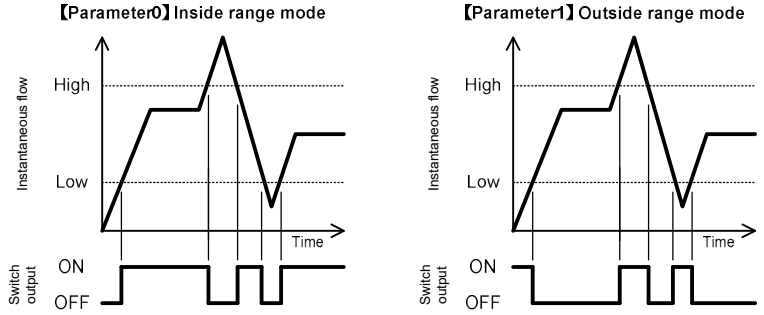
<Input for resetting the cumulative flow rate> **■ ■ PFD Series only ■ ■**



2. Operation Method

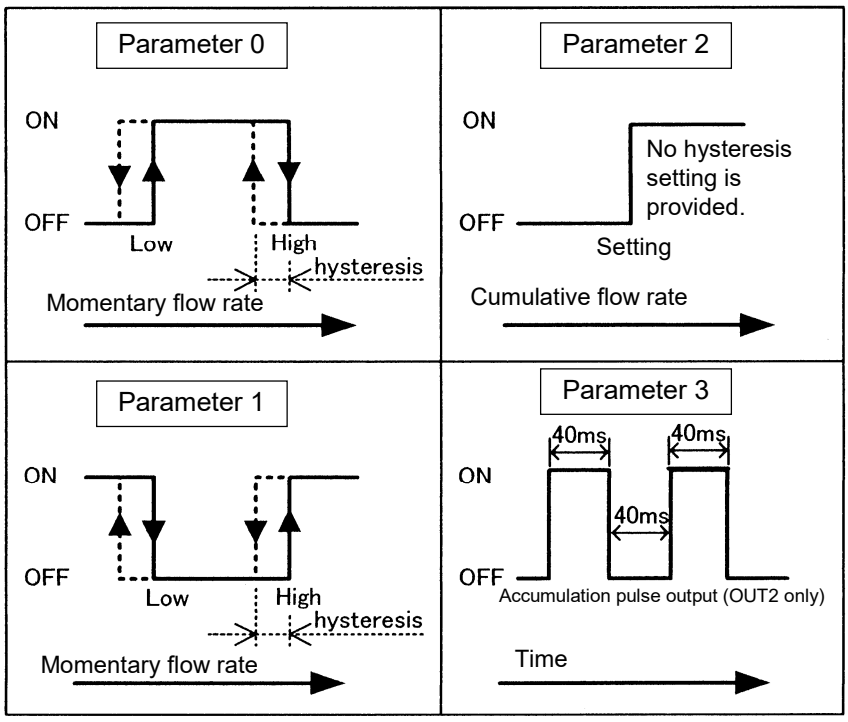
2.1 Name and Function of Each Part



Function	Description	Operation method
Flow rate display function	The momentary or cumulative flow rate is displayed.	**P19**
Analog output function	A voltage or current proportionate to the momentary flow rate is output.	**P13**
Accumulation function	The flow rate is accumulated. The following functions are provided in addition to the cumulative flow rate display function. (1) Accumulation pulse function (2) Switch ON at preset cumulative flow rate (3) Cumulative flow rate starting/stopping function <How to reset the cumulative flow rate> ● Button operation ● External input	 **P14, 16** **P25 to 26** **P20** **P19** **P11, 14**
Switch output function	Following switch functions can be selected. (1) Inside range mode: The switch is turned on if the flow rate is within the arbitrarily specified range. (2) Outside range mode: The switch is turned on if the flow rate is outside the designated range. (3) Accumulation limiter mode: The switch is turned on at the specified cumulative flow rate. (4) Accumulation pulse: Accumulation pulses are output during accumulation mode. 【Parameter0】Inside range mode / 【Parameter1】Outside range mode  	 **P21 to 22** **P23 to 24** **P25 to 26** **P27**
Backup function	The peak cumulative or momentary flow rate is backed up.	**P20**
Peak value display function	The peak momentary flow rate is displayed. <How to reset the peak value> ● Button operation	 **P17 to 18**
Error display function	The error state can be displayed.	**P29**

2.2 Switch Parameter

Four types of settings can be given according to the purpose.



* Specify the hysteresis if the switch chatters due to pulsation of the flow rate.
* The cumulative value is updated at an interval of about one second.

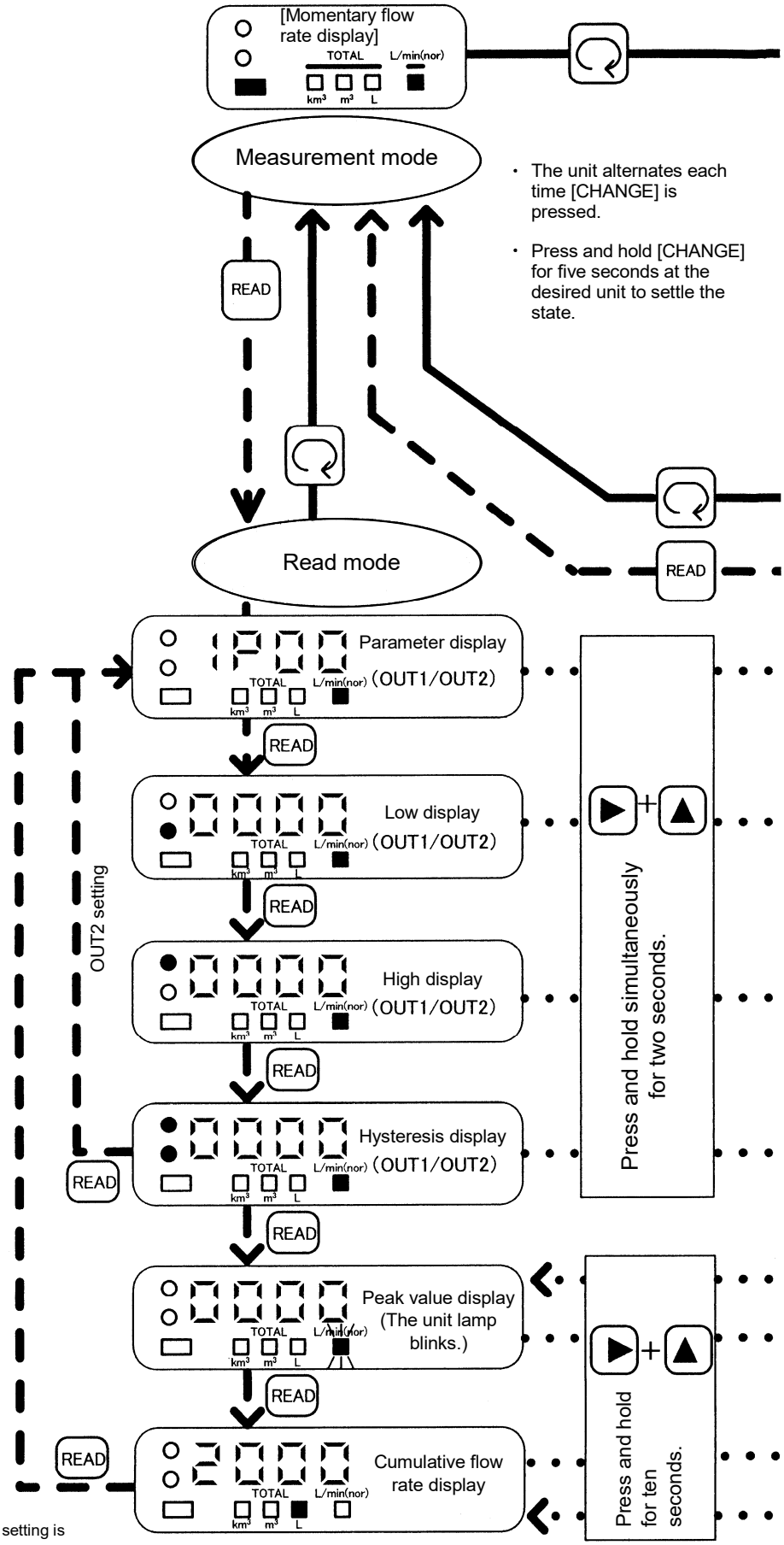
Accumulation pulse output (parameter 3)

- Select parameter [3] for OUT2 to change the switch output function to the accumulation pulse output function.
  Note that the accumulation pulse output function is not provided for OUT1.
- The accumulation pulse is output continuously at an interval of one second.
  (Refer to the chart of parameter [3] above.)
- The switch output lamp does not light up while the accumulation pulse is output.
- The accumulation pulse is output at every accumulation value specified below.

