Flow Sensor for Compressed Air PFD Series

FLOW SENSOR FOR COMPRESSED AIR PFD SERIES

CKD Corporation

CC-836A 1

Contributing to global environment energy conservation control

Plan
Understand current state

■ Measure current flow
■ Review corrective action

Do
Implement corrective action

■ Stop air pressure supply when idle
■ Shorten blow time
■ Use energy-saving nozzle
■ Low pressure

Action
Correct or continue

■ Standardize consumption rate in system and line
■ Horizontally develop to other lines

Check
Confirm effect

■ Measure with flow sensor
■ Calculates costs with integrating function

Flow sensor for compressed air

FLUEREX PFD Series
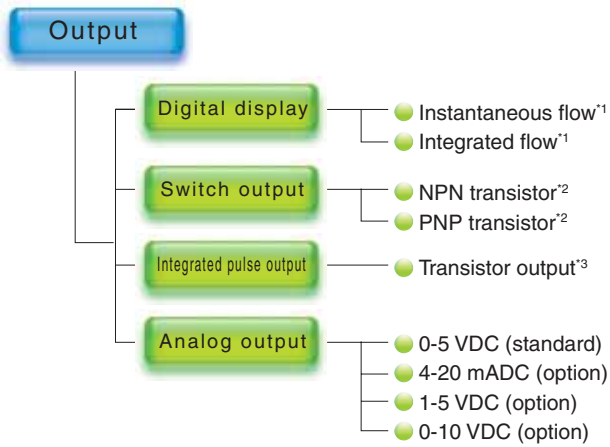
Compressed air flow sensor
PFD Series Excellent for checking current energy consumption and effect

CKD Green Technology

Ample output variations

Output

- Digital display
  - Instantaneous flow[*1]
  - Integrated flow[*1]
- Switch output
  - NPN transistor[*2]
  - PNP transistor[*2]
- Integrated pulse output
  - Transistor output[*3]
- Analog output
  - 0-5 VDC (standard)
  - 4-20 mADC (option)
  - 1-5 VDC (option)
  - 0-10 VDC (option)

[*1]. Switch between instant and integrated flow in one touch.
[*2]. Select NPN or PNP for switch output.
    Two output points are provided, one point for the PFK Series. **New**
[*3]. Easily change one switch output to integrated pulse output. **New**

RoHS directive complied

Harmful substances such as lead and hexavalent chrome that adversely affect the global environment are not used in the materials.

RoHS

Optimum for ISO 14001 acquisition

Large flow rate types compatible with controlling energy saving in the each plant are available. This component is indispensable for acquiring International Standard Organization ISO14001 certification for your environment management system.
This sensor also functions as a flow sensor for general industrial machines.

Eliminate compensation - read directly with a digital gauge

Bothersome pressure compensation and temperature correction are not required.
The digitally displayed value can be directly read in.

- **Pressure compensation not required**
  Detection of mass flow

  Pressure range 0.1MPa – 1.5MPa

- **Temperature correction not required**
  Automatic temperature correction integrated

  Temperature range 40° – 0°
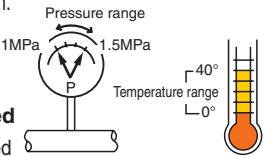
Outstanding general accuracy ±4% F.S.

General accuracy of ±4%F.S. is realized without compensation between 10 and 30 and 0.2 to 0.7 MPa.

$$\text{Total precision} = \pm \sqrt{(\text{linearity})^2 + (\text{temperature characteristics})^2 + (\text{pressure characteristics})^2}$$

(Note) The general accuracy is a reference value which includes all errors including errors caused by fluctuation in the temperature or pressure and errors such as linearity.

Portable kit

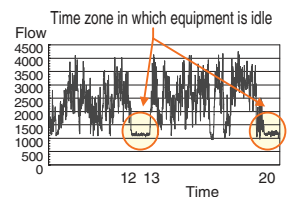Five types of tester kits containing a sensor, monitor, and piping, etc. in a trunk are available.

- Connect pipes and wires in one touch.

ECO-monitoring system

Monitoring is configured based on Save Net.

- Up to 128 devices can be connected to collect data at 3 Mbps over 1 km.

Time zone in which equipment is idle

Covering a wide range of flow rates with 11 models

Standard (port size)	Kit (port size)	Flow rate range [L/min. (normal)]
PFD-501 (Rc3/8)	PFK-501 (Rc1/2)	25 – 500
PFD-102 (Rc1/2)	PFK-102 (Rc1/2)	50 – 1000
PFD-202 (Rc3/4)	PFK-202 (Rc1)	100 – 2000
PFD-402 (Rc1)	PFK-402 (Rc1)	200 – 4000
PFD-802 (Rc1 1/2)	PFK-802 (Rc1 1/2)	400 – 8000
PFD-163 (Rc2)		800 – 16000

* PKF Series uses coupler connection.

Flow sensor for compressed air applications

Controlling flow rate in automobile manufacturing lines

■ Automobile line control
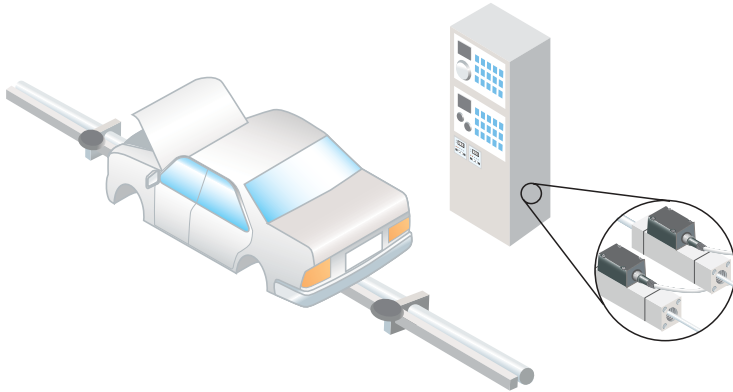
■ Welding line robot
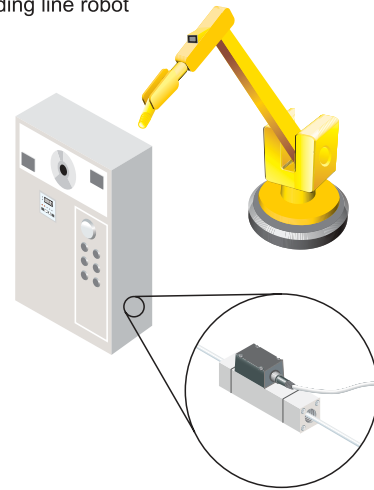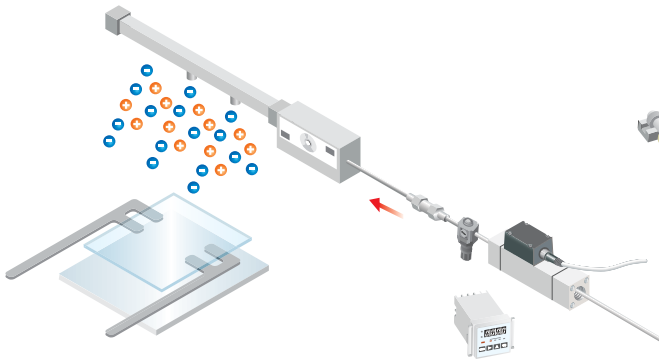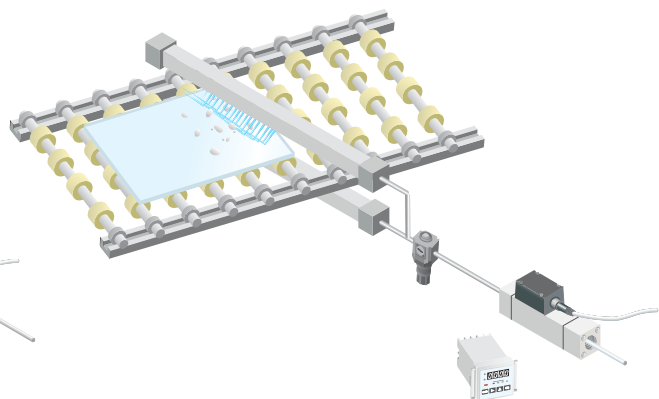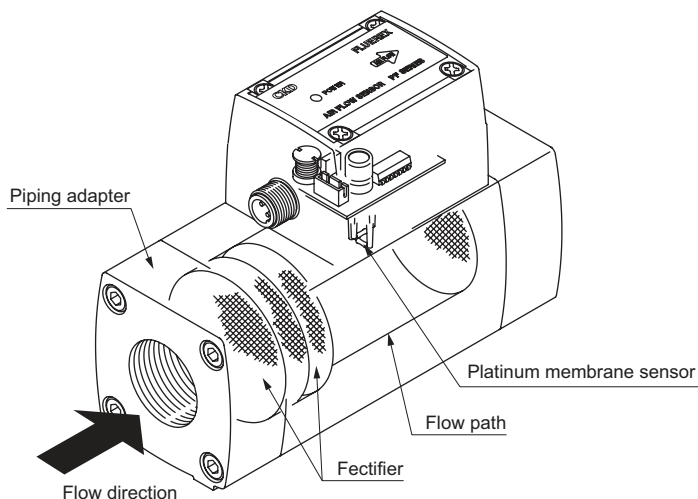
Controlling flow in FPD manufacturing

■ Ionizer

■ Air knife

Functional explanation

Piping adapter

Flow direction

Fectifier

Flow path

Platinum membrane sensor

The Fluerex sensor consists of a rectifier passing even amounts of compressed air and a platinum membrane resistor that detects flow. Inserting a bent pipe such as an elbow just before the sensor evens the rectifier flow. Using multiple rectifier plates suppresses pressure loss, enabling a rectifier effect. When compressed air is not flowing, the platinum membrane sensor that detects flow is heated to a set temperature by the fluid temperature.

When compressed air flows, heat is lost proportional to air, so a current flows to the platinum membrane sensor circuit that detects flow. The display receives this current as the flow signal and indicates the practical atmospheric pressure, instant flow of air converted to 0°C, and cumulative flow. Compressed air temperature is measured and compensated for by the platinum membrane sensor that detects the fluid temperature.

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⚠ 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 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

1 This 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.

2 Use 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.

❶ Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.

❷ Use for applications where life or assets could be adversely affected, and special safety measures are required.

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

ISO 4414, JIS B 8370 (pneumatic system rules)
JPAS 005 (Principles for pneumatic cylinder use and selections)
Including High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety rules, body standards and regulations, etc.

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

❶ Inspect and service the machine and devices after confirming safety of the entire system related to this product.

❷ Note that there may be hot or charged sections even after operation is stopped.

❸ 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 attention to possible water leakage and leakage of electricity.

❹ 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.

5 Observe 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.

Pneumatic components (sensors)

Safety precautions

Be sure to read the instructions before use.
Refer to "Pneumatics, Vacuum, Auxiliary Components Catalog" (No. CB-024S) for general precautions for pneumatic components, refer to "⚠Safety Precautions" of this manual for detailed precautions for each series.

Flow sensor for compressed air PFD Series

Design & Selection

1. Confirmation of specifications

⚠ DANGER

■ Do not use this product with flammable fluids.

⚠ WARNING

■ Use within the product's specific specification range.
Products in this catalog are for use only in a compressed air system. Using this product at a pressure or temperature exceeding specifications could cause ruptures or malfunctions.

■ This product cannot be used as a business meter. This product does not comply with Measurement Laws, and cannot be used for commercial business. Use this as an industrial sensor.

■ Compressed air or nitrogen can be used. Do not use other fluids or the precision cannot be guaranteed.

2. Design for Safety

⚠ WARNING

■ Take measures to protect personnel and equipment against injury or damage if this product fails.

⚠ CAUTION

■ Understand compressed air features before designing a pneumatic circuit.
● Pop-out, air discharge, or leakage due to air compression and expansion could occur.
● Design the circuit so that compressed air in the system is exhausted.

■ Check the leakage current to prevent malfunction caused by current leaking from other controllers.
● When using a programmable controller, etc., the leakage current could cause this product to malfunction.

