ONO SOKKI

FP-2000/200 Series

POSITIVE DISPLACEMENT TYPE FLOW DETECTOR

INSTRUCTION MANUAL

ONO SOKKI CO., LTD.

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Warranty

1. This product is covered by a warranty for a period of one year from the date of purchase.
2. This warranty covers free-of-charge repair for defects judged to be the responsibility of the manufacturer, i.e., defects occurred while the product is used under normal operating conditions according to descriptions in this manual and notices on the unit label.
3. For free-of-charge repair, contact either your sales representative or our sales office nearby.
4. The following failures will be handled on a fee basis even during the warranty period.
   (a) Failures occurring through misuse, mis-operation, or modification
   (b) Failures occurring through mishandling (dropping) or transportation
   (c) Failures occurring through natural calamities (fires, earthquakes, flooding, and lightening), environmental disruption, or abnormal voltage.

* For repairs after the warranty period expired, contact your sales representative or our sales office nearby.

FOREWORD

This document is the instruction manual for FP-2000/200 Series Positive Displacement Type Flow Detector and describes installation and mounting method, piping method, measuring method, specifications, operational precautions, etc.
When you use FP-2000/200 Series Positive Displacement Type Flow Detector for the first time, please read this document carefully until you familiarize yourself with the content before you start piping work or measurement.
Especially, the precautions described in this document include “the danger which may lead to a damage on property”. Be sure to follow the instructions described in this document when you operate the detector.
Besides, when you combine FP-2000/200 Series Positive Displacement Type Flow Detector with a digital counter or a data recorder, also refer to the instruction manuals for these devices.
This document serves also as the letter of warranty and therefore needs to carefully be kept even after you finish reading it.

■ Types of FP-2000/200 Series Positive Displacement Type Flow Detector

Measuring range	Flow rate measurement dedicated type	Temperature/pressure simultaneous measurement type
0.06~60ℓ/h	FP-213	–
0.3~120ℓ/h	FP-2140H	FP-2240HA
1~1440ℓ/h	FP-215	FP-2250A

<Notes>

- FP-2000/200 Series Positive Displacement Type Flow Detectors are shipped after undergoing a strict inspection to confirm correct operation.
- After unpacking, first check for damage on the product due to transportation and then check operation according to this document.
- If the product is damaged or does not function as described in this document, immediately contact the vendor from which you purchased it or a nearby ONO SOKKI sales office.

FOR YOUR SAFETY

In order to safely and correctly use FP-2000/200 Series Positive Displacement Type Flow Detector, be sure to read this document, especially this chapter, until you familiarize with the content before actually operating it.
ONO SOKKI assumes no responsibility for nor guarantees the damages or failures which are attributable to an operation which deviates from the instructions described in this document.

Meaning of Symbols

- In this document, the dangers which may arise due to operation neglecting the instructions described in it are classified into two categories, or “WARNING” and “CAUTION”, according to the degree of severity.

WARNING and CAUTION

This depends on the degree of danger or damage possible if the precaution is ignored and the product is used incorrectly.

WARNING	This symbol is used to indicate precautions where there is a risk of death or serious personal injury to the operator if the product is handled incorrectly.
CAUTION	This symbol is used to indicate precautions where there is a risk of some personal injury to the operator or only material damage to the product if the product is handled incorrectly.

- In this document directions to be followed are classified into three groups: Attention, Prohibited, and Compulsory. The folllowing symbols are used to mark these descriptions. Symbols listed here are examples of the symbols used.

Attention
This symbol is used to indicate items where extra attention is required.

Prohibited
This symbol is used to indicate items which are prohibited and should never be attempted.

Compulsory
This symbol is used to indicate items which are mandatory and must be performed.

WARNING

Operational Precautions

- Measurement shall be done under control of a qualified hazardous material engineer.
  Because the object is a hazardous material, such as gasoline and kerosene, measurement shall be done under control of a qualified hazardous material engineer.

- Prevent fires!
  Prevent fires because the object is a hazardous material, such as gasoline and kerosene. Measurement shall be done under control of a qualified hazardous material engineer.

- Do not allow the liquid contained in the detector to evaporate
  There is a danger that the liquid may ignite or explode when evaporates. Do not allow the liquid contained in the detector to evaporate.
  Besides, because FP-2000/200 series are designed such that the liquid to be measured serves also as lubricating oil for each moving part, evaporation of the internal liquid may lead to poor lubrication and wrong measurement.

- Use the detector within the specified working temperature
  The working temperature range of FP-2000/200 Series Positive Displacement Type Flow Detector is 0 to +65 °C. for both ambient temperature and liquid temperature (non-freezing). Especially, measurement in an abnormally hot place may lead to a fire or explosion and therefore very dangerous.

- Do not let any liquid other than specified ones through the detector.
  For FP-2000/200 Series Positive Displacement Type Flow Detector, only the following liquids are applicable. Letting any other liquid through the device may lead to internal corrosion or damage and, in the worst, a danger on human body. For details, consult the vendor from which you purchased the product or a nearby ONO SOKKI sales office.
  · Standard specification: Gasoline (leaded/nonleaded), light oil, kerosene, petroleum type general hydraulic oil, fuel oil A, engine oil
  · Alcohol adapted specification: methanol, ethanol, mixture of alcohol and gasoline, brake oil

- Do not apply vibration or impact on the detector
  FP-2000/200 Series Positive Displacement Type Flow Detector is a precision instrument. Do not use or store the detector in a place where strong vibration exists. In addition, do not drop nor give a strong impact on it, for example, through violent operation. Otherwise, failure or malfunction may occur, leading to a danger on human body.

WARNING

Precautions for Installation

- Concerning the line filter
  If a different type line filter is used, there is a danger that the liquid leaks out to ignite or explode. Do not remove the line filter attached to the detector, nor replace it with other type of line filter.
  For FP-215/2250A Positive Displacement Type Flow Detector, the accessory line filter is not integrated into the detector. For these detectors, be sure to connect the line filter in front of the liquid inlet port of the detector.

- To install and fix the detector, be sure to use the bracket attached to the detector.
  If the flow detector is tilted or suffers vibration, it may fail or malfunction, leading to a danger on human body. To mount and fix the flow detector, be sure to use the bracket and screws (upper bracket mounting screws) attached to the product.
  When any other bracket is used to mount and fix the flow detector, be sure to use the upper bracket mounting screws (M4 × 4 pcs.) which are attached to the product. For details, consult the vendor from which you purchased the detector or a nearby ONO SOKKI sales office.

- Do not touch the rotation detecting section
  Do not touch the rotation detecting section of FP-213/215/2250A Positive Displacement Type Flow Detector. Otherwise, you may be caught in it to be injured.
  Especially during installation, transportation or piping, be careful not to touch the rotation detecting section.

WARNING

Precautions for Piping

- Be sure that the power is turned OFF before piping work is started
  Before starting piping work, be sure that the power is turned OFF on DF series digital counter side.
  ON/OFF of the power is changed over with the POWER switch provided on the DF series digital counter after connecting it to FP-2000/200 Series Positive Displacement Type Flow Detector by a flow signal cable.