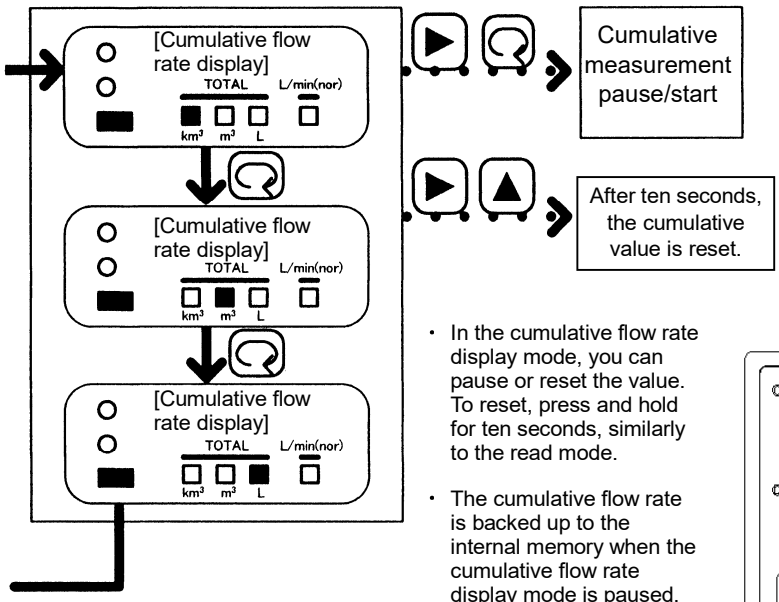
[L (normal)]

Model	PFD-501 PFK-501	PFD-102 PFK-102	PFD-202 PFK-202	PFD-402 PFK-402	PFD-802 PFK-802	PFD-163
Cumulative flow rate per pulse	10				100	

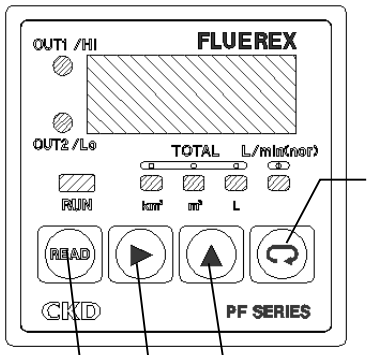
2.3 Operation Method (List)



* In case of parameter 2, the accumulation switch setting is displayed instead of (L), (H) and (h).
* In case of parameter 3, no setting item is provided and the control jumps to peak value display in the read mode or parameter entry in the write mode.



- In the cumulative flow rate display mode, you can pause or reset the value. To reset, press and hold for ten seconds, similarly to the read mode.
- The cumulative flow rate is backed up to the internal memory when the cumulative flow rate display mode is paused.

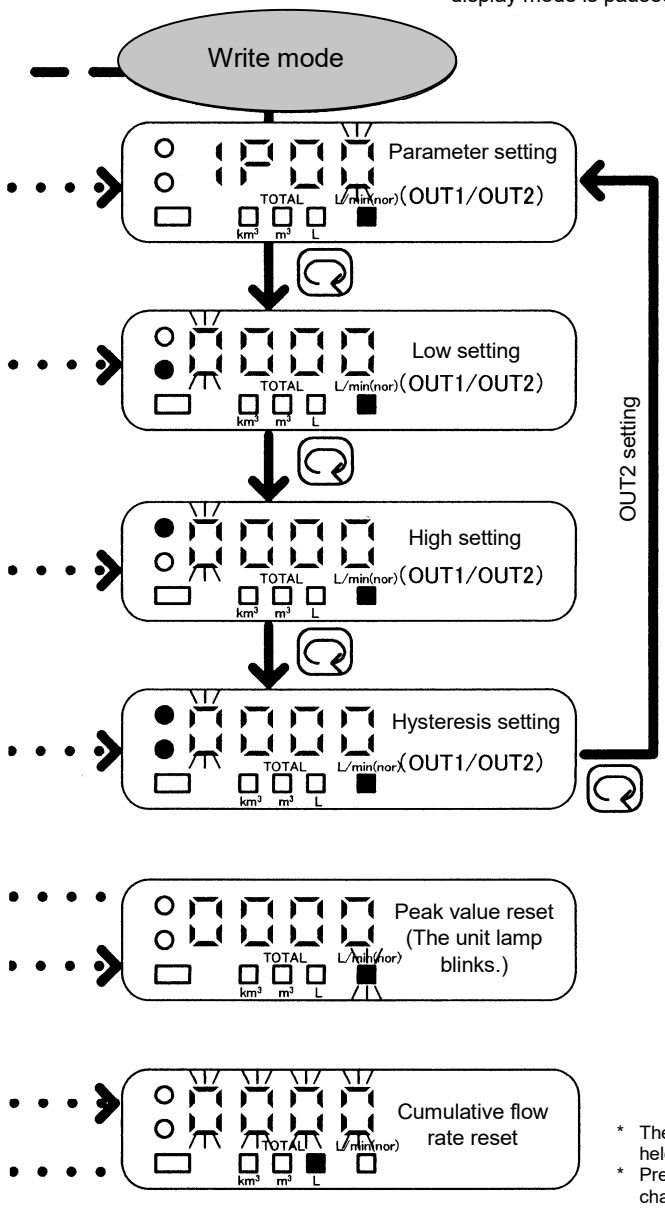


[CHANGE]
- Settle the setting.
- Change or settle the unit.

[UP] key
- Increase the blinking number.

[SHIFT] key
- Shift the blink right.

[READ] key
- Call up the setting.



■ Backing up the cumulative flow rate/peak value

- This product retains the cumulative flow rate and peak value automatically in the internal memory and the backed-up data is held even if the power is turned off.
- Values are backed up at the following timing.

1) Five minutes have passed since the previous backing event and there is a change from the previous cumulative flow rate or peak value.
2) Cumulative flow rate is stopped.
3) The cumulative value is reset. (The peak value at the moment is backed up while the cumulative value after resetting is backed.)
4) The peak value is reset. (The peak value after resetting is backed up while the cumulative value at the moment is backed up.)

- Note that values are not backed up in the following cases.

1) The interval since the previous backing up event is shorter than five minutes.
2) There is no difference in the values five minutes later from those backed up previously.

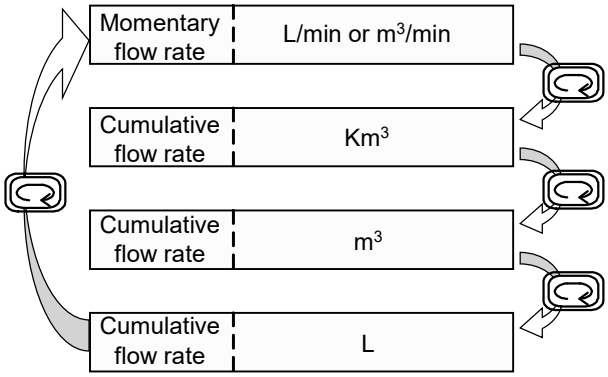
When the power is turned on, previously backed up values are displayed.

* The peak value and cumulative flow rate are reset after [SHIFT] and [UP] are held down for ten seconds.
* Press [SHIFT] while the cumulative flow rate is specified or checked, to change the unit of the cumulative flow rate.

2.4 Flow Rate Display

2.4.1 Momentary/Cumulative flow rate switching method

The four-digit digital display shows the momentary flow rate and cumulative flow rates [km^3], [m^3] and [L] alternately upon the press of the ⟲ key.
The cumulative flow rate can be displayed temporarily while the momentary flow rate is displayed.
Use the function according to the purpose.



* Temporary flow rate change

1) Press ⟲ to switch the indication as shown in the figure above.
2) In case of temporary indication, the unit lamp blinks.
3) The original indication is restored after ten seconds.

* Permanent flow rate change

1) Press the ⟲ key repetitively until the desired unit is displayed. Press and hold the ⟲ key for five seconds.
2) The blinking unit lamp lights up to indicate that the change is finished.
3) The momentary flow rate is displayed in the factory shipment state.