■ The sensor and monitor of this product are independent and can be exchanged if the flow range is within the same model.
● Sections cannot be exchanged for different flow ranges.
● The sensor and monitor must be used as a set. Using only one will not ensure correct functions.

■ The flow sensor has no moving parts but if the solenoid valve is repeatedly turned on or off, the rectifyer's mesh or fixed section could move slightly and generate particles. Be sure to provide a filter on the secondary side (downstream) of the flow sensor for applications susceptible to particle generation.

3. Design per applications

⚠ CAUTION

■ This product is designed for compressed air, and will tolerate small amounts of leakage. Contact CKD when no leaks are tolerable.

4. Working environment

⚠ DANGER

■ Do not use this product in flammable atmosphere. It does not have an explosion-proof structure, so flame or fires could occur.

■ There is a risk of oxygen deficiency if nitrogen gas is used for the applicable fluid. Observe the following points when handling:
1. Use this product in a well-ventilated place.
2. Ventilate the area while using nitrogen gas.
3. Regularly check nitrogen gas piping for leaks.

⚠ WARNING

■ Do not use the product where the product is exposed to direct-sunlight or may come in contact with water or oil.

■ Do not use in a corrosive environment. Use in the environment like this could result in damage or malfunction.

■ Consult with CKD if ozone could occur in supplied air.

■ Avoid use in ozone occurring environments.

■ Keep the fluid temperature within 0 to 40°C.
Even if the temperature is within the specified range, do not use this product if the temperature could suddenly change and cause dew to condense.

■ This product fails if pressure exceeding the maximum working pressure is used. Check that the pressure is less than the maximum working pressure.

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■ The sensor is dust-proof and drip-proof, so problems do not occur if water gets on the sensor during maintenance or cleaning. The sensor should not be exposed to water for long periods or used in places where water and oil scatter with force.

⚠ CAUTION

■ Confirm that the product will withstand the working environment.
  ● This product cannot be used in environments where functional obstacles could occur. Such environments include high temperatures, a chemical atmosphere, or where chemicals, vibration, moisture, water drip, coolant or gas are present; where ozone is generated;

■ Use within an ambient temperature range 0 to 50°C.

■ Avoid using in areas where vibration exceeds 49 m/s^2 and impact 294 m/S^2 .

Securing space

⚠ CAUTION

■ Ensure space around the pneumatic component for installation, removal, wiring, and piping work.

Installation & Adjustment

1. Installation

⚠ DANGER

■ Use power voltage and output within the specified voltage.
When supplying compressed air after connecting piping, be sure to check for air leaks at all sections where piping is connected. If voltage exceeding the specified voltage is applied, the sensor could malfunction or be damaged, or electrical shock or fire could occur. Do not use a load exceeding the output rating.

⚠ WARNING

■ Check the wire color and terminal numbers when wiring. Incorrect wiring connections could result in sensor damage, problems, and malfunctions. Check wire color and terminal numbers against the instruction manual before wiring.
Insert a noise filter if required.

■ Check wiring insulation.
Check that wires do not contact other circuits and that there are no ground faults or insulation faults across terminals. Overcurrent could flow in and damage the sensor.

■ Separate the monitor from high-voltage wires, high voltage devices, and powered devices such as motors.

■ Check that there are no swarf or wire scraps on the monitor's gland and sensor connectors before wiring.

⚠ CAUTION

■ Do not remove air compressor packaging or the dust-proof cap on the piping port until just before the product is piped.
  ● If the piping port cap is removed from the piping port before piping work is started, foreign matter could enter the pneumatic component from the piping port and result in faults or faulty operation.

■ Do not install pneumatic components with a method that supports with pipes.

2. Confirmation before operation

⚠ CAUTION

■ Apply a leakage detection agent on pipe connections with a brush, and check for air leaks.
  ● Apply a leakage detection agent on pipe connections with a brush, and check for air leaks. Check that leak detection fluid does not get on resin parts. Otherwise resin could be damaged.

■ Separate the cable from sources of noise such as power distribution wires. Failure to do so could result in malfunctions caused by noise.

■ Do not short-circuit the output contact.
If the load is short-circuited, the overcurrent protection circuit protects the output transistor. If left as is too long, the output transistor could break.

■ Do not use this product for loads generating surge voltage. When directly driving a load that generates a surge, such as a relay or solenoid valve, use a sensor with integrated surge absorbing element. Similarly, use surge countermeasures if there is a source of surge in the power supply line.

■ This product cannot withstand lightning surges.
This product complies with CE Marking, but is not resistant to lightning surges. Protection must be provided on the system side.

■ Do not repeatedly bend or tension to leads. Failure to observe this could lead to disconnection.

■ Use the enclosed cable (3m) to wire the sensor to the monitor. Check with CKD before extending the cable.
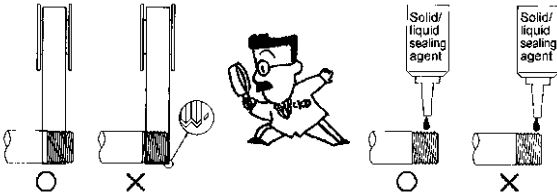
Installation & Adjustment

3. Piping

⚠ CAUTION

■ When connecting pipes, wrap sealing tape in the opposite direction from threads starting 2 mm inside from the end of piping threads.
  ● If sealing tape protrudes from pipe threads, it could be cut when screwed in. This could cause the tape to enter the solenoid valve and lead to faults.

  ● When using a liquid sealing agent, check that it does not get on resin parts. Otherwise resin could be damaged.

■ Check that the pipe connected to the pneumatic component is not dislocated due to vibration, loosening, or pulling.
  ● Dislocation of piping will cause hazards.

■ Observe the following precautions when using nylon tubes or urethane tubes for piping material.
  ● Use a flame resistance tube or steel pipe when using in an environment where spatter could scatter.
  ● When using the standard pushin joint for spiral tubing, fix the base of tubing in place with a hose band. The tube will rotate and holding force will drop if not fixed.

■ Connect piping so that connections are not dislocated by system movement, vibration, or tension.

■ Always flush just before connecting to pneumatic components.
  ● Check that foreign matter entering during piping does not get into the air compressor.

■ Apply adequate torque when connecting pipes.
  ● To prevent air leak and to protect thread.
  ● Tighten by hand first, then use a tool, to prevent screw thread damaged.

[Recommended value]

Port Thread	Tightening torque N·m
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

■ When adjusting the flow with a metering valve (globe valve, ball valve, etc.), install the metering valve on the secondary side of the sensor (downstream). If the metering valve is installed on the primary side, drift (turbulent flow) could occur and result in an error.
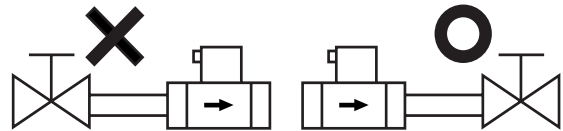
■ Do not install a regulator before the sensor. Incorrect flow could cause errors.
  ● When installing a pressure reduction valve on the primary side, be sure to include straight piping having an inner diameter of 10 D or more.
  * "D" indicates the pipe's inner diameter.
  ● Select a pressure reduction valve having sufficient flow for maximum sensor flow.

■ Check that the fluid direction and the direction indicated on the sensor are the same when piping. Otherwise reading will not be correct.

■ When using an elbow or bushing in piping, install 10 D or larger straight piping on the primary side and 5 D or larger straight piping on the secondary side.
  ● Be sure to provide straight piping when using the PFD-163 Series.
  ● Note that the bore can be changed up to one rank upward with the bushing.

When using elbow

When using bush
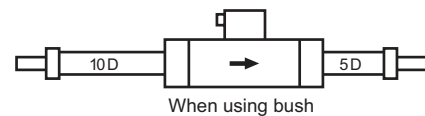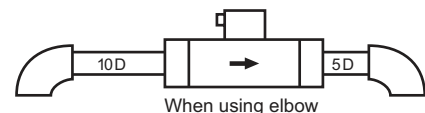
■ Check that force is not applied to resin parts when piping.

4. Pneumatic pressure source

⚠ CAUTION

■ Install the air filter just before the circuit using the pneumatic component.

■ When supplying compressed air for the first time after connecting pipes, do not apply high pressure suddenly.
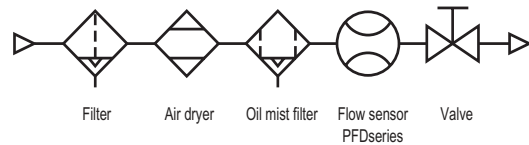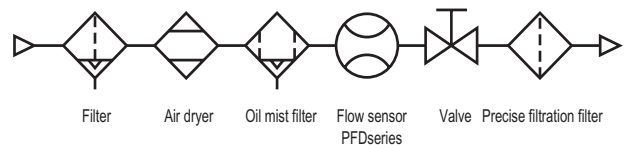 ● Tube may come off and fly out, causing an accident.

■ Air quality
- ● Use a CKD clean air system depending on the application.
- ● Use compressed air free of oxidized oil, tar, or carbon from the air compressor.
- ● Use compressed air free of solid foreign matter.

● Install a filter, air dryer, and oil mist filter on the primary side (upper stream side) of the sensor. The sensor's meshing rectifies flow in the pipe. It does not filter out foreign substances, so provide a filter.

Filter   Air dryer   Oil mist filter   Flow sensor PFDseries   Valve

When requiring ultra clean air

Filter   Air dryer   Oil mist filter   Flow sensor PFDseries   Valve   Precise filtration filter

During Use & Maintenance

1. During use

⚠ WARNING

■ A flow several times higher than the rated flow occurs if the valve connected to the sensor is suddenly opened. This can damage the platinum membrane sensor or rectifying unit and cause fluid to flow to the secondary side. Gradually open the valve connected to the sensor while checking that the monitor display does not exceed the rated flow.

⚠ CAUTION

■ If a problem occurs during operation, immediately turn power off, stop use, and contact your dealer.

■ Internal settings, such as the hardware check, are made in the first 10 seconds after power is turned ON. The display and output do not function correctly during this time. If an interlock circuit is established with control system devices using switch output, an abnormal stop could occur, so mask the output during this time.

■ If the output setting value is changed, control system devices could operate unintentionally. Stop devices before changing settings.

■ When an interlock circuit is used, use a double interlock circuit and regularly check that operations are correct.

2. Maintenance Inspection

⚠ CAUTION

■ Be sure to turn power off, stop supplied compressed air, and check that there is no residual pressure before starting maintenance.
- ● This is required to ensure safety.

■ Inspect the sensor at least once a year and confirm that it operates correctly.