- Before starting piping work, sufficiently flush the flow detector
  At shipment, FP-2000/200 Series Positive Displacement Type Flow Detector is filled with light oil to prevent defective lubrication. Therefore, before measurement is started, it is necessary to flush the detector by letting the liquid to be measured through it.

- If the liquid to be measured leaks from the piping, there is a danger that the leaking liquid ignites or explodes.
  When rubber hose is used for piping, surely fix the hose on the joint by hose bands so that the rubber hose does not come out.
  Rubber hose needs to regularly be inspected. If degraded rubber hose is found, immediately replace it with new one.

CAUTION

Precautions for Installation

- Handle as a precision instrument
  FP-2000/200 Series Positive Displacement Type Flow Detector is a precision instrument. It requires to be installed in a place whose ambient temperature is kept within specified range (0 to +65 °C.) and does not change so greatly and in which no strong vibration occurs.

- Install the detector below the liquid tank level
  When liquid is supplied to the flow detector under gravitational force, in order to prevent air pocket or negative pressure from occurring in the piping, be sure to install the flow detector below the liquid tank level.

CAUTION

Precautions for Piping

- Do not mistake IN and OUT ports of the flow detector
  The flow detector has two ports: “IN” through which liquid comes in the detector and “OUT” from which liquid comes out of the detector. After the end of piping, re-check the propriety of the piping to the IN and OUT ports.

- Recommendation of bypass valve
  To facilitate maintenance or air purging of the object system of measurement, such as engine, or preparing for malfunction of the flow detector, it is recommended to provide a bypass valve in the middle of the piping.

- Carefully wind sealant
  When Teflon seal tape is wound on threaded part, for example, to change a joint, observe the following precautions:
  · Seal tape shall be wound on threaded part such that the next turn completely or half overlaps on the preceding turn, leaving one or two ridges bare at the screw end.
  · When liquid sealant is used, be careful not to allow the sealant to drop in the pipe.

- Do not hump pipes as shown below
  When a pipe is humped as shown below, it is hard to release the air trapped in the hump, which often causes an air pocket.
  Air pocket in the piping results in inaccurate measurement.

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Chapter 1
GENERAL (STRUCTURE AND PRINCIPLE)

1.1 Outline of Product
1.2 Structure and Working Principle

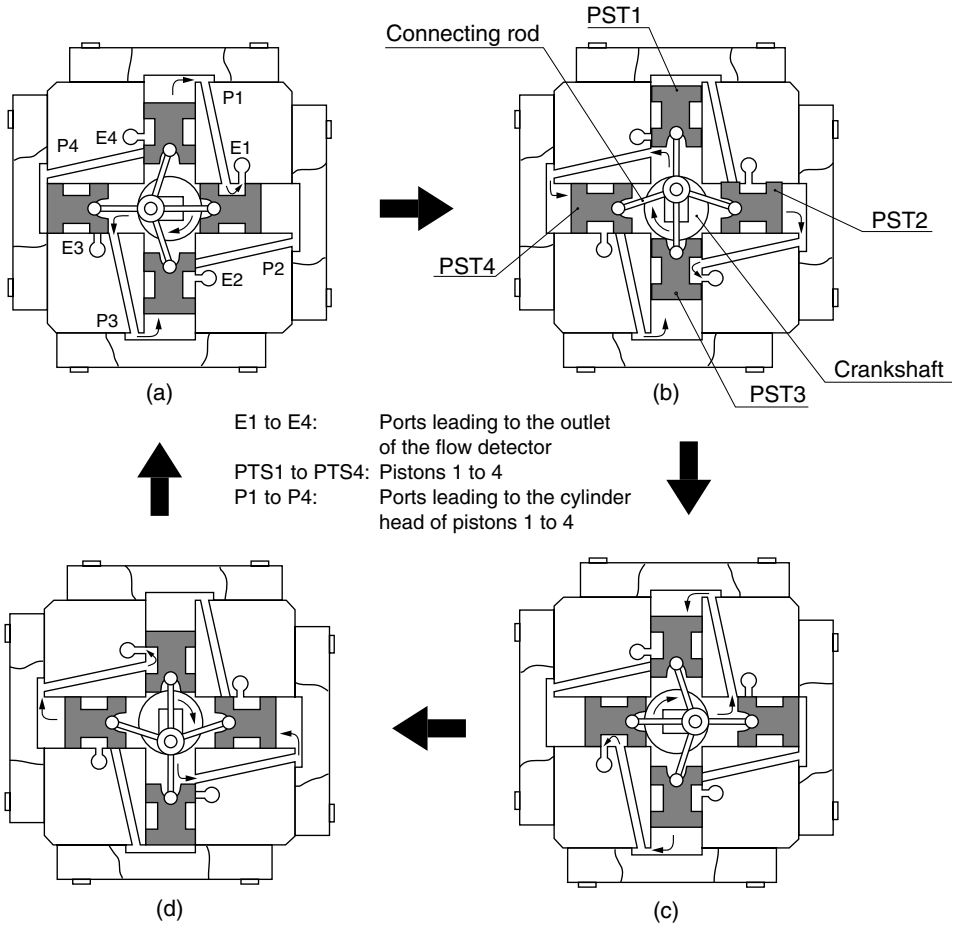
1.1 Outline of Product

FP-2000/200 Series is a positive displacement type flow detector which is combined with a DF/FM series digital counter to accurately measure the flow rate of fuel, such as gasoline, light oil and kerosene.
Thanks to the wide measuring range (1:400 or more in the ratio of flow rate), the device can perform measurement, for example, of fuel consumption in quite a wide range from very small flow rate in idling to large flow rate in high-speed loaded condition.
Besides, because the detector is compact and light-weight and therefore can be installed in a car, it can adapt not only to the measurement of fuel consumption of an engine on a test bench but also to that in actual running test.
Further, various types of the flow detector are prepared which can arbitrarily be combined with DF/FM series digital counter to construct a measuring system which best matches your application and purposes.
Finally, as option, alcohol adapted specification devices are prepared so as to construct a general flow rate measuring system for, for example, plant and chemical industries.

1.2 Structure and Working Principle

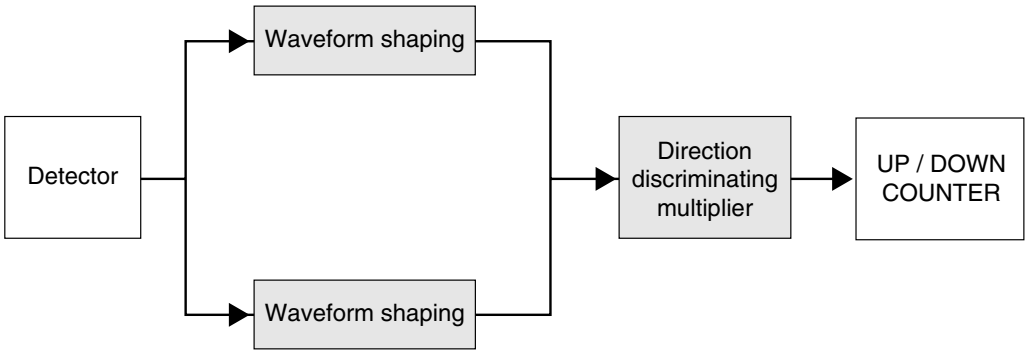
■ Principle of detection

The 4 pistons which are arranged radially in the flow rate detecting section of the flow detector repeats reciprocal action due to the liquid which flows from IN to OUT ports. In the meanwhile, the movement of these pistons is converted into rotary movement by the crankshaft, and the rotary movement is transmitted to the rotation detecting section which is coupled magnetically.
Then, the rotary encoder in the rotation detecting section outputs pulse signal according to the moving length of the pistons, and the processor and indicator of DF/FM series digital counter calculates and displays instantaneous and cumulative values.
Because pulse signal is generated by two pairs of light emitting/receiving elements which have the phase difference of 90 degree, the direction of rotation can be judged. Therefore, flow rate can be measured accurately without influenced by reverse or pulsating flow.