2.4.2 Resetting the cumulative flow rate

Press and hold the ▲ and ▶ keys for about ten seconds to reset the cumulative value.
With the PFD Series, you can supply an external input (at pin (1)) to reset the cumulative value, too.
(With the PFK Series, the cumulative value is not reset through external inputs. Use button operation only.)

2.4.3 Backing up the cumulative flow rate and peak value

- With this product, the cumulative flow rate and peak value are automatically backed up in the internal memory and the backed-up data is retained even if the power is turned off.
- The data is backed up at the following timing.
  1) Five minutes have passed since the previous backing up event and there is a change from the previous cumulative flow rate or peak value.
  2) Cumulative flow rate is stopped.
  3) The cumulative value is reset. (The peak value at the moment is backed up while the cumulative value after resetting is backed up.)
  4) The peak value is reset. (The peak value after resetting is backed up while the cumulative value at the moment is backed up.)
- Note that values are not backed up in the following cases.
  1) The interval since the previous backing up event is shorter than five minutes.
  2) There is no difference in the values five minutes later from those backed up previously.

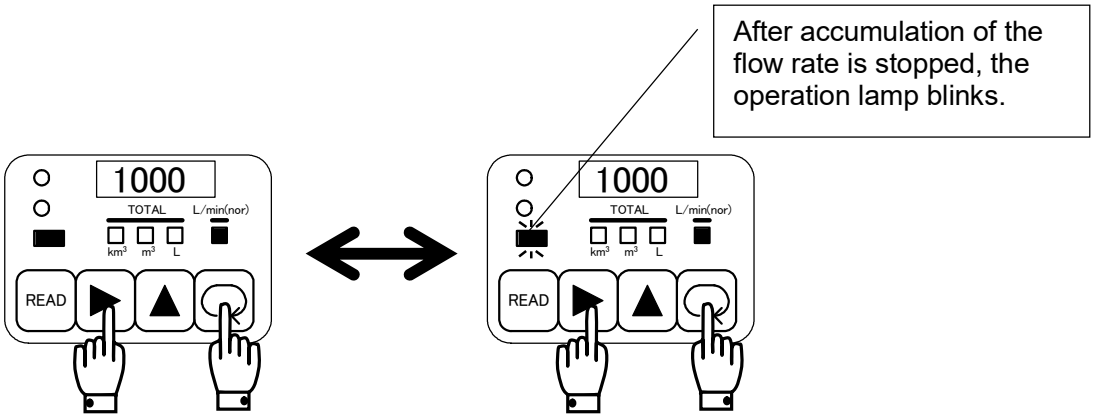
When the power is turned on, previously backed-up values are displayed.

2.4.4 Starting or stopping accumulation of flow rate

Accumulation of the flow rate begins after hardware check is finished.
(As a hardware check, all LEDs light up for three seconds immediately after the power is turned on, and the flow rate range indication lights up for two seconds and analog output lights up for two seconds.)

(1) Measurement mode (Momentary flow rate or cumulative flow rate is displayed.)
(2) Stop the cumulative flow rate.
Press and hold down the ▶ and ↺ keys simultaneously to stop the cumulative flow rate.

(3) Restart the cumulative flow rate.
Press and hold down the ▶ and ↺ keys simultaneously to restart the cumulative flow rate.



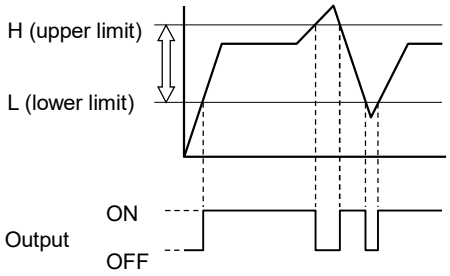
CAUTION:

●Even if the display shows the momentary flow rate as 0, if there is any flow rate signal at all (including error), it may become integrated and displayed as the cumulative flow rate.
If this (momentary flow rate is 0 but there is a measured value for cumulative flow rate) is a problem, carry out the procedures described in “starting or stopping accumulation of flow rate” before use.

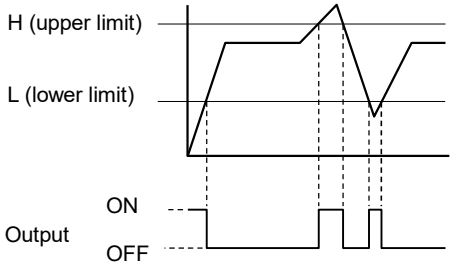
2.5 Using the Switch Output Function

2.5.1 Using the range designation mode (OUT1/OUT2)

● Inside range mode ■■ Parameter 0 ■■
The switch output is turned on if the measurement is within the specified range.



● Outside range mode ■■ Parameter 1 ■■
The switch output is turned on if the measurement is out of the specified range.

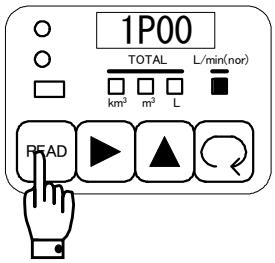


The upper and lower limits of the range can be specified.
For the switch output connection method, refer to Section 1.3 Electric Wiring.
The following description is for the following settings in the measurement mode.

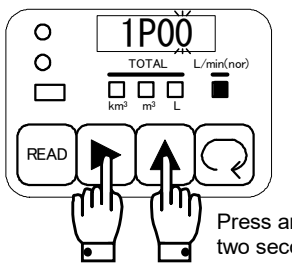
ex) With PFD-501-10N0, use parameter 0 for OUT1 and parameter 1 for OUT2.

OUT1	P (parameter) ----- 0	OUT2	P (parameter) ------- 0
	L (lower limit)------ 100L/min(nor)		L (lower limit)-------- 50L/min(nor)
	H (upper limit)----- 300L/min(nor)		H (upper limit)------- 100L/min(nor)
	h (hysteresis) ----- 10L/min(nor)		h (hysteresis) ------- 10L/min(nor)

<Operation method>
(1) Measurement mode (momentary/cumulative flow rate)
(2) Start the read mode.
Press the READ key to start the read mode.

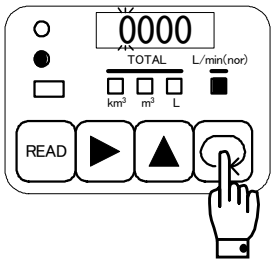


(3) Parameter setting for OUT1
Press and hold the ▲ and ▶ keys for two seconds to start the write mode.

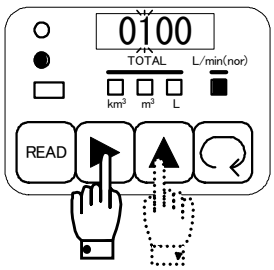


Press and hold for two seconds.

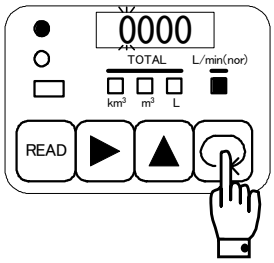
(4) Settling the parameter for OUT1
After checking that "1P00" is displayed, press the [↺] key to settle the setting.



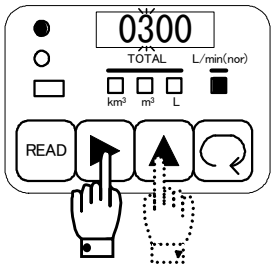
(5) L (lower limit) setting of OUT1
Using the [▶] and [▲] keys, change the L setting.
(To change from 0 to 100, press the shift key once and up key once.)



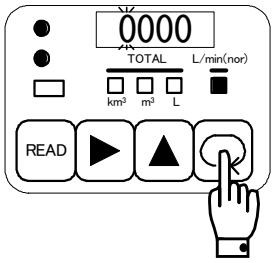
(6) Settling the L setting for OUT1
Press the [↺] key to settle the setting.



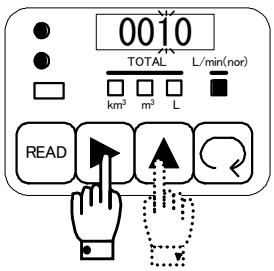
(7) H (upper limit) setting of OUT1
Using the [▶] and [▲] keys, change the H setting.
(To change from 0 to 300, press the shift key once and up key three times.)



(8) Settling the H setting for OUT1
Press the [↺] key to settle the setting.