■ Do not disassemble or modify this product. Doing so could result in faults.
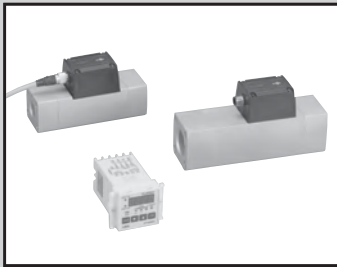
Flow sensor

PFD Series

● Flow rate ranges: 25 to 500, 50 to 1000, 100 to 2000, 200 to 4000
400 to 8000, 800 to 16000 L/min (normal)

Features

● Detect flow with a general accuracy of ±4%F.S.
● No adjustment required for pressure and temperature variations
● Flow measurements are converted to those in the reference status (0°C, 101.3 kPa) for display.
● Display and pulse output of the cumulative values are possible.
● Various functions and variations including different flow ranges and electric outputs

Specifications

	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
	Port size	Rc3/8	Rc1/2	Rc3/4	Rc1	Rc1½	Rc2
working conditions	Applied fluid	Clean compressed air/nitrogen gas					
	Working air quality	JIS B8392-1: 2003/1.1.1–1.6.1 (Note 1)					
	Max. working pressure MPa	1.0					
	Min. working pressure MPa	0.1					
	Withstanding pressure MPa	1.5					
	Ambient temperature	0 to 50°C, 85% R.H. or less (no dew)					
	Fluid temperature °C	0 to 40					
Accuracy	Straightness	±3.0% F.S. (0.5 MPa at 20°C)					
	Pressure characteristics	±2.0% F.S. (normally 0.5 MPa in 0.2 to 0.7 MPa range)					
	Temperature characteristics	±2.0% F.S. (normally 20°C in 10 to 30°C range)					
	Pressure loss MPa	0.015 or less (maximum flow rate, 0.5MPa)					
	Responsiveness sec	2.5 or less					
output	Display	Instantaneous/integrated flow 4 digit LED display					
	Resolution L/min (normal)	1	5	5	10	20	50
	Minimum flow displayed L/min (normal)	10	20	40	80	160	320
	Integrated flow	Max. 9 digits (display switched by change key) (Note 4)					
	Analog output	Standard: 0 to 5 VDC / Option: 4 to 20 mADC, 1 to 5 V, 0 to 10 V					
	Switch output	2 points (NPN/PNP transistor output: selection type)					
	Pulse output (Note 2)	10L(normal)/pulse				100L(normal)/pulse	
	Power voltage V	24 VDC (6 W or less, excluding switch output load current)					
	Cable	Accompanying (3 m, 4-core, finished outer diameter of 6, core wire: 0.5 mm², Insulator diameter of 1.72 mm, with connector)					
Installation	How to install the product	Both vertical and horizontal					
	Introductory straight pipe section	In: 10 D; Out: 5 D recommended (Note 3)					
	Protective structure	Equivalent to IP64 (only sensor section)					
	Weight kg	1.1	1.1	1.3	1.4	1.7	4.5

Note 1: Dew could collect if ambient temperature is lower than working fluid temperature.
　　　　Defection faults could occur if oil accumulates.
　　　　This product does not have clean device specifications, so particles could form on the secondary side.
　　　　If ultra-clean air is required, a precision filtration filter should be installed on the end.
Note 2: Pulse output is used with switch output. Switch the function before use.
Note 3: A straight pipe should be installed to eliminate the effect of piping conditions. D indicates the piping bore size.
Note 4: The integrated flow value is periodically backed up. Backup can also be made manually.
　　　　Refer to page 13 for details, "Function and operation description".

CKD

How to order

● Separate display type

PFD - 501 - 10 N 0 - B

❶ Flow rate range

❷ Port size

❸ Switch output

❹ Analog output

❺ Bracket (note 1)

Symbol	Description
❶ Flow rate range	
501	25 to 500L /min (normal)
102	50 to 1000L /min (normal)
202	100 to 2000L /min (normal)
402	200 to 4000L /min (normal)
802	400 to 8000L /min (normal)
163	0.80 to 16.00m³/min (normal)

❷ Port size							
Flow rate range		501	102	202	402	802	163
10	Rc3/8	●					
15	Rc1/2		●				
20	Rc3/4			●			
25	Rc1				●		
40	Rc1½					●	
50	Rc2						●

❸ Switch output	
N	NPN transistor output × 2
P	PNP transistor output × 2

❹ Analog output		
0	0 to 5 VDC	Standard
1	4 to 20 mA DC	Option
2	1 to 5 VDC	Option
3	0 to 10 VDC	Option

❺ Bracket		
Blank	None	Standard
B	Bracket attached	Option

⚠ Note on model no. selection

Note 1: The bracket option is not available for PFD-163.
Note 2: This product consists of a sensor, monitor, and
cable.
The following are indicated on the nameplate.
The model is not indicated on the cable.

Product: PFD–(A)–(B) (C) (D)–(E)
Sensor: PFD–(A)–(B)
Monitor: PFD–(A)–(C) (D)

<Example of model number>

PFD-501-10N0-B

Model no.: PFD
❶ Flow rate range   : 25 to 500 L/min (normal)
❷ Port size   : Rc3/8
❸ Switch output   : NPN transistor output
❹ Analog output   : 0 to 5 VDC
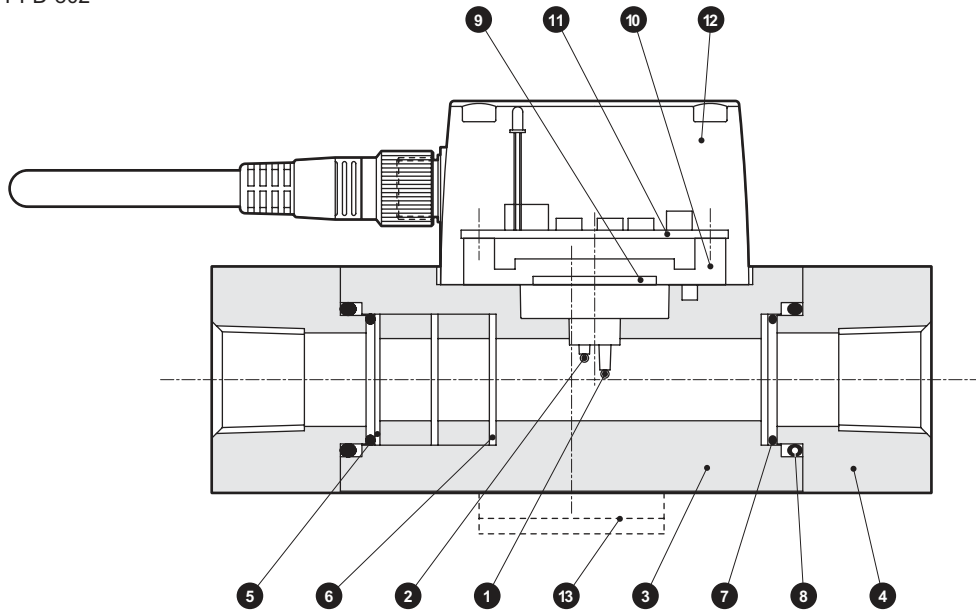❺ Bracket   : Bracket attached

● Discrete option model no.

PFD - C3

Symbol	Description
C3	Standard cable
CW	Extension cable
B	Bracket (for 501/102/202/402)
B1	Bracket (for 802)

Internal structure and parts list

● PFD-501 to PFD-802

No.	Parts name	Material		No.	Parts name	Material	
1	Platinum membrane sensor 1		Alumina/platinum	7	O ring	NBR	Nitrile rubber
2	Platinum membrane sensor 2		Alumina/platinum	8	O ring	NBR	Nitrile rubber
3	Body	A6063S	Aluminum alloy	9	Sensor base substrate		Glass epoxy
4	Adaptor	A6063S	Aluminum alloy	10	Sensor base	PBT	Polybutylene terephthalate
5	Rectification plate	SUS304	Stainless steel	11	Sensor substrate		Glass epoxy
6	Mesh	SUS304	Stainless steel	12	Cover	ABS	ABS resin
				13	Bracket	SUS304	Stainless steel

● PFD-163
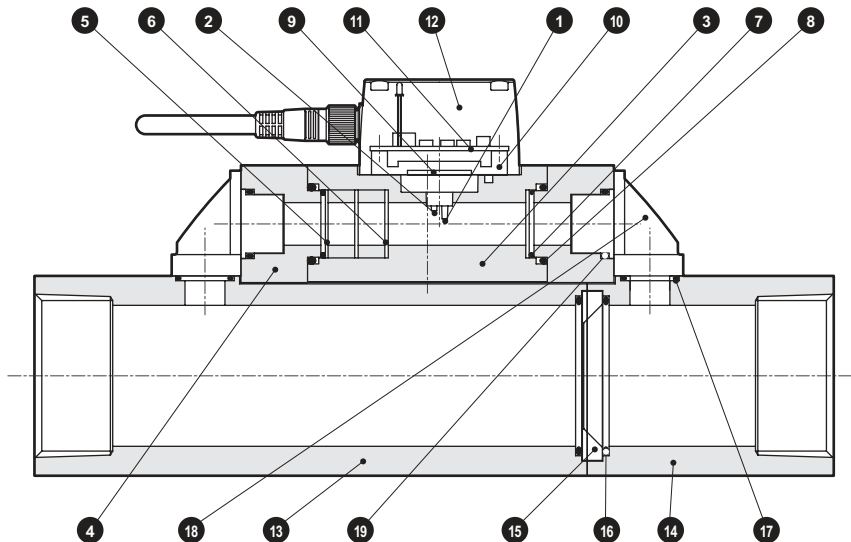
No.	Parts name	Material		No.	Parts name	Material	
1	Platinum membrane sensor 1		Alumina/platinum	11	Sensor PCB		Glass epoxy
2	Platinum membrane sensor 2		Alumina/platinum	12	Cover	ABS	ABS resin
3	Body	A6063S	Aluminum alloy	13	Flow path 1	A6063S	Aluminum alloy
4	Branch adapter	A6063S	Aluminum alloy	14	Flow path 2	A6063S	Aluminum alloy
5	Rectification 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 substrate		Glass epoxy	19	O ring	NBR	Nitrile rubber
10	Sensor base	PBT	Polybutylene terephthalate				

Dimensions

● PFD-501 to 802

Standard cable (3 m)
(Note) Accompanying
the product
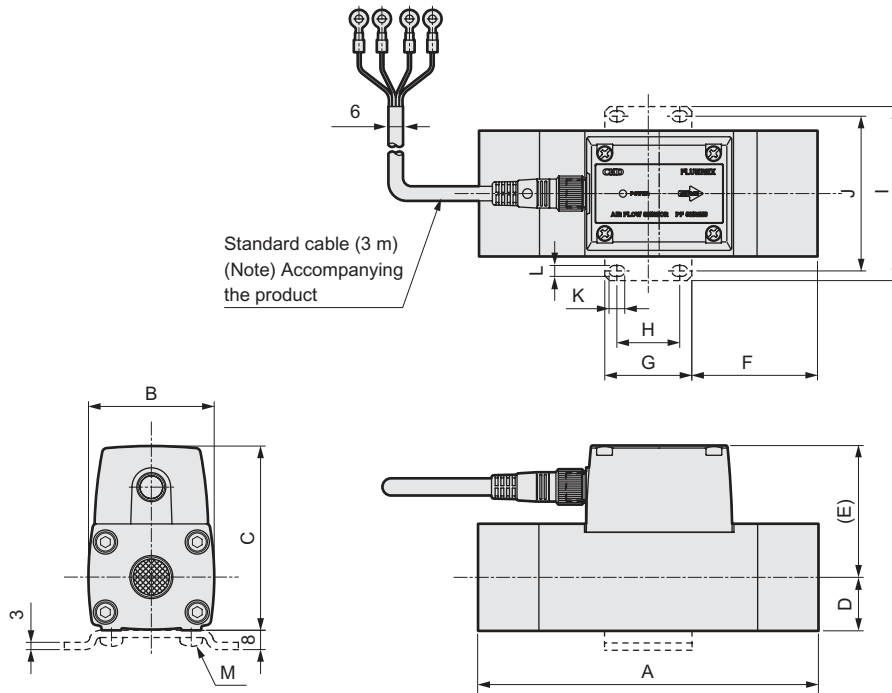
Model No.	Port size
PFD-501-10	Rc3/8
PFD-102-15	Rc1/2
PFD-202-20	Rc3/4
PFD-402-25	Rc1
PFD-802-40	Rc1½

Model No.	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 thread length 6
PFD-202	150	55	87.2	27.5	59.7	57	36	26	72	64	6.5	4.5	M4 thread length 6
PFD-402	175	55	90.7	27.5	63.2	69.5	36	26	72	64	6.5	4.5	M4 thread length 6
PFD-802	190	65	103.7	34	69.7	75	40	26	94	80	8	6	M5 thread length 8