■ Reversible compensation function

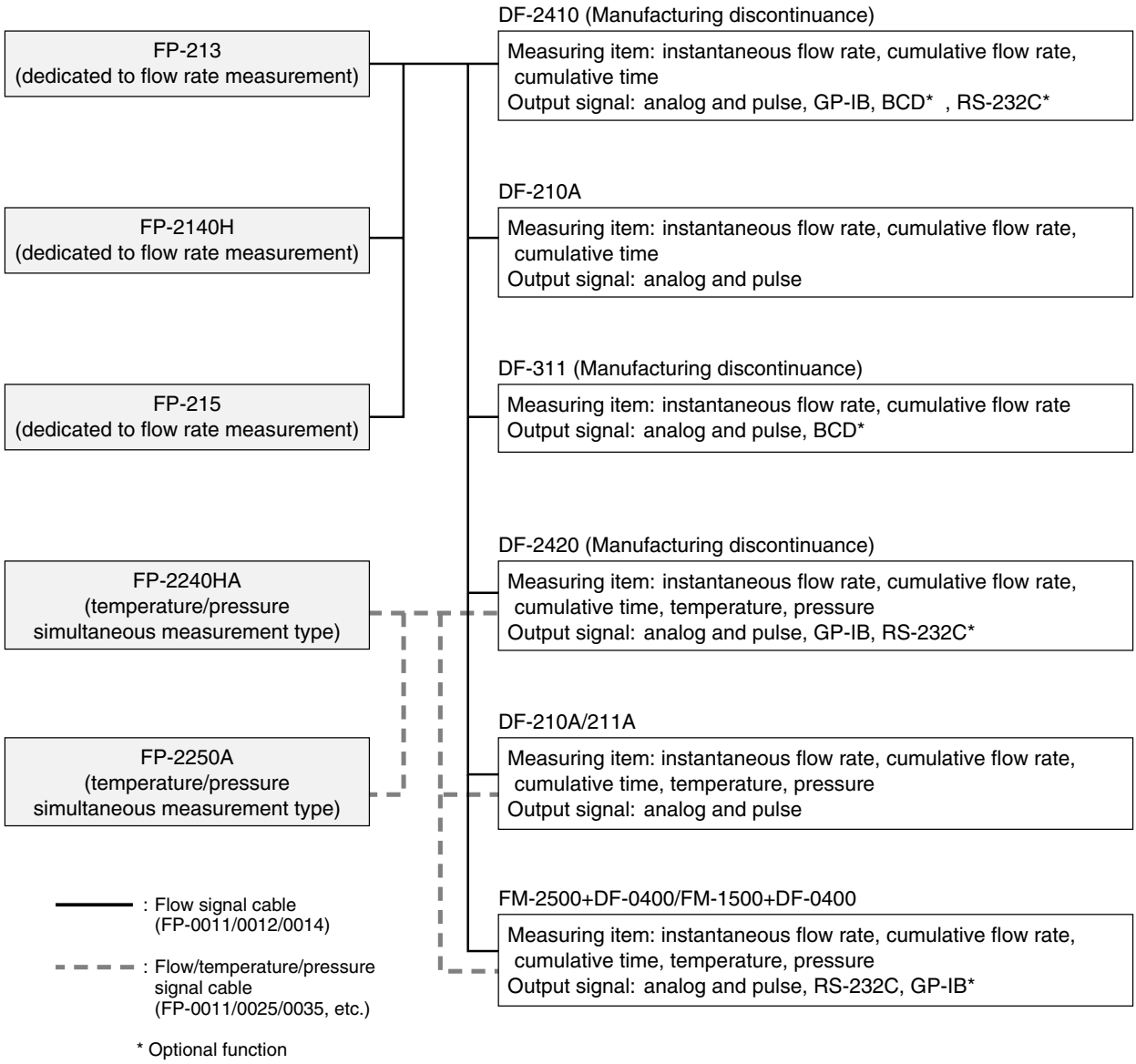
This is the function to compensate for reverse or pulsating flow.
As shown in the figure below, because pulse signal from the flow rate detecting section is made into two signals with 90 degree phase difference, the direction of rotation can be judged according to the change in the phase difference of the two signals to compensate for reverse and pulsating flows.



Chapter 2
SYSTEM CONFIGURATION

<Note>

Depending on the object of measurement, a positive displacement flow sensor other than that of FP-2000/200 series may be necessary.