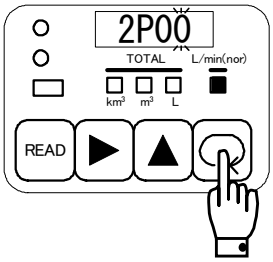


(9) h (hysteresis) setting of OUT1
Using the [▶] and [▲] keys, change the h setting.
(To change from 0 to 10, press the shift key twice and up key once.)

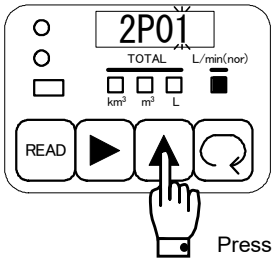


2
OPERATION METHOD

(10) Settling the h setting for OUT1
Press the [SET] key to settle the setting.
Transition to OUT2 setting occurs.

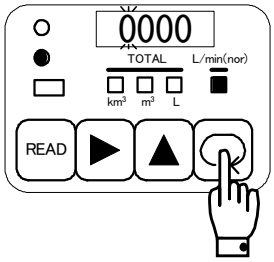


(11) Setting the parameter for OUT2
Press the [▲] key once to enter "2P01."

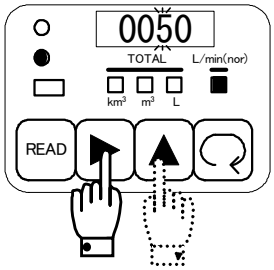


Press once.

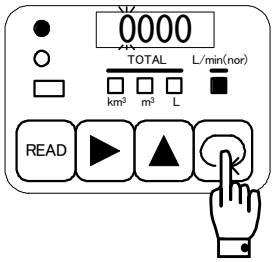
(12) Settling the parameter for OUT2
Press the [SET] key to settle the setting.



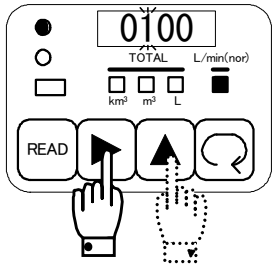
(13) L (lower limit) setting of OUT2
Using the [▶] and [▲] keys to change the L setting.
(To change from 0 to 50, press the shift key twice and up key five times.)



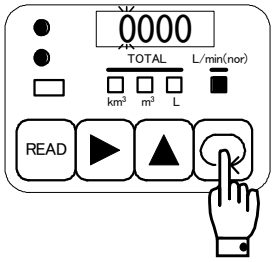
(14) Settling the L setting for OUT2
Press the [SET] key to settle the setting.



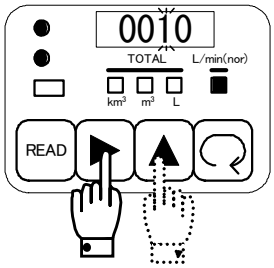
(15) H (upper limit) setting of OUT2
Using the [▶] and [▲] keys, change the H setting.
(To change from 0 to 100, press the shift key once and up key once.)



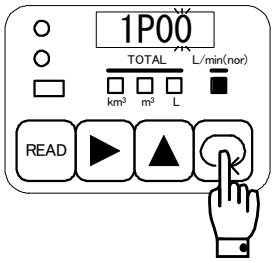
(16) Settling the H setting for OUT2
Press the key to settle the setting.



(17) h (hysteresis) setting of OUT2
Using the ▶ and ▲ keys, change the h setting.
(To change from 0 to 10, press the shift key twice and up key once.)



(18) Settling the h setting for OUT2
Press the key to settle the setting and exit from setting entry.
The OUT1 setting is displayed again.

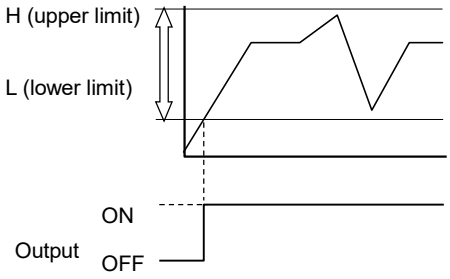


CAUTION:

- As a hardware check, all LEDs light up for three seconds immediately after the power is turned on, and the flow rate range indication lights up for two seconds and analog output lights up for two seconds.
- Even in the middle of setting entry, the measurement mode starts automatically after ten seconds.
- The setting does not change if the key is not pressed to settle the setting.
- The PFK Series is provided with only one point (OUT2). OUT1 settings can be entered but no output is issued.

■■ Application example ■■

To turn the switch output on or off at flow rates above a certain level as shown in the figure on the right
Specify 105% (F.S. (full scale)) value as the H (upper limit) value. Flow rates larger than 105% F.S. causes an error to turn the output off completely.



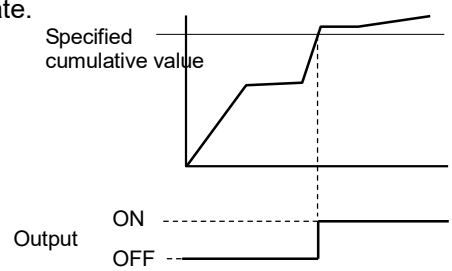
ex) With PFD-501-10N0, turning OUT1 on at 300L or above

OUT1
- P (parameter) ----- 0
- L (lower limit) ------ 300L/min(nor)
- H (upper limit) ----- 525L/min(nor)
- h (hysteresis) ----- 10L/min(nor)

* If P = 1, the output is turned off at 300L or above.

2.5.2 Using the accumulation limiter mode (OUT1/OUT2) ■■ Parameter 2 ■■

The switch output is turned on at the specified cumulative flow rate.
For the switch output connection method, refer to Section 1.3 Electric Wiring.



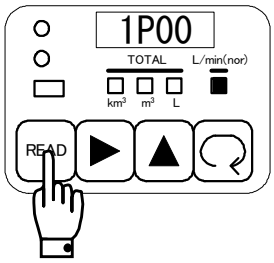
ex) With PFD-501-10A0
OUT1 ... Cumulative setting 200,000L/min (nor)
OUT2 ... Cumulative pulse output

As a hardware check, all LEDs light up for three seconds immediately after the power is turned on, and the flow rate range indication lights up for two seconds and analog output lights up for two seconds.

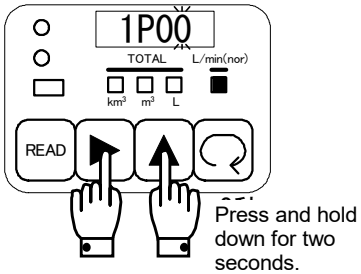
<Operation method>

(1) Measurement mode (momentary/cumulative flow rate indication)

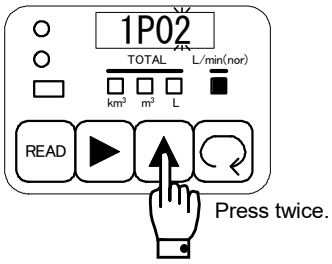
(2) Starting the read mode.
Press the READ key once to start the read mode.



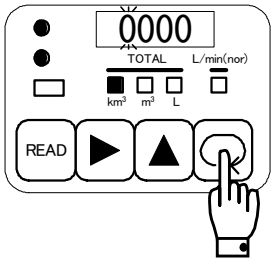
(3) Starting the write mode
Press and hold the ▲ and ▶ keys simultaneously for two seconds to start the write mode.



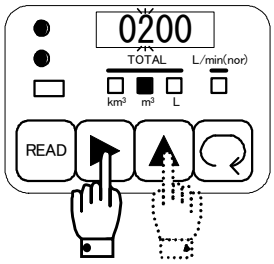
(4) Entering "OUT1" parameters
Press the ▲ key twice to enter "1P02."