● Monitor

<Panel cut dimension>

<Panel bracket>

2-3×10ℓ
Tapping screw

* Panel thickness (t.5 to 9.5)
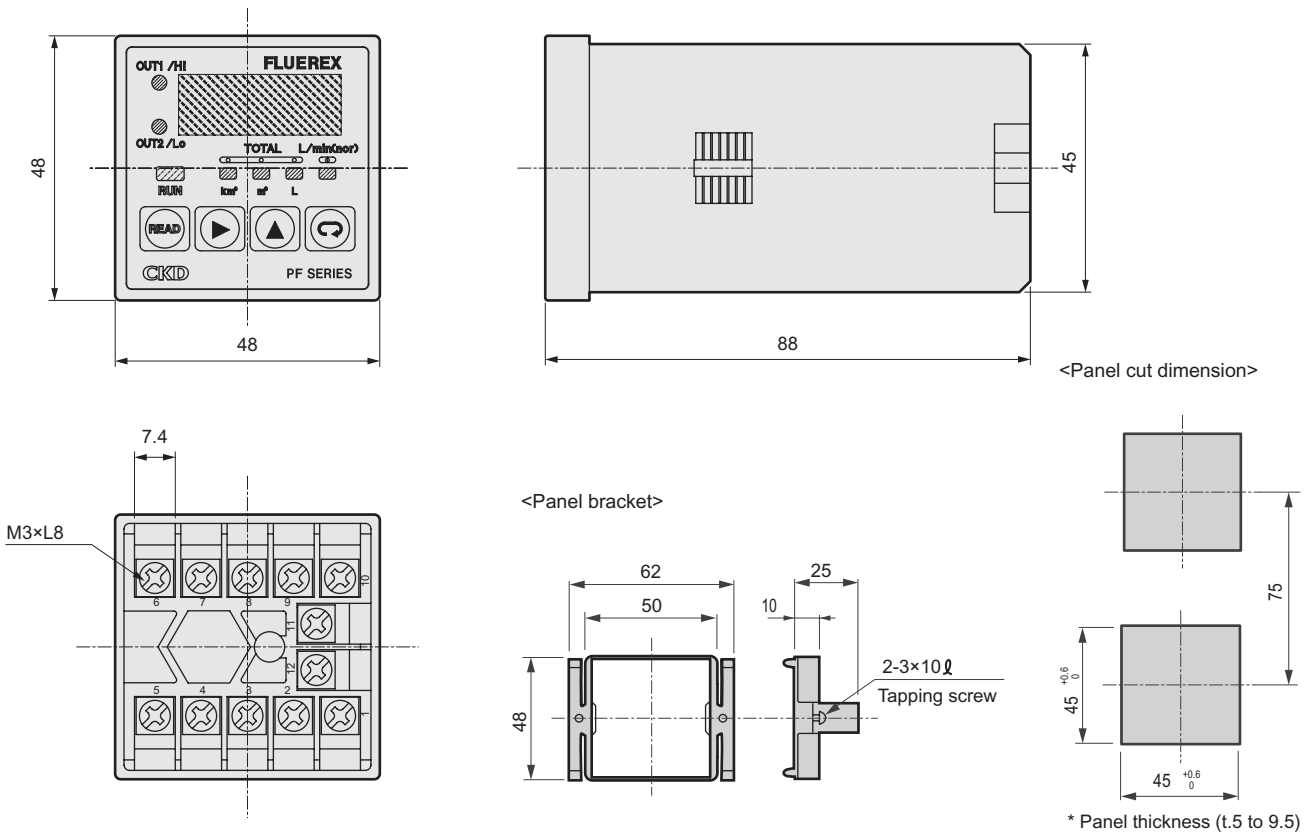
Dimensions

● PFD-163

Standard cable (3 m)
(Note) Accompanying the product

6

(111.2)

37.5

300

Product name plate

148.7

75

79

Port size Rc2

CKD
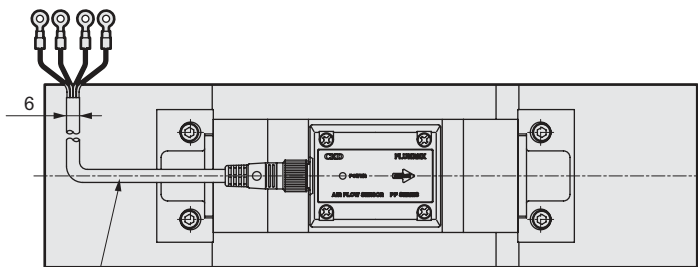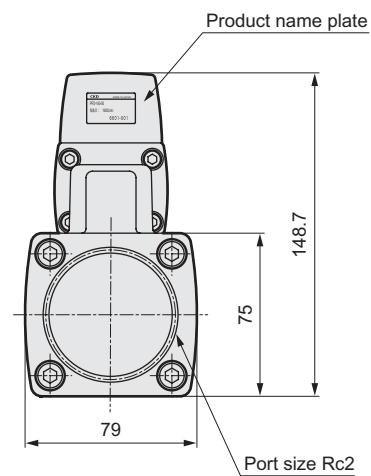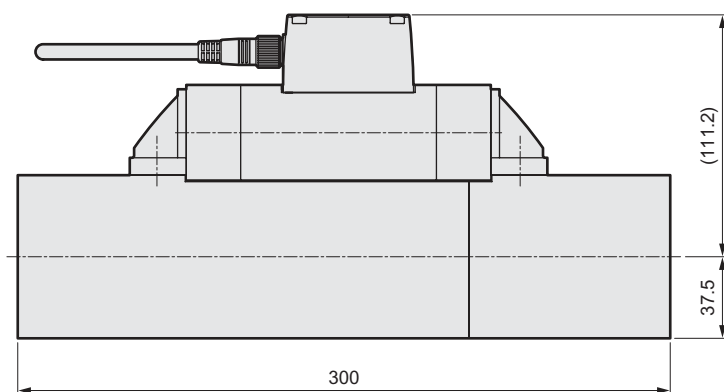
MEMO

Tester kit
PFK Series

Kits of air flow measurement devices enable you to instantly measure flows on site.
● Flow ranges: 25 to 500, 50 to 1000, 100 to 2000, 200 to 4000, 400 to 8000 L/min (normal)

specifications

descriptions		PFK-501-15NO	PFK-102-15NO	PFK-202-25NO	PFK-402-25NO	PFK-802-40NO
specifications	flow rate rangeL/min(normal)	25 to 500	50 to 1000	100 to 2000	200 to 4000	400 to 8000
	port size	Rc½		Rc1		Rc1½
working conditions	Working fluid	Clean compressed air/nitrogen gas				
	Working air quality	JIS B8392-1: 2003/1.1.1 to 1.6.1 (Note 1)				
	max. working pressure MPa	1.0				
	min. working pressure MPa	0.1				
	withstanding pressure MPa	1.5				
	Ambient temperature	0 to 50°C, 85%R.H. or less (no dew)				
	fluid temperature °C	0 to 40				
Accuracy	Straightness	±3.0% F.S. (0.5 MPa at 20°C)				
	pressure characteristics	±2.0% F.S. (normally 0.5 MPa in 0.2 to 0.7 MPa range)				
	temperature characteristics	±2.0% F.S. (normally 20°C in 10 to 30°C range)				
	pressure loss MPa	0.015 or less (Max. flow, at 0.5 MPa)				
	Responsiveness sec	2.5 or less				
output	display	Instantaneous/integrated flow 4 digit LED display				
	resolution L/min(normal)	1	5	5	10	20
	Minimum flow displayed L/min(normal)	10	20	40	80	160
	integrated flow	Max. 9 digits (display switched by change key) (Note 4)				
	analog output	0 to 5 VDC				
	switch output	1 (NPN transistor output) (Note5)				
	Pulse output (Note 2)	10L (normal)/pulse				100L (normal)/pulse
	power voltage V	100 VAC (6 W or less, excluding switch output load current				
	cable	Enclosed item (for between the sensor and the monitor: 3 m; power cable: 2.5 m)				
Installation	How to install the product	Both vertical and horizontal				
	Strait piping section	IN side: 10D, OUT side: 5D recommended (Note 3)				
	protective structure	Equivalent to IP64 (only sensor section)				
	Weight kg	6.0		7.5		9.5

Note 1: Dew could collect if ambient temperature is lower than working fluid temperature.
　　　　Defection faults could occur if oil accumulates.
　　　　This product does not have clean device specifications, so particles could form on the secondary side.
　　　　If ultra-clean air is required, a precision filtration filter should be installed on the end.
Note 2: Pulse output is used with switch output. Switch the function before use.
Note 3: A straight pipe should be installed to eliminate the effect of piping conditions. D indicates the piping bore size.
Note 4: The integrated flow value is periodically backed up. Backup can also be made manually. Refer to page 13, "Function and operation description".
Note 5: Only OUT2 can be used. OUT1 can be set, but no output terminal is available.

Product composition

Case (Monitor)

Sensor

Coupler (2 pieces)

Cable (3 m)

Power cable (2.5 m)

CKD
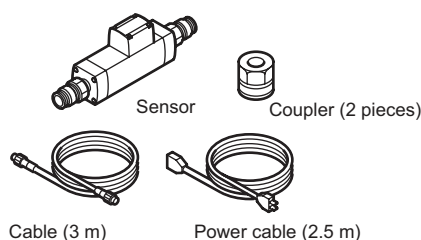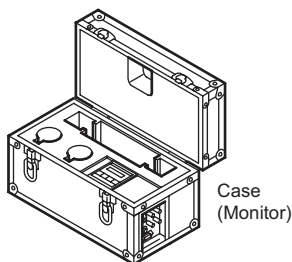
How to order

● Tester kit

PFK - (402) - (25) N 0

❶ Flow rate range

❷ Port size

❸ Switch output

❹ Analog output

Symbol	Descriptions				
❶ 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)				
❷ Port size					
Flow rate range		501	102	202	402	802
15	Coupler for 15 A	●	●			
25	Coupler for 25 A			●	●	
40	Coupler for 40 A					●
❸ Switch output					
N	NPN transistor out put Note 1				
❹ Analog output					
0	0 to 5 VDC				

⚠ Note on model no. selection

Note 1: Only OUT2 can be used. OUT1 can be set, but no output terminal is available.

Note 2: The sensor, monitor, cable, and coupler for this product are enclosed in a dedicated trunk.
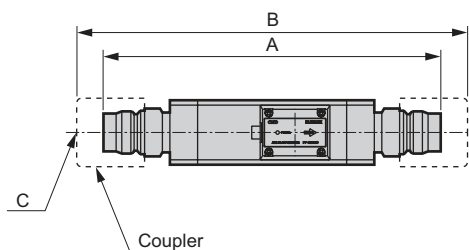
Product: PFK (A) - (B) N0

<Example of model number>

PFK-402-25N0

❶ Flow rate range : 200 to 4000 L/min (normal)
❷ Port size   : Coupler for 25 A
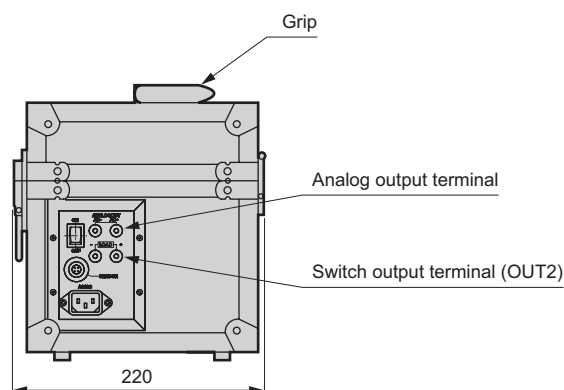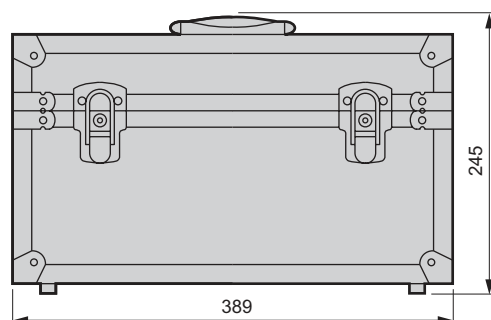❸ Switch output   : NPN transistor output
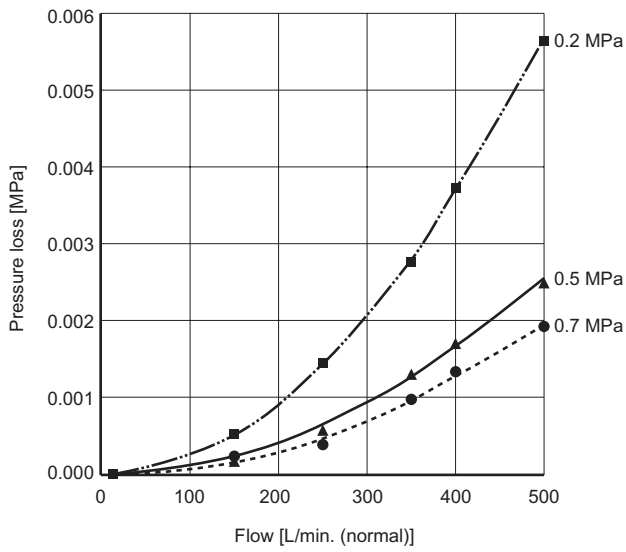❹ Analog output   : 0 to 5 VDC