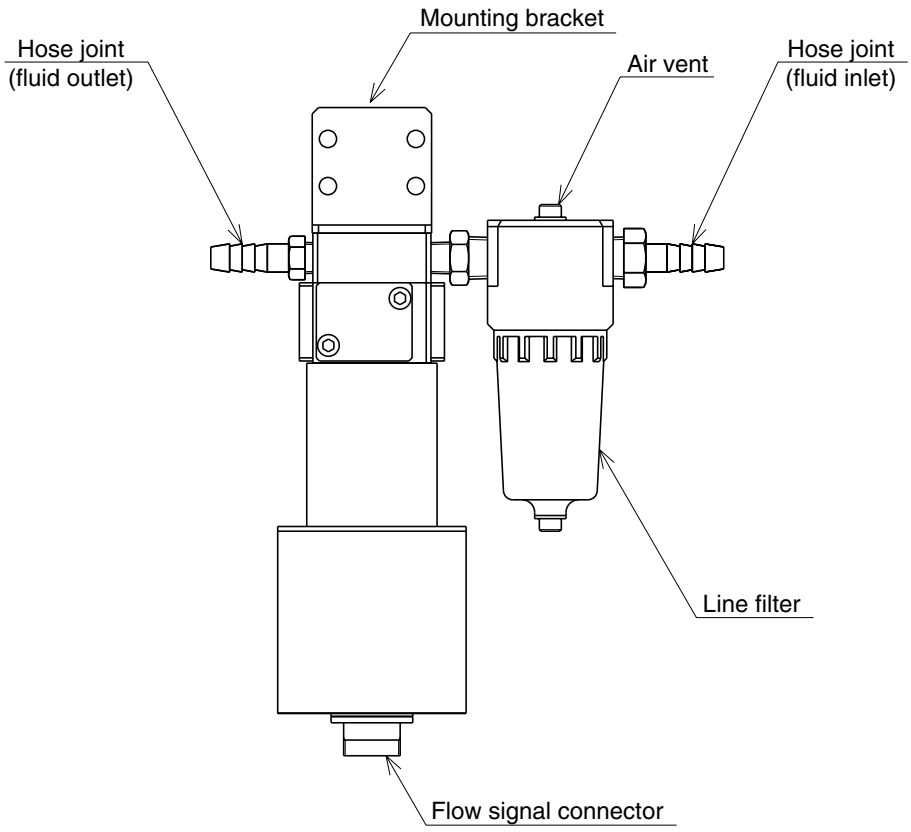


<Note>

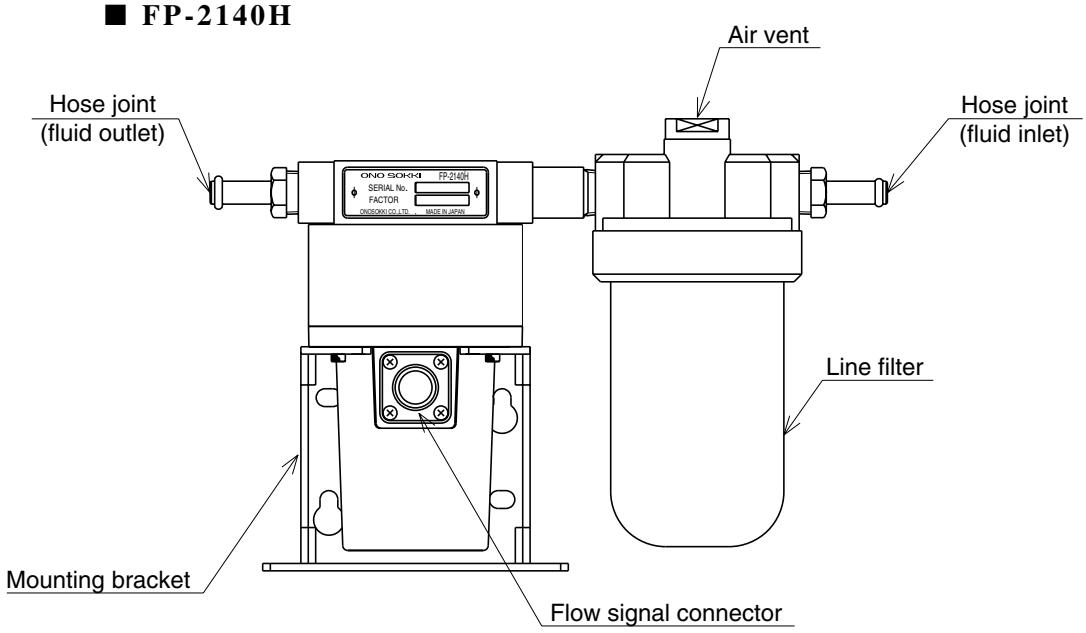
To use the DF2420 digital flowmeter in combination with the FP2240HA, which has been used in combination with the FP2240H, or vice versa, scaling change (factory adjustment) of the input amplifier of the DF2420 digital flowmeter is required.
This relationship also applies to the FP2250 and FP2250A. When using the DF2420 digital flowmeter with a different combination, contact the retail store where you bought the product or ONO SOKKI sales office nearby.