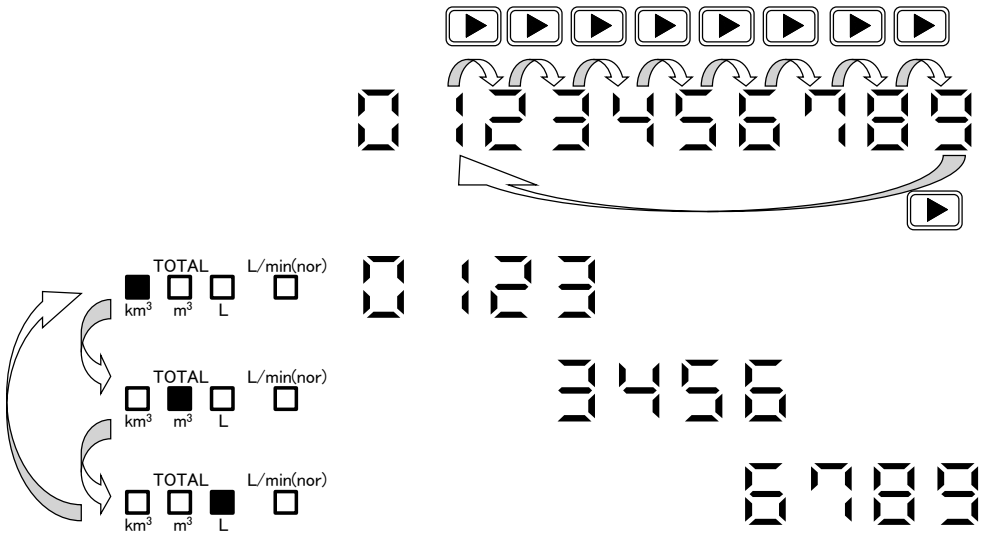


(5) Settling the parameter and moving to entry of the cumulative flow rate setting
Press the ↺ key to settle the parameter and move to entry of the cumulative flow rate setting.



(6) Entering cumulative flow rate setting
Press the ▶ and ▲ keys to change the cumulative flow rate setting.
Nine digits of the cumulative flow rate setting are displayed in [km³], [m³] or [L].
Press the ▶ key to shift the digit (unit).
Press the ▶ key three times and ▲ key twice to enter "0000200000."

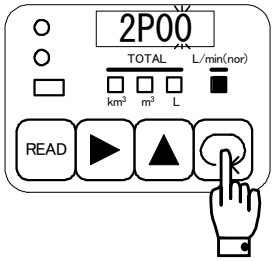




CAUTION:
- Enter the setting in nine digits or fewer digits.

(7) Settling the cumulative flow rate setting and moving to entry of "OUT2" settings
Press the ↻ key to settle the parameter and move to entry of cumulative pulses of "OUT2."

Refer to step (4) and the following procedure in Section 2.5.3 Outputting cumulative pulses (OUT2 only).



CAUTION:
- Even in the middle of setting entry, the measurement mode starts automatically after ten seconds.
- The setting does not change if the ↻ key is not pressed to settle the setting.
- The PFK Series is provided with only one point (OUT2). OUT1 settings can be entered but no output is issued.

2.5.3 Outputting cumulative pulses (OUT2 only) ■■ Parameter 3 ■■

Cumulative pulses are output.
For the cumulative pulse connection method, refer to Section 1.3 Electric Wiring.
The cumulative pulse output setting is for OUT2 only. (Unavailable for OUT1)

[L (normal)]

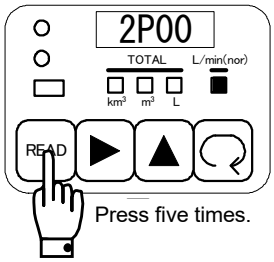
Model	PFD-501 PFK-501	PFD-102 PFK-102	PFD-202 PFK-202	PFD-402 PFK-402	PFD-802 PFK-802	PFD-163
Cumulative flow rate per pulse	10				100	

(As a hardware check, all LEDs light up for three seconds immediately after the power is turned on, and the flow rate range indication lights up for two seconds and analog output lights up for two seconds.)

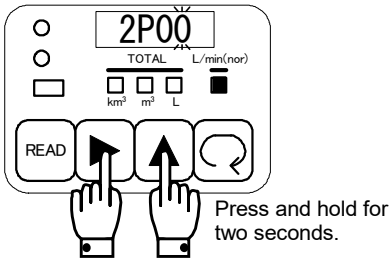
<Operation method>

(1) Measurement mode (momentary/cumulative flow rate indication)

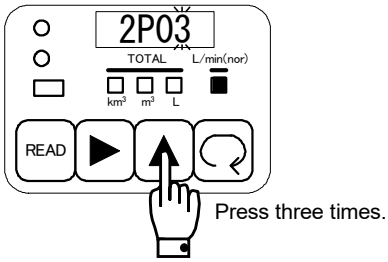
(2) Starting the read mode
Press the READ key five times until "OUT2" parameters are displayed.



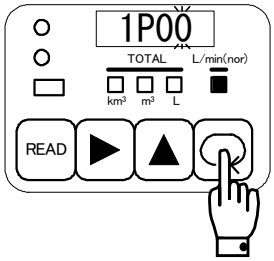
(3) Starting the write mode
Press and hold the ▲ and ▶ keys simultaneously for two seconds to start the write mode.



(4) Entering parameter
Press the ▲ key three times. "2PO3" blinks.

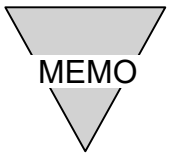


(5) Settling the parameter and moving to entry of the cumulative flow rate setting
Press the ⟲ key once to settle the cumulative pulse output.
Press the READ key to return to the measurement mode.



CAUTION:

- Even in the middle of setting entry, the measurement mode starts automatically after ten seconds.
- The setting does not change if the ⟲ key is not pressed to settle the setting.
- The PFK Series is provided with only one point (OUT2). OUT1 settings can be entered but no output is issued.



2.6 Error Code

Error code (error indication)	Description of error	Remedy	Condition for resetting	Switch and analog outputs at error occurrence
Er01	(1) Connector cable connection fault (2) Mixing of fluid other than air or N2 (3) Mixing of foreign matter (4) Mixing of vapor (5) Outside rated flow rate range (Er01 and 02 only) (6) Outside operating temperature range. (Er03 and 04 only)	(1) Check wiring of the connector cable. (2) Do not supply fluids other than air and N2. (3) Remove the foreign matter. (4) Remove vapor. (5) Operate within the rated flow rate range. (6) Operate within the operating temperature range.	Automatic recovery (*1)	If the error persists for 5 seconds or longer, the switch output is turned on and the analog output changes to the voltage and current corresponding to zero flow rate.
Er02				
Er03				
Er04				
Er10	Memory writing fault	Turn power on again.	Shutdown and power-on	The value before the error is held.
Er11	Memory reading fault	Turn power on again after executing an external input(Resetting of cumulative) in P14.		
Er12	Source voltage fault (20VDC or lower)	Operate within the 24VDC ±10% range.	Automatic recovery (*2)	Varies according to the flow rate signal issued by the sensor.
[OUT lamp blink]	Switch output over-current state	Operate within the maximum rated current.	Automatic recovery (*2)	Only the switch output is turned off.
[Displayed value blink]	Flow rate over (*3) (105% F.S. or above)	Operate within the rated range.	Automatic recovery (*2)	Varies according to the flow rate indication. (*4)

*1: Note that recovery may take about ten seconds even if the correct value is displayed.
If the fault persists for five seconds or longer, the sensor power supply is turned off for the protection of the sensor. The power is supplied periodically (in an interval of about 5 sec) and, if each sensor signal is within the correct range, the error is removed after about 3 sec.
*2: Immediate recovery after error correction
*3: The correct indication is obtained up to +5% of the full scale (F.S.) flow rate, but the value is not guaranteed. Operate within the rated flow rate range without fail.
*4: The analog output may be inconsistent with the indication due to characteristics of the circuit.
*5: If recovery is not obtained after error correction, contact the nearest sales office.

2.7 Procedure Related to Maintenance

CAUTION:

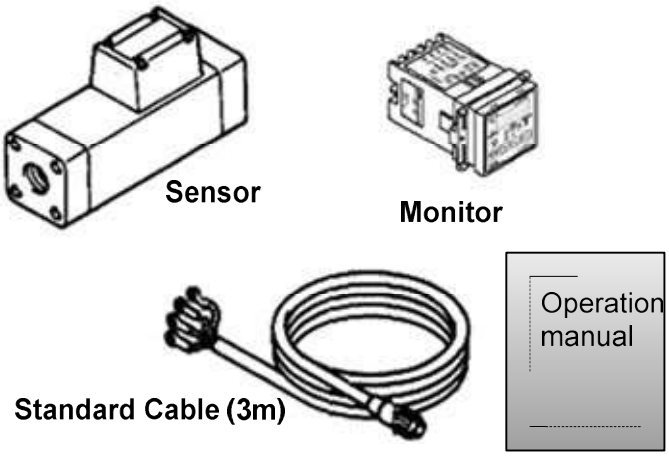
- When performing maintenance, turn the power off in advance and stop compressed air supply, and check that there is no residual pressure.
  This is necessary for safety assurance.
- Perform periodic inspection at least once every year and check for correct operation.
- To avoid failures, do not disassemble or remodel.