Dimensions

● PFK
  Sensor

C
Coupler

	A	**B**	**C**
Sensor for PFK-501–102	228	264	Rc½
Sensor for PFK-202	285	331	Rc1
Sensor for PFK-402	300	346	Rc1
Sensor for PFK-802	350	402	Rc1½

Case

Grip

Analog output terminal

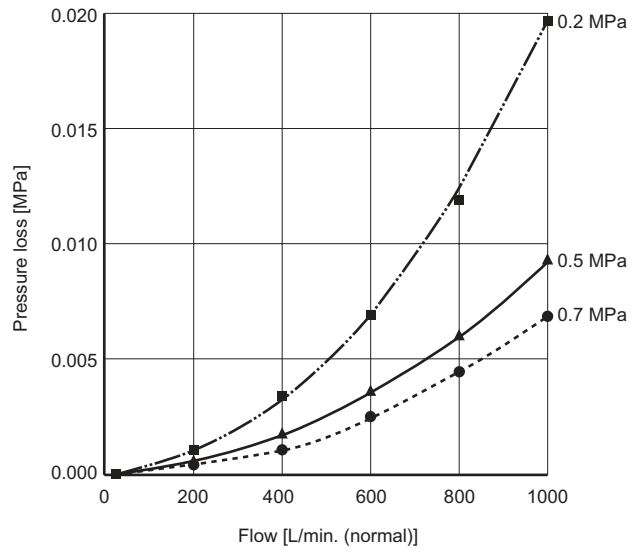Switch output terminal (OUT2)

245

389

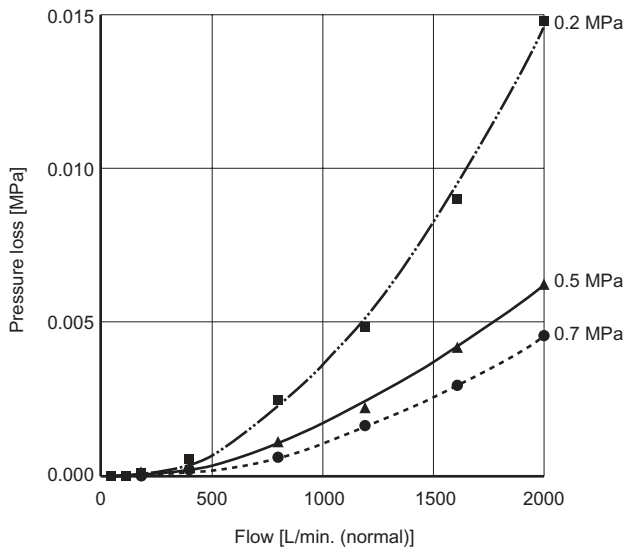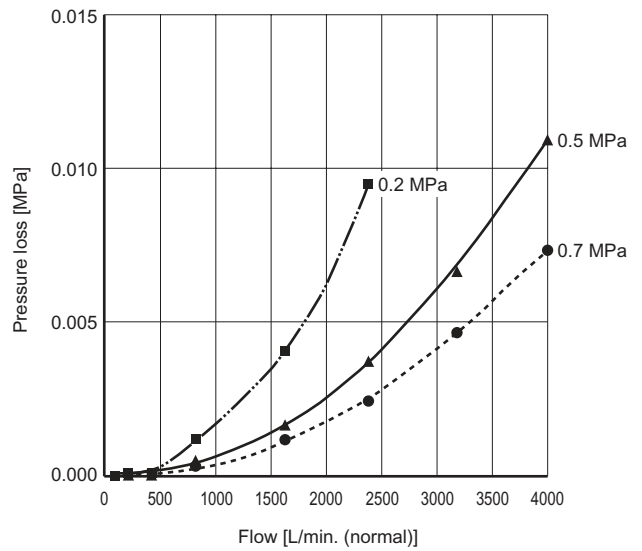220

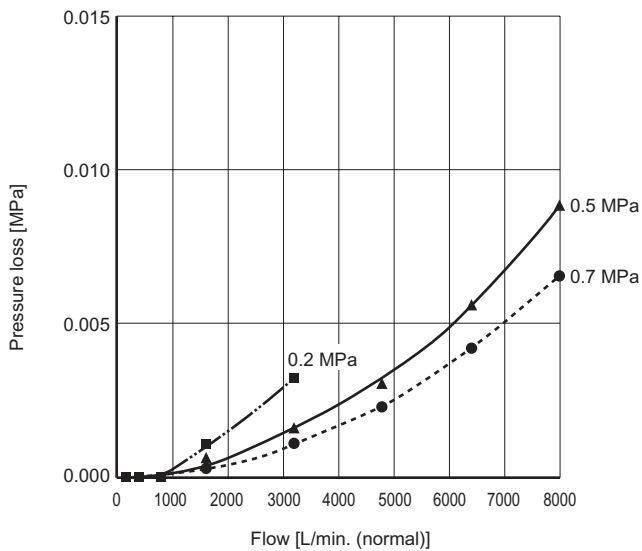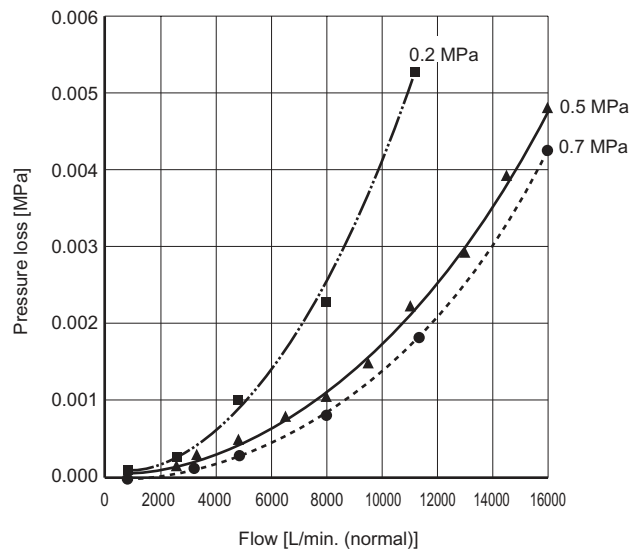# PFD Series

Pressure loss characteristics

● PFD-501-10
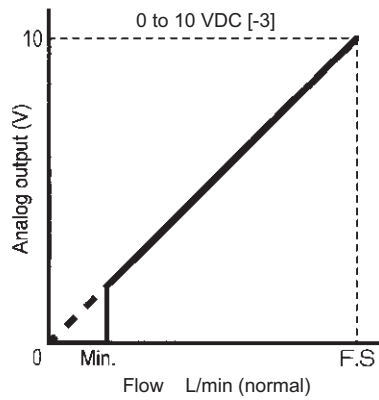

● PFD-102-15

● PFD-202-20

● PFD-402-25

● PFD-802-40
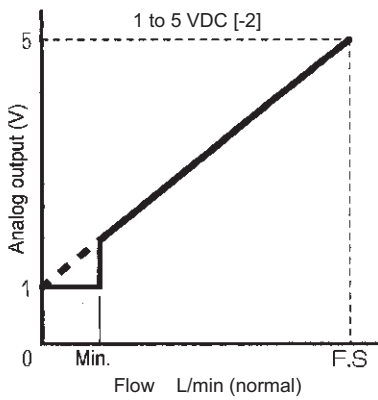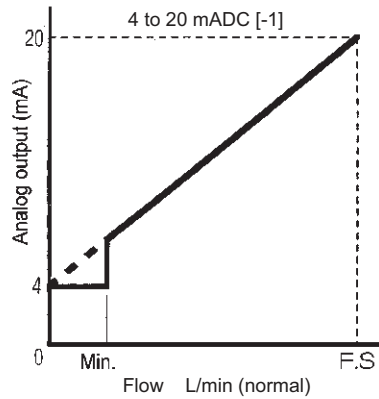

● PFD-163-50

CKD

MEMO

PFD series electric wiring

1 Analog output [Option symbol: -0 (standard), -1, -2, -3]

0 to 5 VDC [-0]

4 to 20 mADC [-1]

1 to 5 VDC [-2]
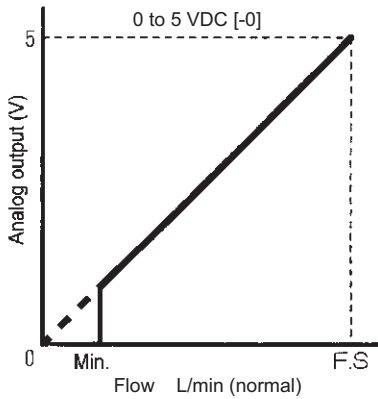
0 to 10 VDC [-3]

Load resistance of analog output

Analog output Descriptions	Load resistance
0 to 5 VDC	50 kΩ or more
4 to 20 mADC	300 kΩ or less
1 to 5 VDC	50 kΩ or more
0 to 10 VDC	50 kΩ or more

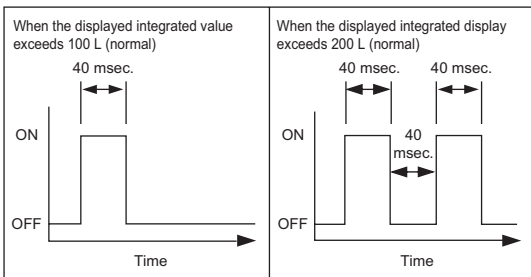| Model No.	Min. L/min. (normal)	FS L/min (normal)
PFD-501-10	25	500
PFD-102-15	50	1000
PFD-202-20	100	2000
PFD-402-25	200	4000
PFD-802-40	400	8000
PFD-163-50	800	16000

● The graph on the right shows the relationship between the flow and analog output. Note that analog output is not made normally with a flow below the minimum value.

● Do never connect the analog terminal with other terminal. Doing so could cause a failure.

● Keep wiring short to prevent the effect of noise. Separate the wire from sources of noise such as power distribution cables.

2 Integrated pulse output [Change with switch output. Only OUT2 is used.]

● The integrated pulse outputs the pulse at the following integrated value.   L (normal)

Model No.	PFD-501 PFK-501	PFD-102 PFK-102	PFD-202 PFK-202	PFD-402 PFK-402	PFD-802 PFK-802	PFD-163
Integrated flow per pulse	10					100

<ex> The pulse waveform for the PFD-802 is shown below.

When the displayed integrated value exceeds 100 L (normal)

When the displayed integrated display exceeds 200 L (normal)

Note that the integrated display is updated at 1 sec. intervals.

● Output circuit
◆ For NPN output

NPN transistor output

(7) OUT2

Max. rated voltage 30 VDC
Max. rated current 50 mA

(9) GND

GND common

◆ For PNP output

(10) 24 VDC

Max. rated current 50 mA

PNP transistor output

(7) OUT2

(9) GND
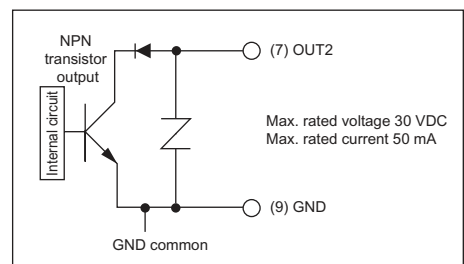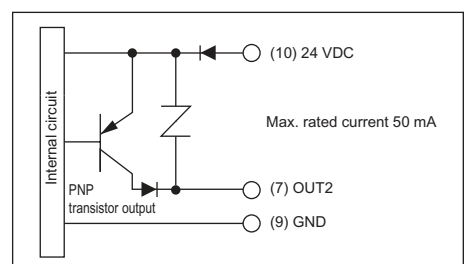
3 Wiring the sensor and monitor

● Observe the following precautions when wiring.