Chapter 3
NOMENCLATURE

■ **FP-213**

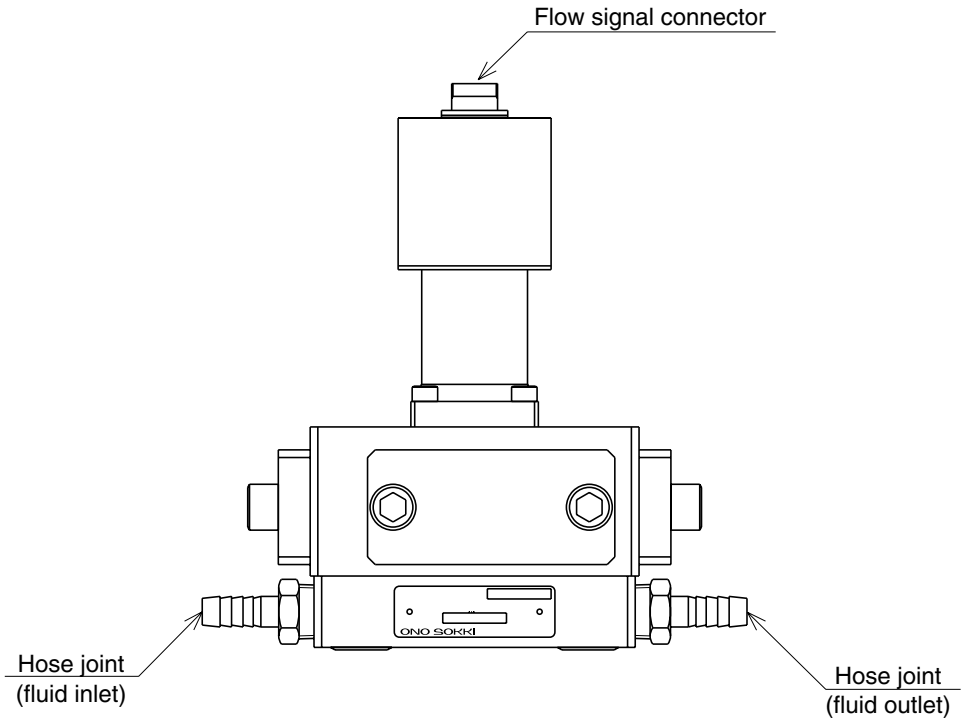


■ **FP-2140H**

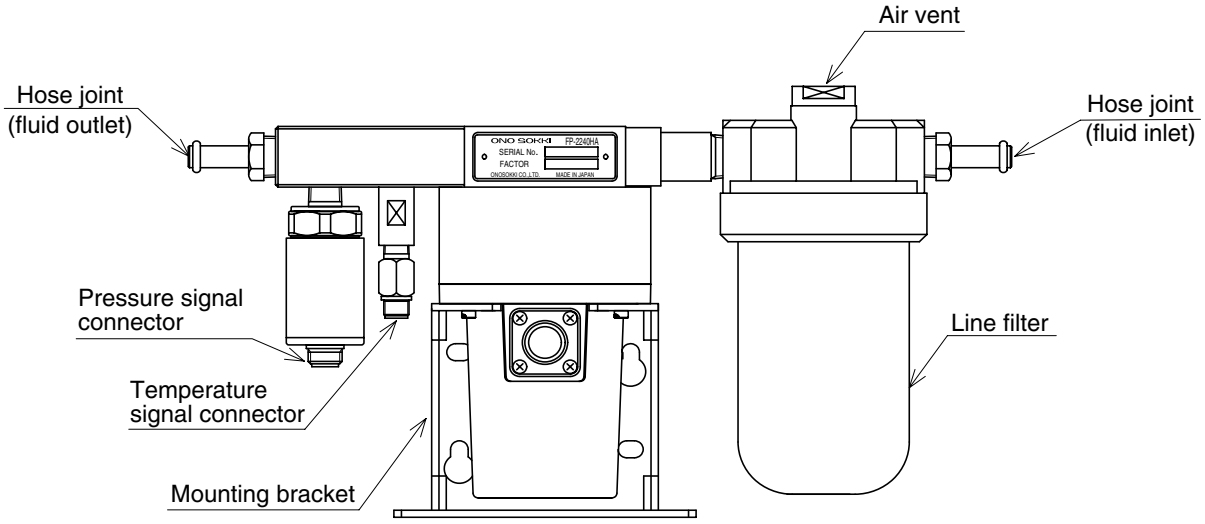


3. Nomenclature

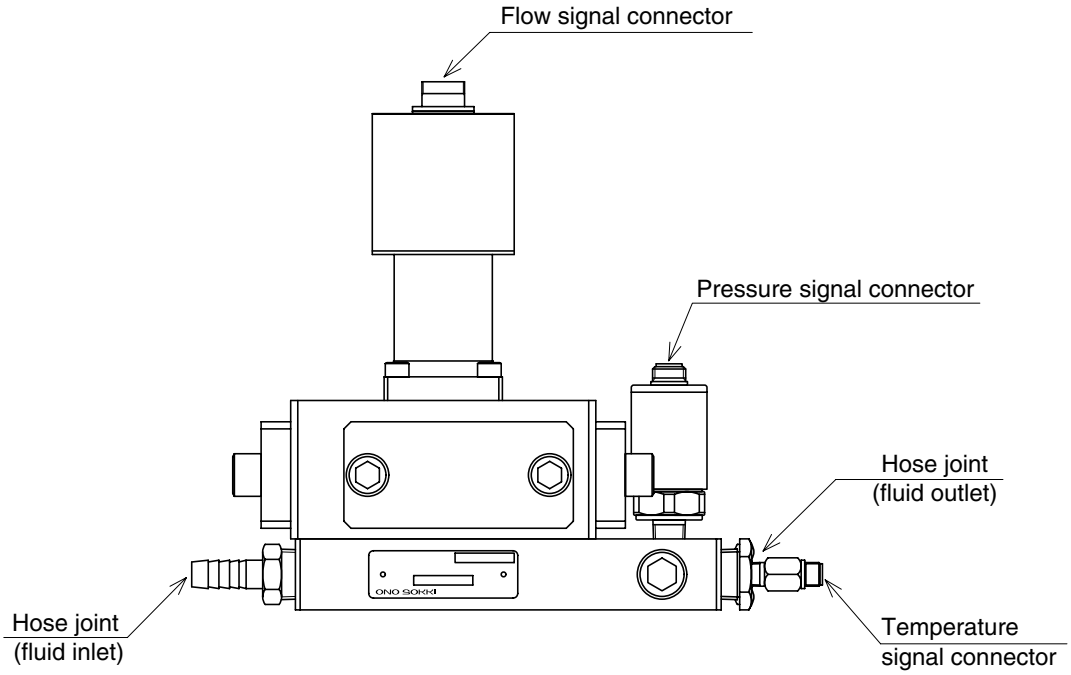
■ FP-215



■ FP-2240HA



■ **FP-2250A**


Flow signal connector
Pressure signal connector
Hose joint
(fluid outlet)
Hose joint
(fluid inlet)
Temperature
signal connector
ONO SOKKI

Chapter 4 INSTALLATION AND MOUNTING METHOD

4.1 Precautions for Installation
4.2 Mounting

4.1 Precautions for Installation

To install the FP-2000/200 Series Positive Displacement Type Flow Detector, be sure to observe the following precautions.

● **Handle as a precision instrument**

FP-2000/200 Series Positive Displacement Type Flow Detector is a precision instrument. Be sure to install it in a place whose ambient temperature is within the range from 0 to +65 °C and where no strong vibration occurs.

● **Install the detector below the liquid tank level**

When the detector is used such that it obtains supply pressure by the head of working liquid, be sure to install it below the liquid tank level in order to prevent air from remaining in the piping and negative pressure from occurring.

● **Precautions for the line filter**

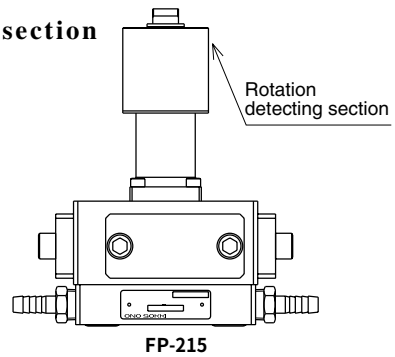
For FP-213, -2140H and -2240HA Positive Displacement Type Flow Detectors, a line filter is integrated into the detector unit. Do not remove the line filter from the detector nor replace it with other line filter.
For FP-215 and -2250A Positive Displacement Type Flow Detectors, although the line filter is not integrated into the detector unit, it must be connected in front of the fluid inlet port of the detector.

● **Always use the attached bracket to install and fix the detector**

To install and fix the detector, be sure to use the attached mounting bracket.
Even when a bracket other than the attached ones is used with FP-213, be sure to use the upper bracket mounting screws (M4 × 4) to fix the detector.
For brackets other than the attached ones, contact the vendor from which you purchased the product or a nearby ONO SOKKI sales office.

● **Do not touch the rotation detecting section**

FP-213, -215 and -2250A have a rotation detecting section. When installing or moving the detector or during piping work, do not touch the rotation detecting section.



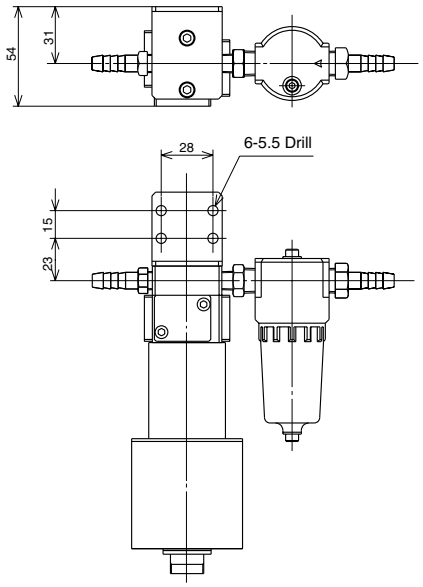
FP-215

4.2 Mounting

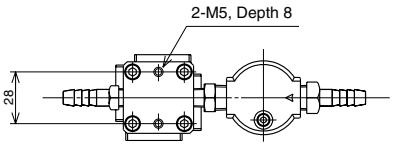
Mount the detector according to the following dimensional drawings.