3. Product

3.1 Components and Accessories

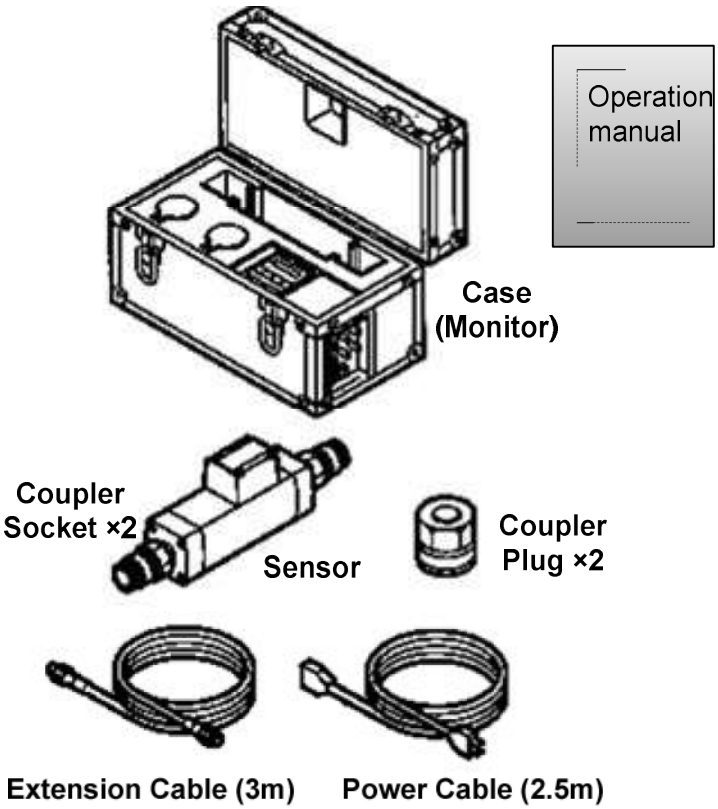
■■ PFD series ■■

- Sensor
- Monitor
- Standard cable
- Operation manual



■■ PFK series ■■

- Sensor
- Trunk case (Monitor)
- Extension cable
- Power cable
- Coupler
- Operation manual



3.2 Specifications

■■ PFD Series ■■

Item		PFD-501-10	PFD-102-15	PFD-202-20	PFD-402-25	PFD-802-40	PFD-163-50
Specifications	Flow rate range [L/min(normal)]	25 to 500	50 to 1000	100 to 2000	200 to 4000	400 to 8000	800 to 16000
	Bore size	Rc3/8	Rc1/2	Rc3/4	Rc1	Rc1 1/2	Rc2
Operating conditions	Applicable fluid	Clean compressed air and nitrogen gas					
	Quality of air to be used	JIS B8392-1: 2003/1.1.1 to 1.6.1 (Note 1)					
	Max. operating pressure [MPa]	1.0					
	Min. operating pressure [MPa]	0.1					
	Guaranteed withstanding pressure [MPa]	1.5					
	Ambient temperature and humidity	0 to 50°C, 85% R.H. or less (No condensation allowed)					
	Fluid temperature [° C]	0 to 40					
Accuracy	Linearity	±3.0%F.S. (at 0.5MPa and 20°C)					
	Pressure characteristics	±2.0%F.S .(at 0.5MPa standard, 0.2 to 0.7MPa)					
	Temperature characteristics	±2.0%F.S. (at 20°C standard, 10 to 30°C)					
	Pressure loss [MPa]	Within 0.015 (at max. flow rate and 0.5MPa)					
	Response [sec]	Within 2.5					
Output	Indication	Momentary/Cumulative, 4-digit LED indication					
	Resolution [L/min(normal)]	1	5	5	10	20	50
	Min. displayed flow rate [L/min(normal)]	10	20	40	80	160	320
	Cumulative flow rate	Max. 9 digits (however, switching with CHANGE key) (Note 4)					
	Analog output	Standard: 0 to 5VDC. Option: 4 to 20mA DC, 1 to 5V, 0 to 10V					
	Switch output	2 points (NPN/PNP transistor output: selection type)					
	Pulse output (Note 2)	10L(normal)/pulse				100L(normal)/pulse	
	Source voltage [V]	24VDC (6W or less; without switch output load current)					
	Cable	Attached (3m, 4 conductors, finish O.D. Ø6, conductor 0.5mm2, O.D. of insulator 1.72mm, with connector)					
Installation	Installation direction	Vertical or horizontal without limitation					
	Straight pipe for introduction	Inlet: 10D recommended. Outlet: 5D recommended. (Note 3)					
	Protective structure	IP64 or equivalent (sensor section only)					
	Mass [kg]	1.1	1.1	1.3	1.4	1.7	4.5

(Note 1) Note that condensation may be formed if the ambient temperature is lower than the fluid temperature.
Note that detection faults may be caused if permeating oil content is accumulated.
Because the product is not clean device specification, particles are generated on the secondary circuit. If ultra-clean air is necessary, installation of a final air filter at the end is recommended.

(Note 2) The pulse output is common with switch output. Switch the function.

(Note 3) Installation of a straight pipe section is recommended for measurement free from piping conditions ("D" indicates the bore of the pipe).

(Note 4) The cumulative flow rate is periodically backed up. It can be backed up with manual operation, too.

■■ PFK Series ■■

Item		PFK-501-15N0	PFK-102-15N0	PFK-202-25N0	PFK-402-25N0	PFK-802-40N0
Specifications	Flow rate range [L/min(normal)]	25 to 500	50 to 1000	100 to 2000	200 to 4000	400 to 8000
	Bore size	Rc1/2		Rc1		Rc1 1/2
Operating conditions	Applicable fluid	Clean compressed air and nitrogen gas				
	Quality of air to be used	JIS B8392-1: 2003/1.1.1 to 1.6.1 (Note 1)				
	Max. operating pressure [MPa]	1.0				
	Min. operating pressure [MPa]	0.1				
	Guaranteed withstanding pressure [MPa]	1.5				
	Ambient temperature and humidity	0 to 50°C, 85% R.H. or less (No condensation allowed)				
	Fluid temperature [°C]	0 to 40				
Accuracy	Linearity	±3.0%F.S. (at 0.5MPa and 20°C)				
	Pressure characteristics	±2.0%F.S .(at 0.5MPa standard, 0.2 to 0.7MPa)				
	Temperature characteristics	±2.0%F.S. (at 20°C standard, 10 to 30°C)				
	Pressure loss [MPa]	Within 0.015 (at max. flow rate and 0.5MPa)				
	Response [sec]	Within 2.5				
Output	Indication	Momentary/Cumulative, 4-digit LED indication				
	Resolution [L/min(normal)]	1	5	5	10	20
	Min. displayed flow rate [L/min(normal)]	10	20	40	80	160
	Cumulative flow rate	Max. 9 digits (however, switching with CHANGE key) (Note 4)				
	Analog output	0 to 5VDC				
	Switch output	1 point (NPN transistor output) (Note 5)				
	Pulse output (Note 2)	10L(normal)/pulse				100L(normal)/pulse
	Source voltage [V]	100VAC (6W or less; without switch output load current)				
	Cable	Attached (For connection between sensor and monitor: 3m. Power cable: 2.5m)				
Instal-lation	Installation direction	Vertical or horizontal without limitation				
	Straight pipe for introduction	Inlet: 10D recommended. Outlet: 5D recommended. (Note 3)				
	Protective structure	IP64 or equivalent (sensor section only)				
	Mass [kg]	6.0		7.5		9.5

(Note 1) Note that condensation may be formed if the ambient temperature is lower than the fluid temperature.
Note that detection faults may be caused if permeating oil content is accumulated.
Because the product is not clean device specification, particles is generated on the secondary circuit. If ultra-clean air is necessary, installation of a final air filter at the end is recommended.

(Note 2) The pulse output is common with switch output. Switch the function.

(Note 3) Installation of a straight pipe section at the pre-stage of the coupler (female) is recommended for measurement free from piping conditions ("D" indicates the bore of the pipe).

(Note 4) The cumulative flow rate is periodically backed up. It can be backed up with manual operation, too.