OUT1 (6)
OUT2 (7)
Analog output (8)
Power supply GND (9)
Power supply 24 VDC (10)

(11) N.C.

(12) N.C.

(5) Sensor power supply
(4) Sensor GND
(3) Sensor signal 1
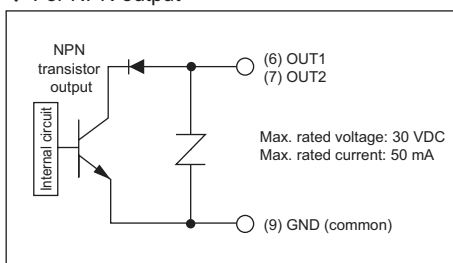(2) Sensor signal 2
(1) Integration reset
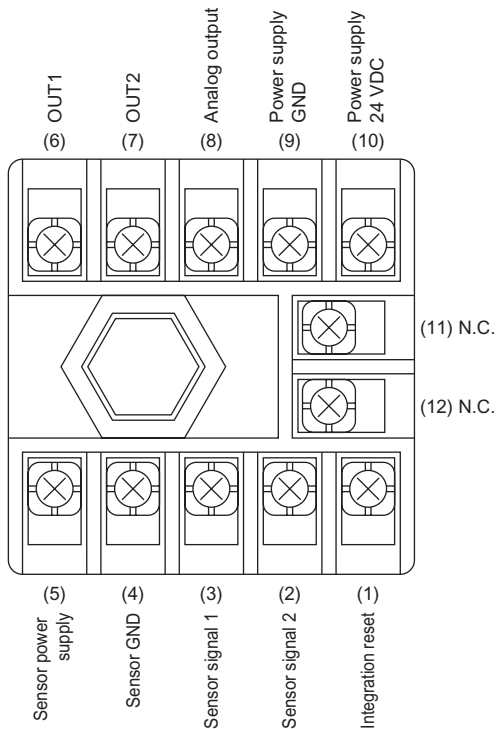
● Use the enclosed cable for wiring.
  [Specifications]
    With 4-core connector for DC
    Finished outer diameter of 6
    Core size 0.5 mm²
    Insulator outer diameter of 1.72
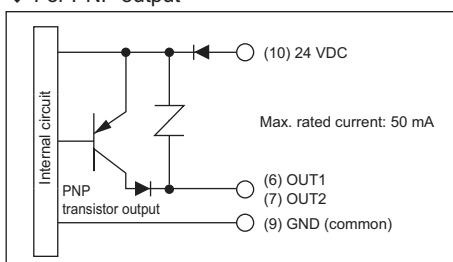● Check with CKD before extending the cable.

No.	Function	
1	Integration reset	Integrated flow is cleared by connecting this terminal to the (9) GND terminal.
2	Sensor signal 2	Connect to enclosed cable [black]
3	Sensor signal 1	Connect to enclosed cable [white]
4	Sensor GND	Connect to enclosed cable [blue]
5	Sensor power supply	Connect to enclosed cable [brown]
6	OUT1	NPN/PNP transistor output
7	OUT2	NPN/PNP transistor output
8	analog output	Voltage/current output
9	Power supply GND	Connect to 0 VDC power supply
10	Power supply 24 VDC	Connect to 24 VDC power supply
11	N.C.	Do not connect anything.
12	N.C.	Do not connect anything.

● Switch output circuit

◆ For NPN output

NPN transistor output

Internal circuit

(6) OUT1
(7) OUT2

Max. rated voltage: 30 VDC
Max. rated current: 50 mA

(9) GND (common)

◆ For PNP output

Internal circuit

(10) 24 VDC

Max. rated current: 50 mA

PNP transistor output

(6) OUT1
(7) OUT2

(9) GND (common)

● Analog output circuit

◆ For voltage output

Internal circuit

(8) Analog output

V Recorder (voltmeter)
Load resistance
150 kΩ and over

(9) GND (common)

◆ For current output

Internal circuit

(8) Analog output

A Recorder (ammeter)
Load resistance
300 kΩ or less

(9) GND (common)

CKD

PFD/PFK Series
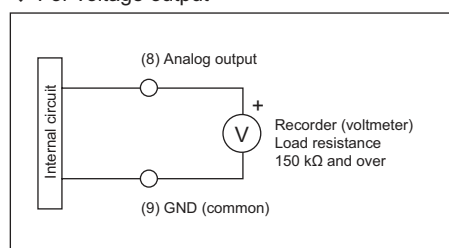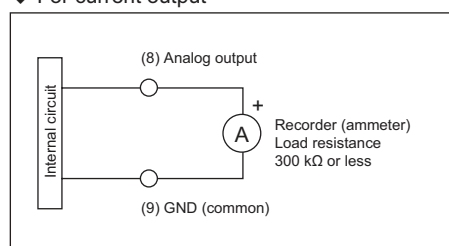
■ Explanation of monitor functions and operations

Switch output light

• ON... Switch is on.
• Blinking … Overcurrent protection is activated

Operation light

• ON ... Flow is displayed
• Blinking ... Count is stopped
• OFF ... In setting (confirmation) process

[READ] key

• Calls set pressure

[SHIFT] key

• Shifts blinking to right

[UP] key

• Increments digit at blinking

OUT1/HI
OUT2/Lo
RUN
FLUEREX
TOTAL   L/min (normal)
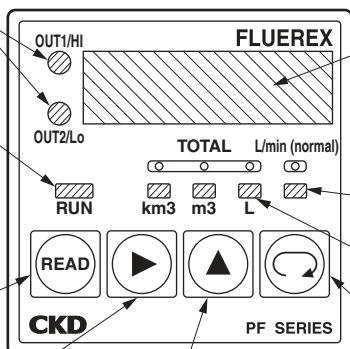km3   m3   L
READ
CKD   PF SERIES

4 digit digital display

<Measuring mode>
• Instantaneous/integrated flow
• Error display
<Read/write mode>
• Set value display

Instantaneous flow unit display

• Turns on when instantaneous flow is displayed

Integrated flow unit display

• Turns on when integrated flow is displayed

[CHANGE] key

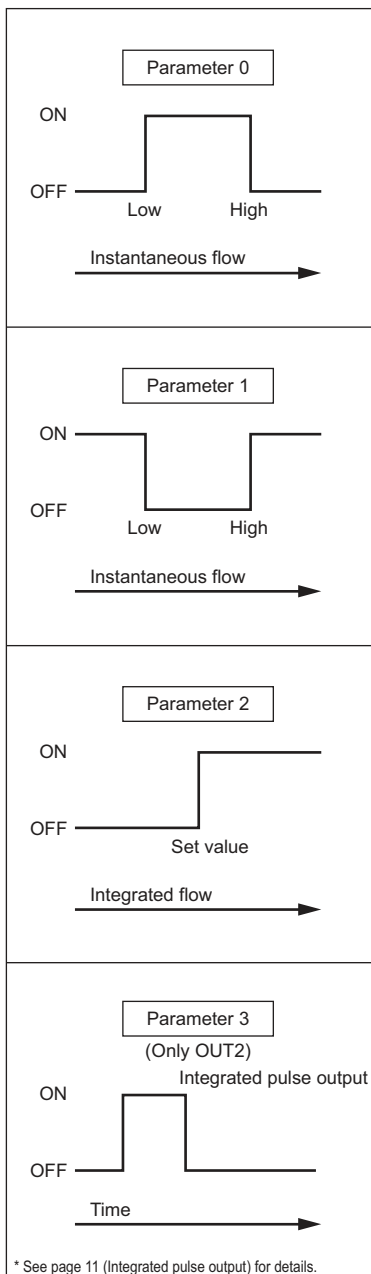• Enters setting
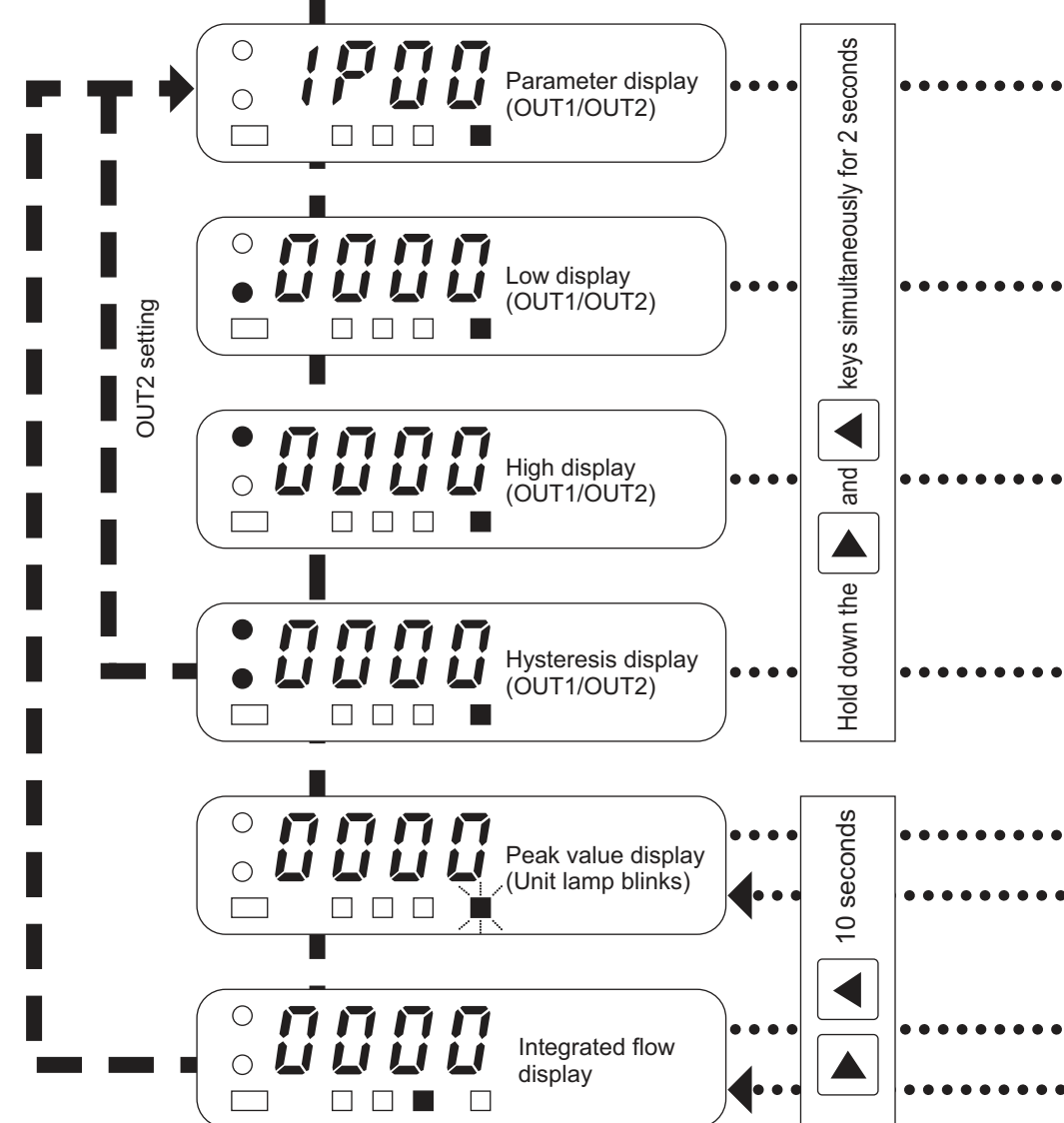• Changes/enters unit

Measuring mode

READ

■ Switch parameter

Four types of setting are available based on the applications.

Read mode

Parameter 0

ON
OFF
Low   High

Instantaneous flow

Parameter 1

ON
OFF
Low   High

Instantaneous flow

Parameter 2

ON
OFF
Set value

Integrated flow

Parameter 3

(Only OUT2)

Integrated pulse output

ON
OFF
Time

* See page 11 (Integrated pulse output) for details.