■ Mounting dimensional drawing for FP-213

Mounting dimensions of bracket

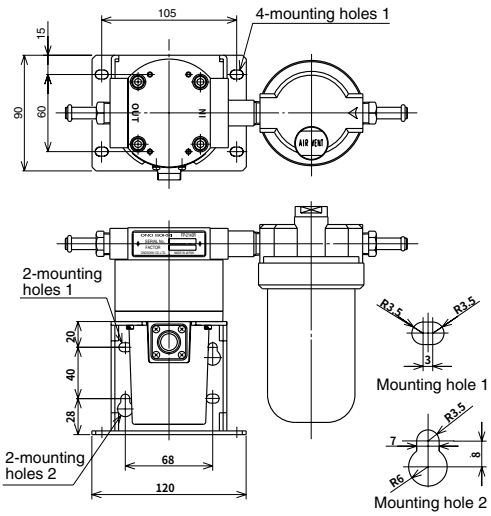


Mounting dimensions of body

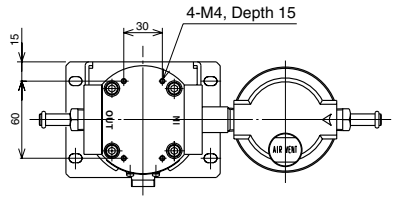


■ Mounting dimensional drawing for FP-2140H

Mounting dimensions of bracket

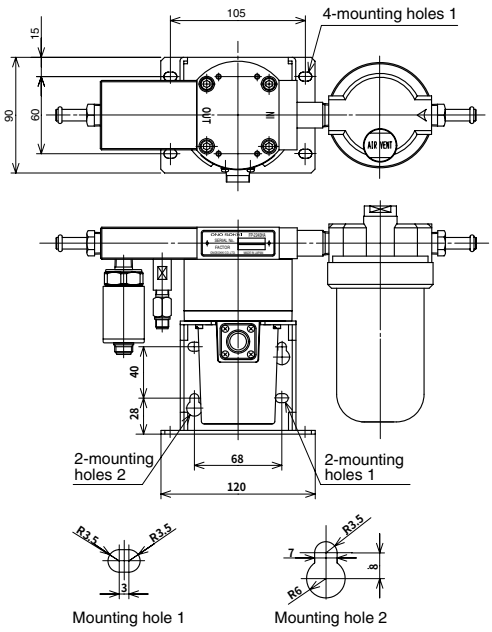


Mounting dimensions of body

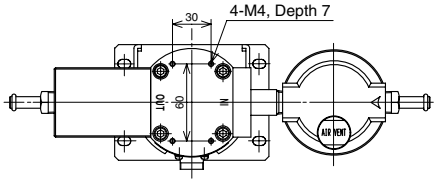


■ Mounting dimensional drawing for FP-2240HA

Mounting dimensions of bracket

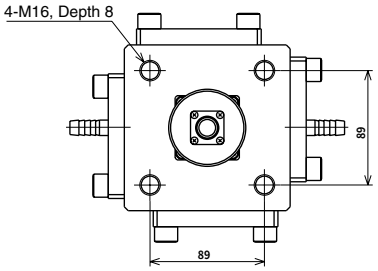


Mounting dimensions of body



■ Fixing of FP-215/2250A

Mounting dimensions of body



Chapter 5
PIPING METHOD

5.1 Precautions for Piping
5.2 Replacing Hose Joint
5.3 Sample Piping

5.1 Precautions for Piping

Check the following items before starting piping for FP-2000/200 Series Positive Displacement Type Flow Detector.

● **Precautions for the line filter**

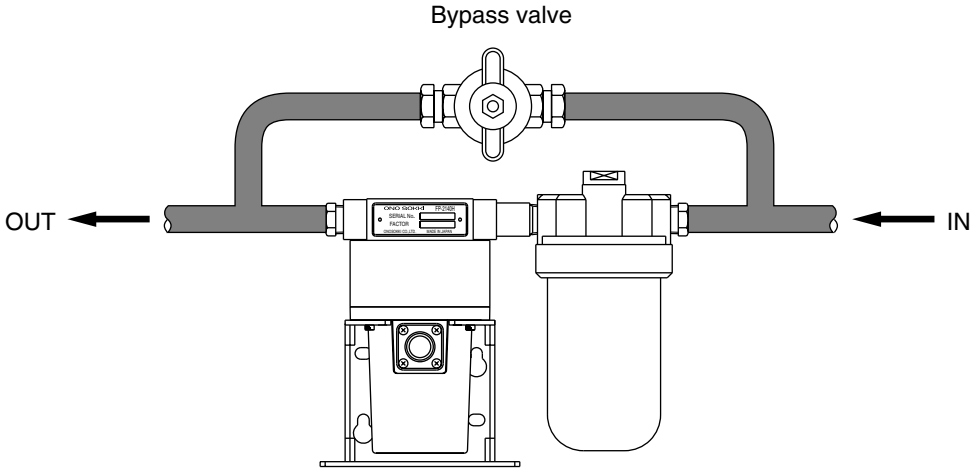
For FP-213, -2140H and -2240HA Series Positive Displacement Type Flow Detectors, a line filter is integrated into the detector unit. Do not remove the line filter from the detector nor replace it with other line filter.
For FP-215 and -2250A Series Positive Displacement Type Flow Detectors, although the line filter is not integrated into the detector unit, it must be connected in front of the fluid inlet port of the detector.

● **Do not mistake IN and OUT ports of the detector**

The detector has two ports: “IN” through which fluid comes in the detector and “OUT” through which fluid comes out of the detector. Before piping, recheck “IN” and “OUT” of the detector.

● **Recommendation to install a bypass valve**

It is recommended that a bypass valve be provided in the flow path as shown below, in order to facilitate maintenance of the system to be measured or air purging, or to prepare for malfunction of the detector.



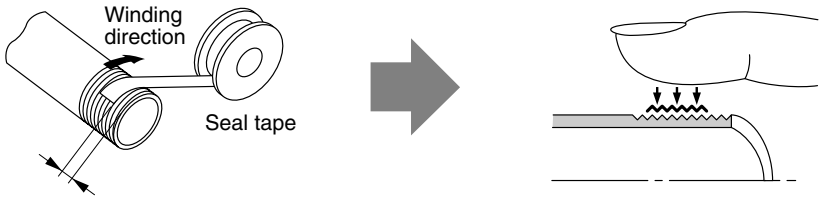
● **Be sure that the power is turned OFF before starting piping**

Before starting piping work, be sure that the power is turned OFF on DF/FM series digital counter side.
ON/OFF of the power is changed over with the POWER switch provided on the DF/FM series digital counter after connecting it to FP-2000/200 Series Positive Displacement Type Flow Detector by the attached flow signal cable.

● **Carefully wind sealant**

When Teflon seal tape is wound around a threaded part, for example, in order to replace a joint, observe the following precautions:

· Seal tape shall be wound around the threaded part such that the next turn completely or half overlaps on the preceding turn, leaving one or two ridges bare at the screw end.



· When liquid sealant is used, be careful not to allow the sealant to drop in the pipe.

· Standard tightening torque for joints is as follows:

Type	Screw size	Tightening torque
FP-213	R1/8	4 N·m
	R1/4	5 N·m
FP-2140H/2240HA	R3/8	20 N·m
FP-215/2250A	R1/2	46 N·m

● **Flush the detector before starting piping**

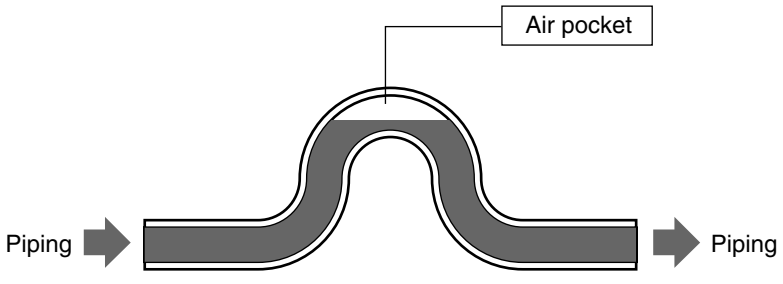
At shipment, FP-2000/200 Series Positive Displacement Type Flow Detector is filled with light oil to prevent defective lubrication from occurring. Therefore, before starting measurement, it is necessary to sufficiently flush the detector by letting the liquid to be measured through it.