(Note 5) Can be used only for OUT2. The setting can be entered for OUT1, but no corresponding output terminal is provided.

3
PRODUCT

3.3 How to Order

■■ PFD Series ■■

● Separate display type

PFD - [501] - [10] [N] [0] - [B]

Symbol	Symbol	
(a) Flow rate range		
501	25 to 500 L/min (normal)	
102	50 to 1000 L/min (normal)	
202	100 to 2000 L/min (normal)	
402	200 to 4000 L/min (normal)	
802	400 to 8000 L/min (normal)	
163	0.80 to 16.00 m^3/min (normal)	
(b) Bore size		
10	Rc 3/8	Applicable to 501
15	Rc 1/2	Applicable to 102
20	Rc 3/4	Applicable to 202
25	Rc 1	Applicable to 402
40	Rc 1 1/2	Applicable to 802
50	Rc 2	Applicable to 163
(c) Alarm output		
N	NPN transistor output x 2	
P	PNP transistor output x 2	
(d) Analog output		
0	0 to 5 VDC	Standard
1	4 to 20 mADC	Option
2	1 to 5 VDC	Option
3	0 to 10 VDC	Option
(e) Bracket		
Blank	None; standard	
B	Bracket attached; option	

Notes on model number selection

Note 1: The product consists of a sensor section, monitor section and cable.
Indication on the nameplate follows the following rule.
The cable is not provided with model number indication.

Product: PFD - (a) - (b) (c) (d) - (e)

Sensor section: PFD -0 (a) - (b)
Monitor section: PFD - (a) - (c) (d)

<Model number example>

PFD-501-10N0-B

(a) Flow rate range [501] : 25 to 50L/min (normal)
(b) Bore size [10] : Rc3/8
(c) Alarm output [N] : NPN transistor output
(d) Analog output [0] : 0 to 5VDC
(e) Bracket: [B] : Bracket attached

■■ PFK Series ■■

● Tester kit

PFK - 402 - 25 N 0

Symbol	Symbol
(a)	Flow rate range
501	25 to 500 L/min (normal)
102	50 to 1000 L/min (normal)
202	100 to 2000 L/min (normal)
402	200 to 4000 L/min (normal)
802	400 to 8000 L/min (normal)
(b)	Bore size
15	Coupler for 15A; applicable to 501 and 102
25	Coupler for 25A; applicable to 202 and 402
40	Coupler for 40A; applicable to 802
Alarm output	
N	NPN transistor output x2
Analog output	
0	0 to 5 VDC

Notes on model number selection

Note 1: Can be used for OUT2 only. The setting can be entered for OUT1 but no corresponding output terminal is provided.

Note 2: The product comes with a special trunk case that houses the sensor section, monitor section, cable and coupler.

Product: PFK- (a) - (b) N0

<Model number example>

PFK-402-25N0

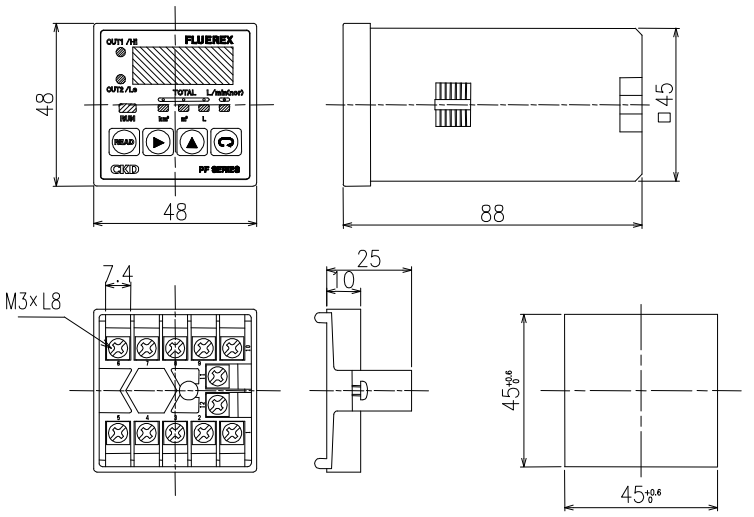
(a) Flow rate range [402] : 200 to 4000L/min (normal)
(b) Bore size [25] : Coupler for 25A
Alarm output [N] : NPN transistor output
Analog output [0] : 0 to 5VDC

3
PRODUCT

3.4 Dimensioned Drawing

■■ PFD Series ■■

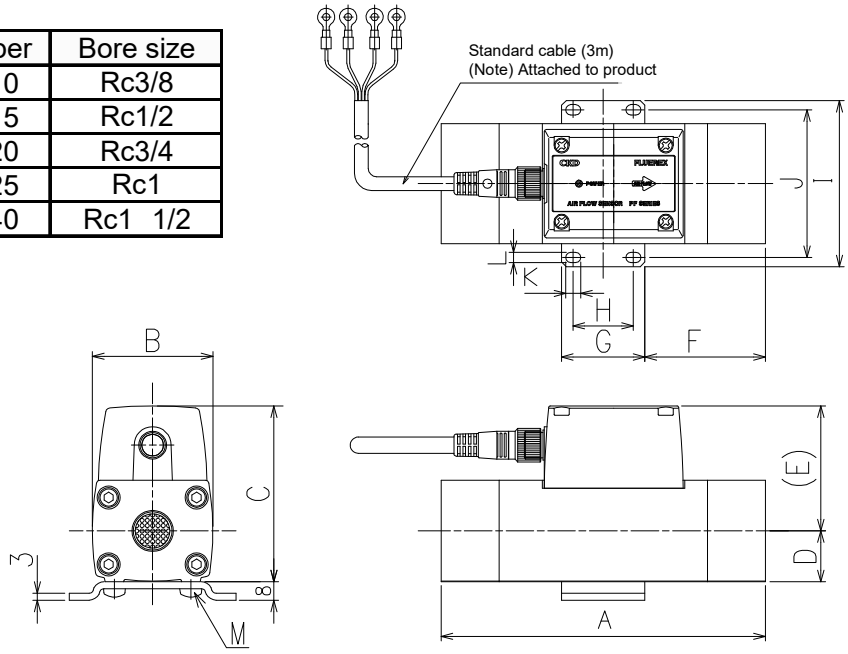
<Monitor section>



<Sensor section>

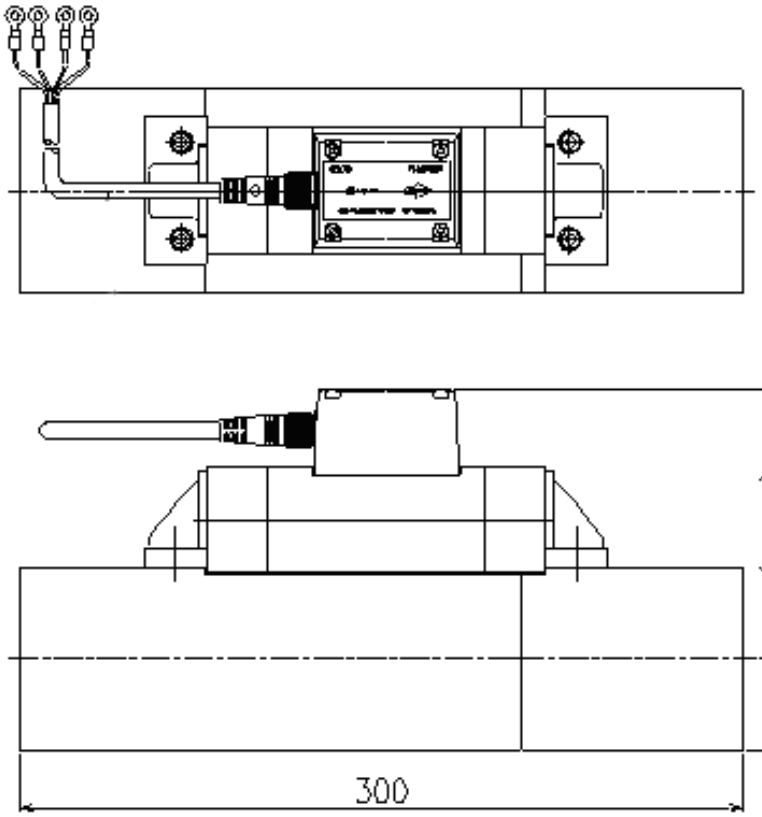
● **PFD-501/102/202/402/802**

Model number	Bore size
PFD-501-10	Rc3/8
PFD-102-15	Rc1/2
PFD-202-20	Rc3/4
PFD-402-25	Rc1
PFD-802-40	Rc1 1/2