OUT2 setting

1P00 — Parameter display (OUT1/OUT2)

0000 — Low display (OUT1/OUT2)

0000 — High display (OUT1/OUT2)

0000 — Hysteresis display (OUT1/OUT2)

0000 — Peak value display (Unit lamp blinks)

0000 — Integrated flow display

Hold down the ◄ and ▲ keys simultaneously for 2 seconds

10 seconds
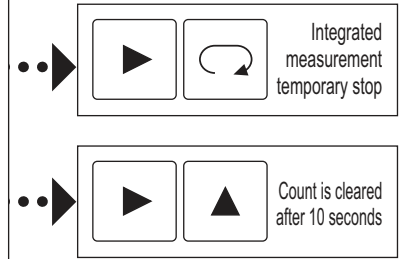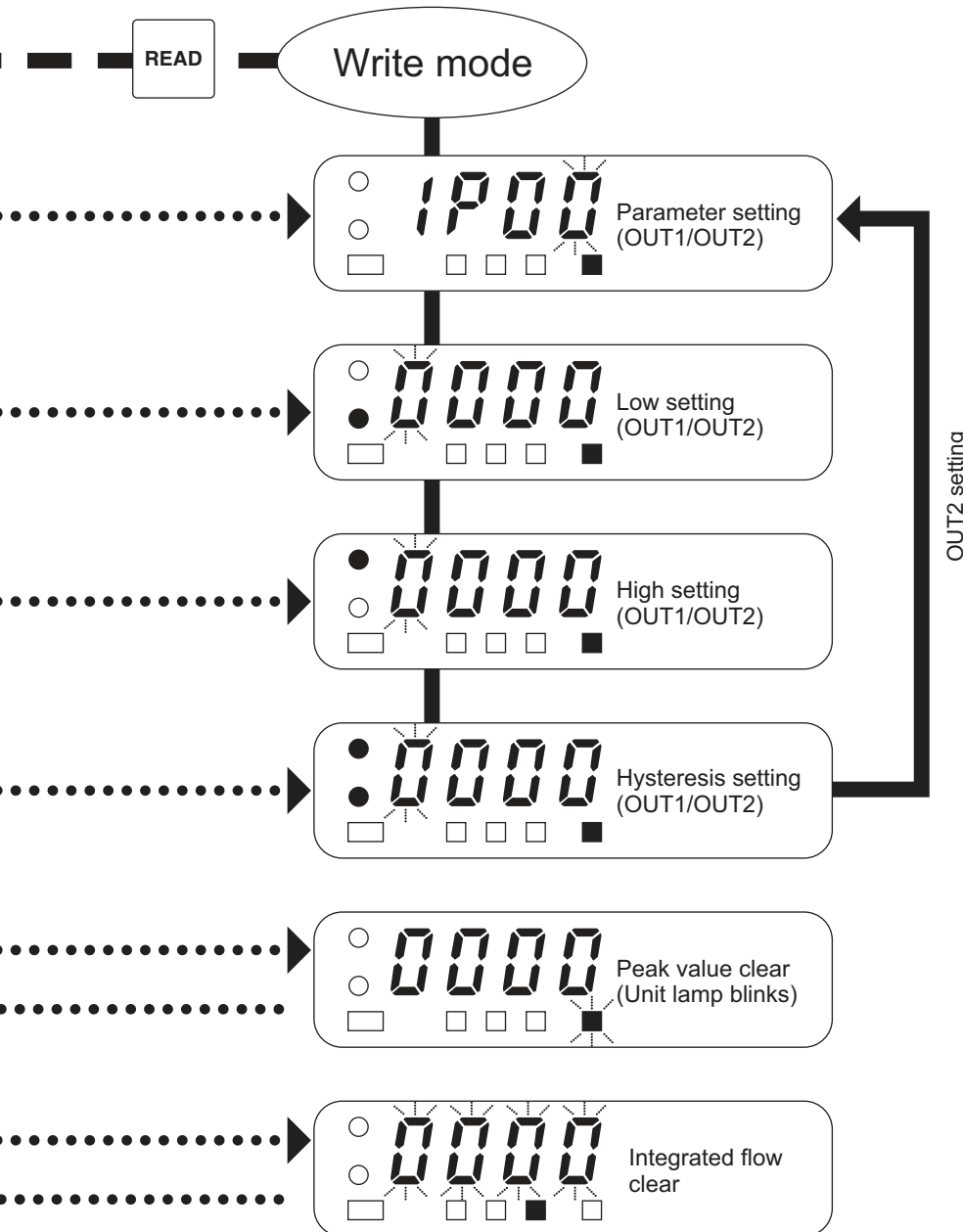◄
▲

* For parameter 2, the integrated switch setting is used instead of (L) (H) and (h).
* There are no setting modes for parameter 3, so in read mode the display goes to "peak value display" and in write mode to "parameter setting."
* If ▶ (shift key) is pressed after setting or confirming integrated flow, the integrated flow display changes.

[Integrated flow]

TOTAL   L/min (normal)

km3   m3   L
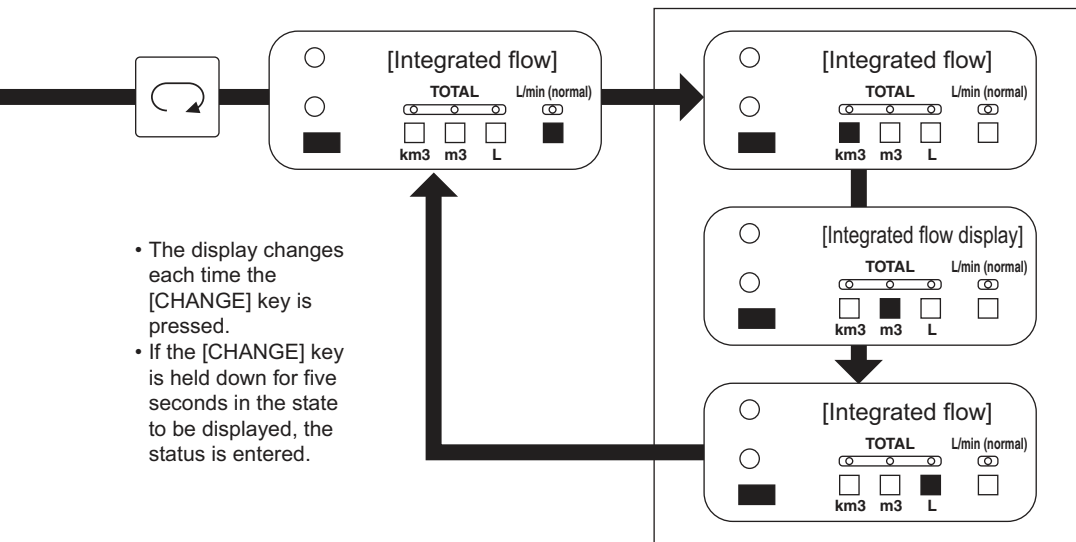
- The display changes each time the [CHANGE] key is pressed.
- If the [CHANGE] key is held down for five seconds in the state to be displayed, the status is entered.

[Integrated flow]

TOTAL   L/min (normal)

km3   m3   L

[Integrated flow display]

TOTAL   L/min (normal)

km3   m3   L

[Integrated flow]

TOTAL   L/min (normal)

km3   m3   L

Integrated measurement temporary stop

Count is cleared after 10 seconds

- {Delay/value clear} is executed when integrated flow is displayed. To clear, the key must be held down for 10 seconds as in read mode.
- If the integrated flow display is temporarily stopped, the integrated flow is backed up in internal memory.

READ

Write mode

1P00   Parameter setting (OUT1/OUT2)

0000   Low setting (OUT1/OUT2)

0000   High setting (OUT1/OUT2)

0000   Hysteresis setting (OUT1/OUT2)

OUT2 setting

0000   Peak value clear (Unit lamp blinks)

0000   Integrated flow clear

* The peak and integrated flow are cleared when [SHIFT] [UP] are held down at the same time for 10 seconds.

■ Hysteresis

Hysteresis

ON

OFF

Low   High
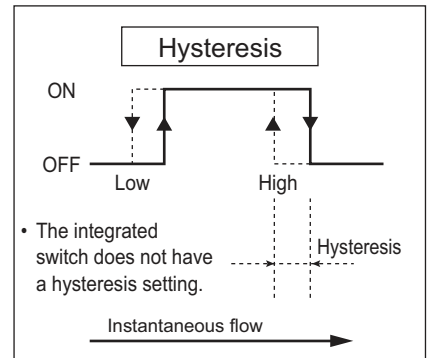
- The integrated switch does not have a hysteresis setting.

Hysteresis

Instantaneous flow

■ Integrated pulse output

If the parameter is set to [3] when OUT2, switch output is changed to cumulative pulse output.
Note that OUT1 does not have integrated pulse output.

■ Backup of integrated flow and peak values

- This product automatically backs up integrated flow and peak in internal memory. Data is saved even if power is turned off.
- Data is backed up at the following timing:
  1) When five or more minutes have passed from previous backup and the value changed from the previous integrated flow or peak.
  2) When integrated flow stop was executed.
  3) When the integrated value is cleared. (The peak value at that point is backed up. For the integrated value, the value after clearing is backed up.)
  4) When the peak value is cleared. (The peak value after clearing is backed up, and the integrated value at that point is backed up.)
- Data is not backed up in the following cases:
  1) Less than five minutes have passed since data was backed up.
  2) Previous data has not changed, even after five minutes.

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

CKD

14

Flow sensor
ECO monitoring system

Energy conservation starts with monitoring.

When promoting energy conservation, data collected by combining this flow sensor and ecological monitoring, both devices based on experience and intuition are used effectively to monitor previously undetected sections and accurately show problems.

Understanding these problems and taking corrective action enables "visible" energy conservation.

Plan

Understand current state

● Measure flow rates with the ecological monitoring.
● Extract and pinpoint corrective action.

Do

Implement corrective action

● Use optimum layouts to reduce piping loss.
● Stop air supply during idle periods to reduce consumption.
● Review leakage preventing blow and purge to reduce consumption.

Action

Correcting and continuing corrective action

● Correction of improvement point Progress of the next-step countermeasures
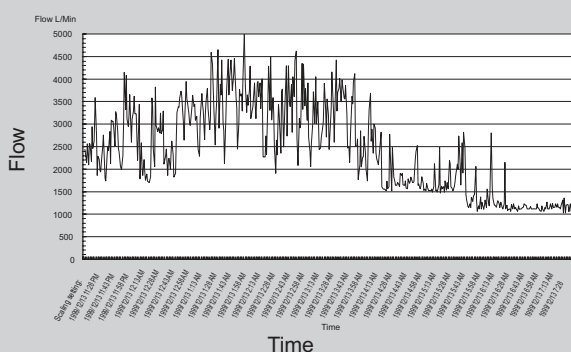● Confirm continuing effect with ecological monitoring.

Check

Confirm effect

● Confirm and measure the effect with ecological monitoring.
● Was corrective action effective? Is ongoing control possible?
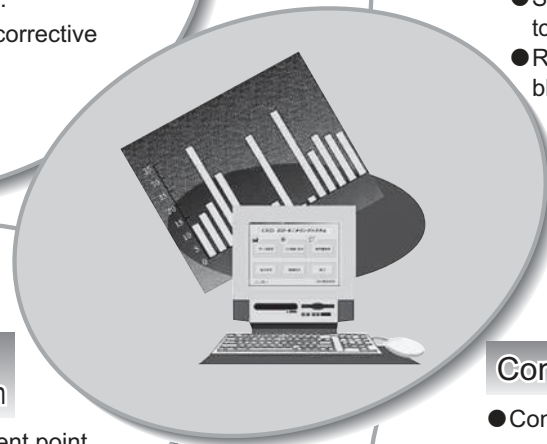
Equipment air consumption

The flow sensor PFD, PFK, PFF, and PFU Series have standard external output. A simple system to easily collect flow sensor and pressure sensor data with ecological monitoring is easily constructed.