● **When rubber hose is used for piping, surely fix the hose on the joint by hose bands so that it will not come out.**

Rubber hose needs to regularly be inspected. If degraded rubber hose is found, immediately replace it with new one.

● **Do not hump pipes as shown below**

When a pipe is humped as shown below, it is hard to release the air trapped in the hump, which often causes an air pocket.
Air pocket in the piping results in inaccurate measurement.

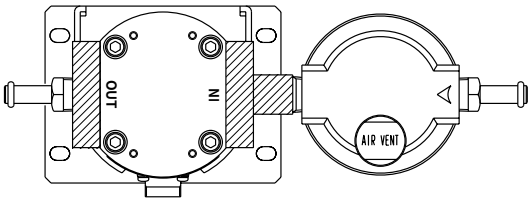


5.2 Replaing Hose Joints

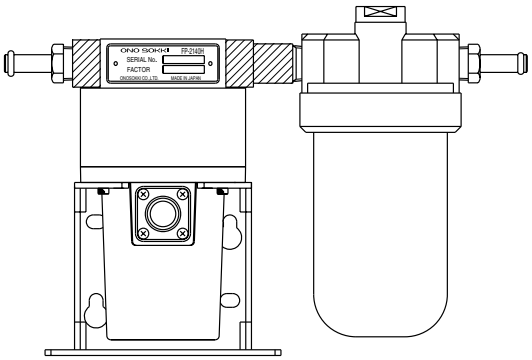
Only for FP-2140H and -2240HA, the attached hose joints are replaced in the following manner: first the flange shaded in the figure is removed, and then the hose joints are replaced.

- **FP-2140H**

[Top view]

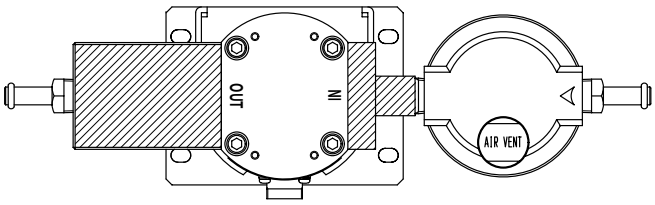


[Front view]

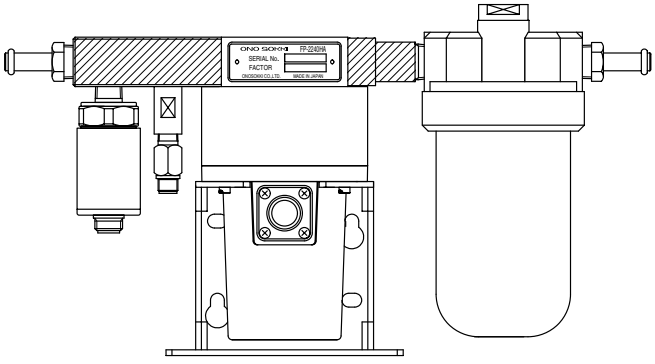


- **FP-2240HA**

[Top view]



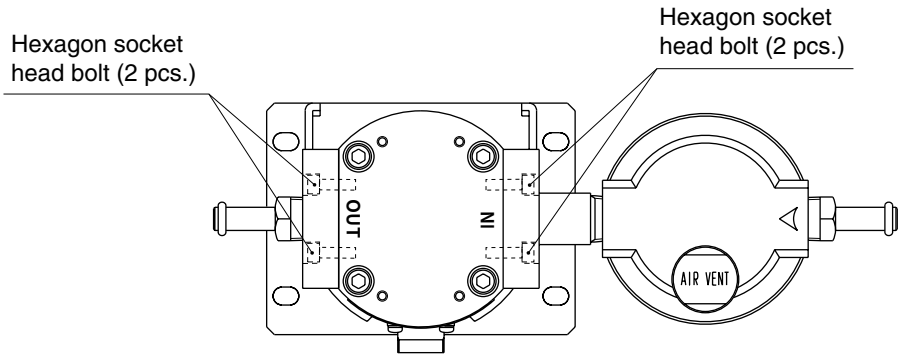
[Front view]



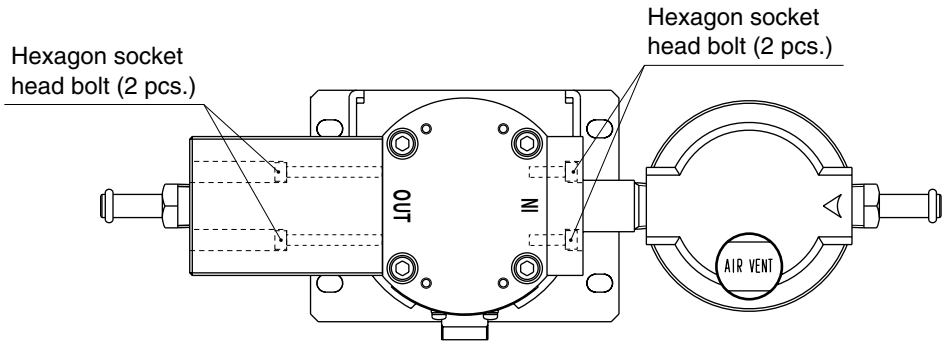
■ Removing the flange

The flange is removed with an Allen wrench having 4 mm width across flats. According to the figure below, with an Allen wrench having 4 mm width across flats, remove the hexagon socket head bolts which fix the flange. After removing the flange, replace the hose joint with new one.
When removing the flange or replacing the hose joint, be careful not to lose O-rings for sealing.

- **FP-2140H**



- **FP-2240HA**



■ Reassembling the flange

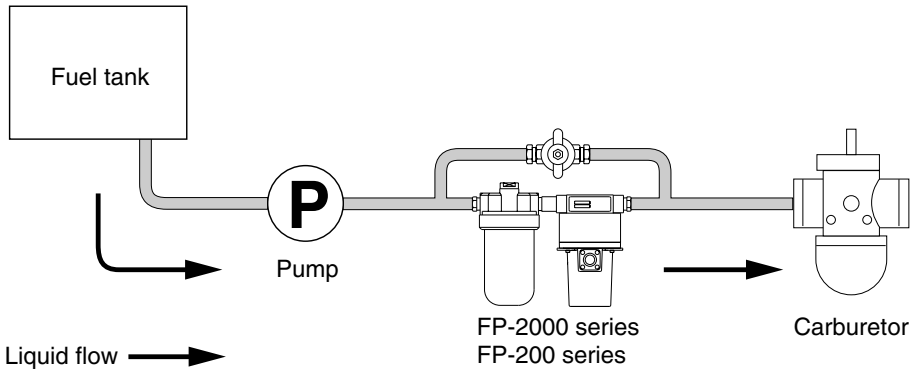
After replacing the hose joint with new one, reassemble the flange in the reverse order of removal. During the reassembly, be sure that O-rings are securely fitted in the grooves provided on the flange.