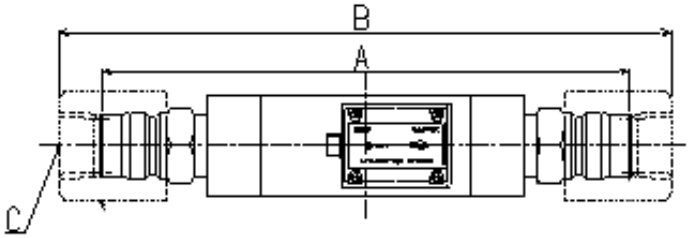


Model number	A	B	C	D	E	F	G	H	I	J	K	L	M
PFD-501/102	140	52	76.2	22	54.2	52	36	26	72	64	6.5	4.5	M4 screw, 6 long
PFD-202	150	55	87.2	27.5	59.7	57	36	26	72	64	6.5	4.5	M4 screw, 6 long
PFD-402	175	55	90.7	27.5	63.2	69.5	36	26	72	64	6.5	4.5	M4 screw, 6 long
PFD-802	190	65	103.7	34	69.7	75	40	26	94	80	8	6	M5 screw, 8 long

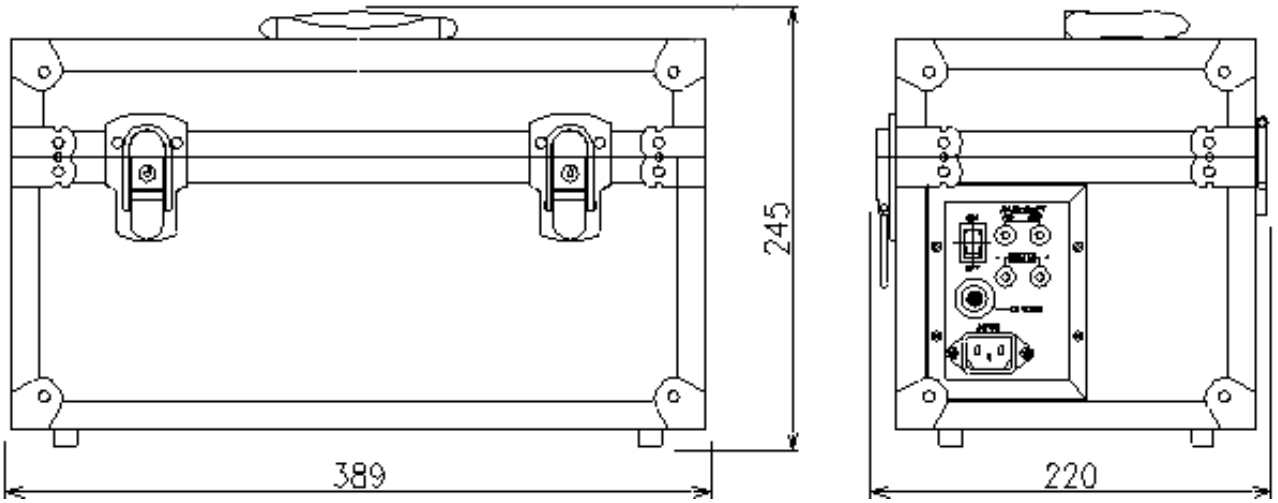
● PFD-501/102/202/4



■■ PFK series ■■

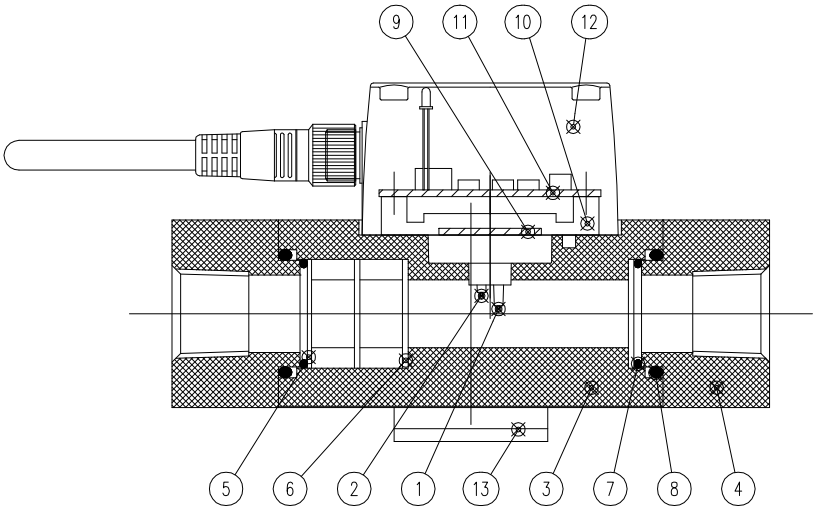


	A	B	C
Sensor for PFK-501/102	228	264	Rc1/2
Sensor for PFK-202	286	332	Rc1
Sensor for PFK-402	301	347	Rc1
Sensor for PFK-802	350	402	Rc1 1/2

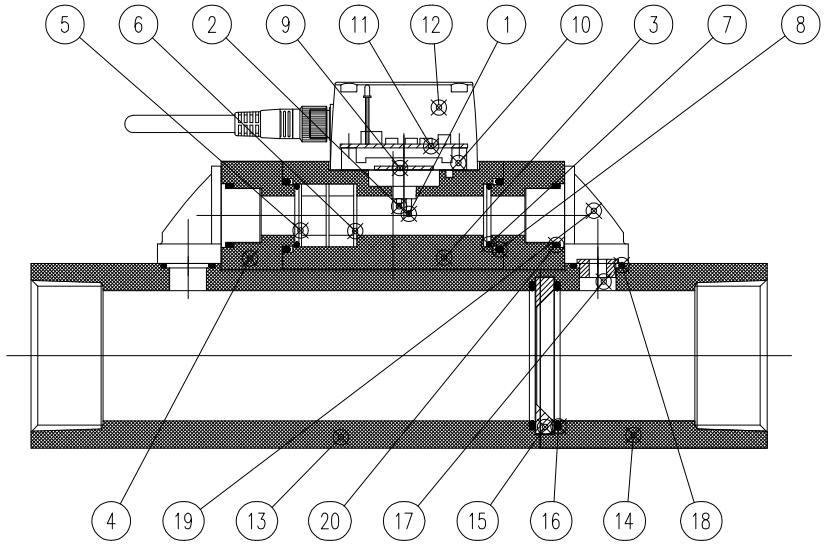


3
PRODUCT

3.5 Internal Structure and Parts List



Item name	Part name	Material		Item name	Part name	Material	
1	Platinum thin film sensor 1		Aluminum oxide/Platinum	8	O ring	NBR	Nitrile rubber
2	Platinum thin film sensor 2		Aluminum oxide/Platinum	9	Sensor base PCB		Glass epoxy
3	Body	A6063S	Aluminum alloy	10	Sensor base	PBT	Polybutylene terephthalate
4	Adaptor	A6063S	Aluminum alloy	11	Sensor PCB		Glass epoxy
5	Rectifying plate	SUS304	Stainless steel	12	Cover	ABS	ABS resin
6	Mesh	SUS304	Stainless steel	13	Bracket	SUS304	Stainless steel
7	O ring	NBR	Nitrile rubber				



Item name	Part name	Material		Item name	Part name	Material	
1	Platinum thin film sensor 1		Aluminum oxide/Platinum	11	Sensor PCB		Glass epoxy
2	Platinum thin film sensor 2		Aluminum oxide/Platinum	12	Cover	ABS	ABS resin
3	Body	A6063S	Aluminum alloy	13	Flow path 1	A6063S	Aluminum alloy
4	Diffluence adaptor	A6063S	Aluminum alloy	14	Flow path 2	A6063S	Aluminum alloy
5	Rectifying plate	SUS304	Stainless steel	15	Orifice	C3604BD	Brass
6	Mesh	SUS304	Stainless steel	16	O ring	NBR	Nitrile rubber
7	O ring	NBR	Nitrile rubber	17	O ring	NBR	Nitrile rubber
8	O ring	NBR	Nitrile rubber	18	Sub attachment	SCS13	Stainless steel
9	Sensor base PCB		Glass epoxy	19	O ring	NBR	Nitrile rubber
10	Sensor base	PBT	Polybutylene terephthalate				

MEMO