Compressor/equipment consumption and pressure fluctuation are easily sent and controlled at an office at a set time, day, week, or month. Use this data to prepare reports, conduct analysis based on different data, and pinpoint equipment trends and problems.

Time zone in which equipment is idle
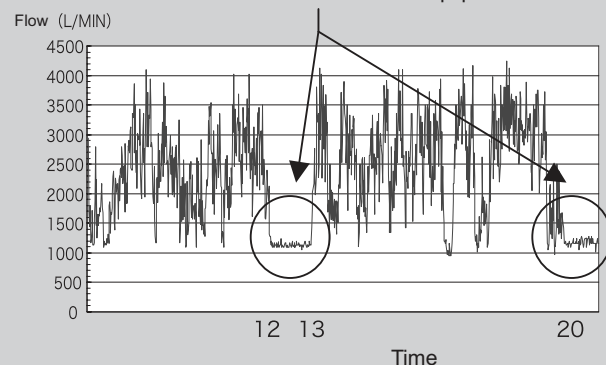
The above graph was prepared using 24-hour air consumption data from a certain system.

The graph shows that large amounts of air are consumed even when the system is idle, such as during lunch breaks. Note that improvements are required for this equipment.

When there is no data, even if it is known that air is consumed, it is not possible to pinpoint the amount or time. Data is essential for energy conservation.

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Guide to Program Functions Data Analysis

★ After measurement conditions are set, measurement data is retrieved in real time.
Data is retrieved with continuous measurement (no limit) or with time-designated measurement, enabling required data to be collected.

◉ Easy-to-read screen design and multiscreen design
Screen space is freed by arranging only required icons, making it reading easier. This makes the screen easy to view. Multiscreen design enables data currently being collected and data collected over 24 hours to be displayed at the same time. (See the data analysis screen.)

◉ Either continuous measurement or random time-designated measurement is possible.

◉ One sampling time is selectable from 1, 3, 5, 10, 20, 30, or 60 seconds.

◉ The flow is set freely up to 40,000 NL/min.

◉ Data collection time displayed during data collection is selected from three patterns.
Changes in data based on the time series is changed and confirmed in real time.

◉ Instantaneous flow and integrated display (digital) for each setting CH
The display is usually behind the screen. This screen can be opened randomly.

Data Analysis screen
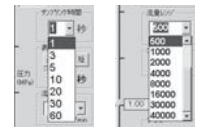
Sampling rates and Flow range

File Output Function

CSV File Output Selection screen
(daily or monthly reports)

CSV File Output screen
(daily reports)

★ This function quickly finds and outputs the daily report and month report CSV file.
Collected data is saved and stored in a specific CSV file so that the PC is not overloaded.

◉ Daily and monthly report output, search, and simple daily and monthly report preparation programs incorporated.
Search is incorporated to enable required data to be quickly retrieved from stored data. (Note 1)
Required data is found from daily and monthly reports (Note 2), and is output as a CSV file to the PC. Daily reports are output as single reports or in groups (Note 3). It is also possible to output only required data from collected data.
Output data can be quickly prepared as a report using simple graph preparation using Excel macros provided in the program.

Note 1: Data collection must be stopped before data can be output. Data cannot be collected during data output.

Note 2: Daily report data applies to 24 hours from 00:00to 11:59 of a specific day.
The monthly report includes data for 28, 30, or 31 days. The monthly report cannot be output until at least one month of data is collected and stored.

Note 3: A single day refers to one day, such as January 1, 2003. A group refers to eight days from January 1 to January 8, 2003.
Data output in a group is limited to 31 days or less, e.g., January 1 to January 31. (Example: January 1 to January 31)

Details of structuring monitoring

CKD SAVE-NET
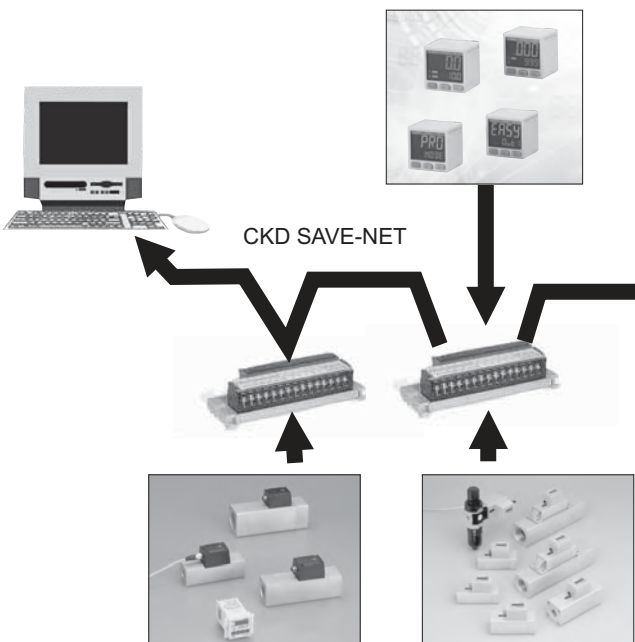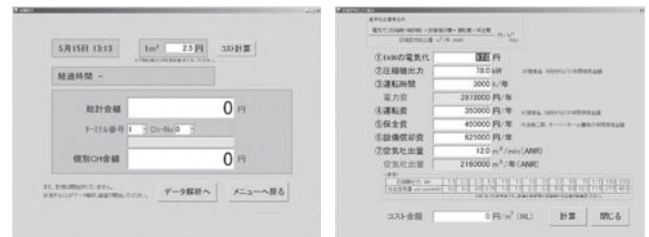
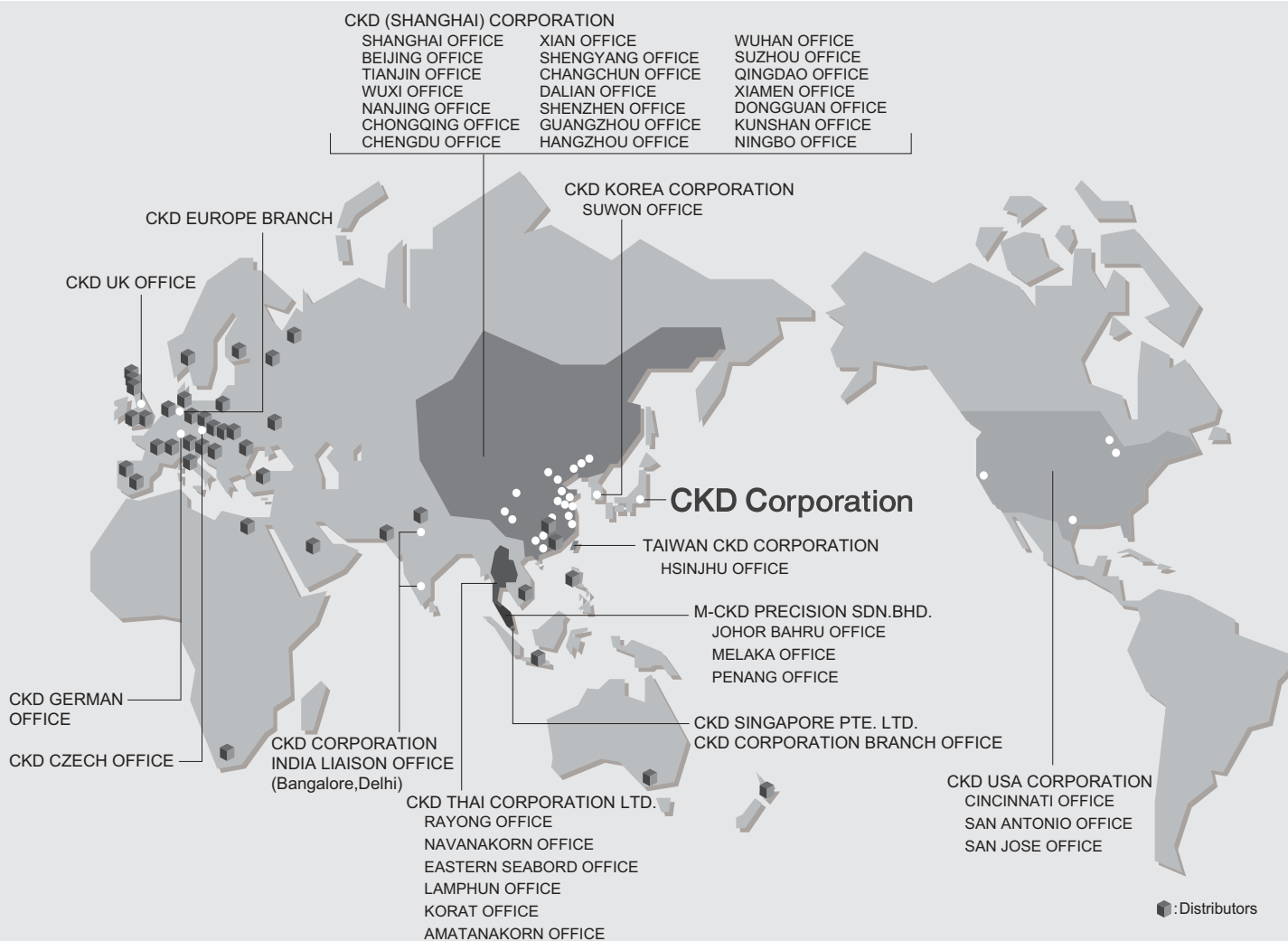## Cost Display

Cost Display screen

Cost Calculation screen

★ Improve energy-conservation awareness with "visible" display of air cost.
Showing the financial cost effectively increases awareness of energy conservation. The popular air cost display has been upgraded and incorporated into ecological monitoring as standard.
When the cost of 1 m3 of air calculated on the cost calculation screen is input in the Cost Screen display and data is collected, the amount of money used for the amount of air consumed is displayed in real time.

◉ Total money display and individual CH money display
Total money display
If 128 flow sensors are used to measure the flow, total cost of their air consumption is displayed on the upper line.
Individual CH display
To display the cost of air consumed for a specific flow sensor among the 128 operating sensors, select the terminal No. and CH-No. The cost is displayed on the bottom line.

CKD-ECO monitoring system specifications list

■ Operation environment

No.	Descriptions	Descriptions
1	OS	Windows98/98SE/2000/XP (excluding 95/ME)
2	PC environment	PC-AT-compatible HDD 10 GB or more recommended
3	Display	1024 x 768 and over
4	CPU performance	Pentium III 400 MHz or faster recommended (233 MHz minimum)
5	Memory	128 MB or more recommended (64 MB for 98 or 98SE, and 128 MB for 2000 or XP)
6	HDD	A HDD capacity of 2 GB or more is recommended for data storage (for one-year data storage)

■ Data collection
• Measurement mode is can be selected from infinite mode or time-designated mode.
• Sufficient time is selected and set from 1, 3, 5, 10, 20, 30, or 60 seconds.
• The flow range is can be selected from 0 to 30,000 NL/min or randomly set.
Pressure range: -0.1 Mps to 1 Mps
• Screen display time: Three types of times are can be selected for each sampling time, e.g., (Example: for 1 second sampling time, select from 300, 60, or 12 seconds.
• Display instant value or integrated value for each CH.

■ Device selection
• PC and terminal connection: Master I/F card (PCMCIA card or ISA board), dedicated adaptor, dedicated cable, terminal
• Number of connected devices: Max. 128 CH maximum, Number of terminals: Max. 16 terminals maximum
• Analog output 0 to 5 VDC, 0 to 10 VDC, CKD device with output or other brand also connectable. (Select terminals based on output.) Analog and pulse output terminals can be installed together.

■ Data control, search function, simple graphs
• Daily and monthly report data is saved in CSV format in PCC program folders.
• The above data is output to designated sites in CSV format using daily/monthly report search.
• Data is converted from CSV format to Windows Excel 2000 or higher Excel data.
• Simple reports showing daily reports as polygonal or bar graphs and monthly reports as bar graphs are prepared using simple graphs and Excel macros.

■ Cost calculation and cost display
• 1 m3 air cost calculation
• By calculating consumption 1 m3 x set cost, the connected device portion or discrete device use cost is displayed on the PC in real time.
• Linked with data collection. Independent function is not available.

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MEMO

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