<Notes>

- If an O-ring is damaged or deformed, replace it with new one. To order O-rings for replacement, contact the vendor from which you purchased the detector or a nearby ONO SOKKI sales office.
- After the replacement of hose joint, carefully check the flow detector for leakage.

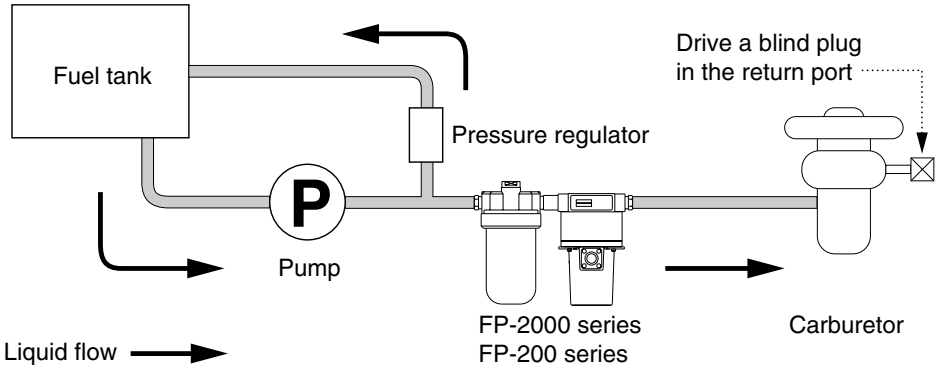
5.3 Sample Piping

■ **For the measurement of cars with carburetor and fuel pump**



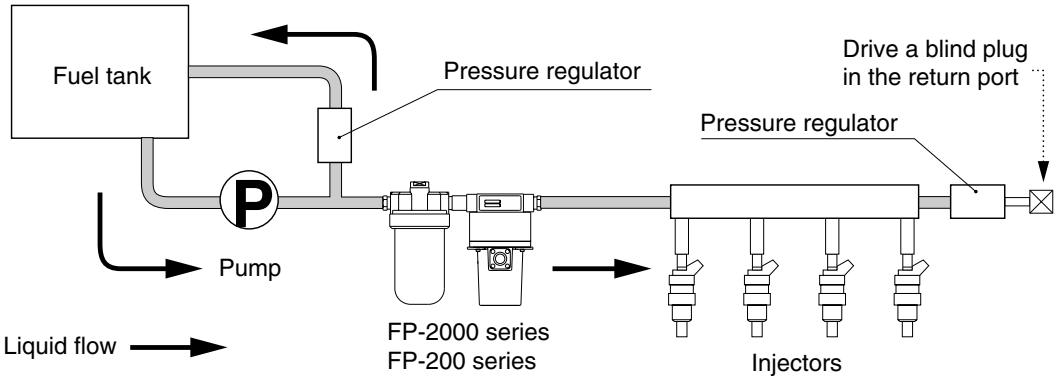
■ **For the measurement of cars with cab-return system**

(Fuel pressure is regulated by the carburetor, and fuel is returned from carburetor to fuel tank.)



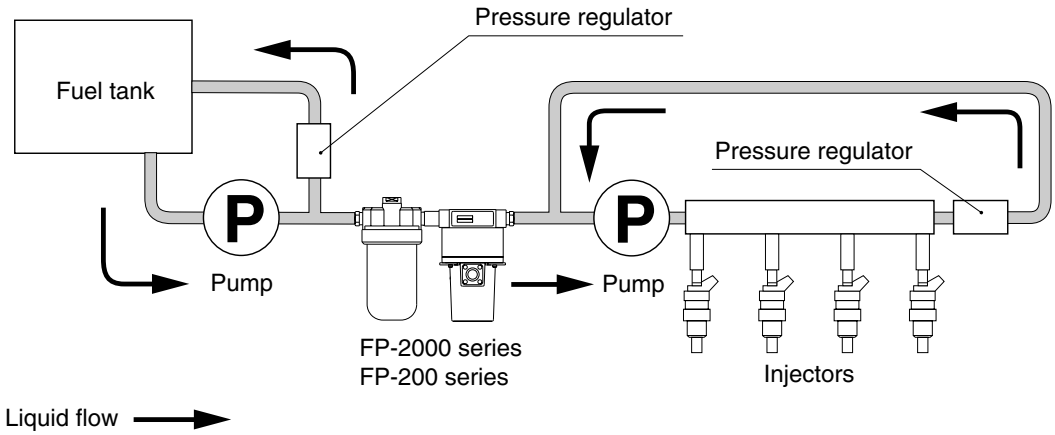
■ **For the measurement of electronic fuel injection cars**

(When FP-2000/200 Series Positive Displacement Type Flow Detector is used on the high-pressure side)



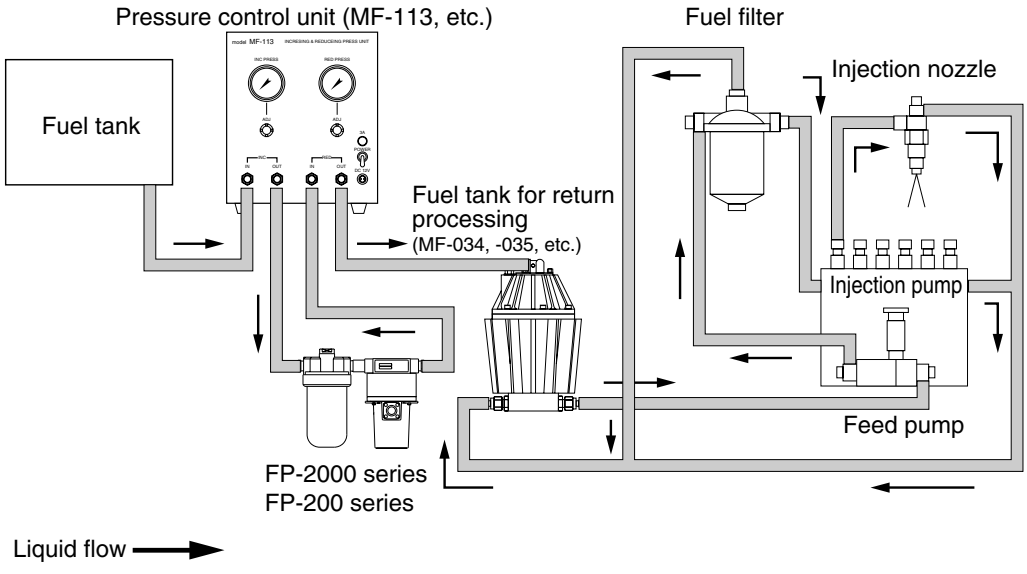
■ **For the measurement of electronic fuel injection cars**

(When FP-2000/200 Series Positive Displacement Type Flow Detector is used on the low-pressure side)

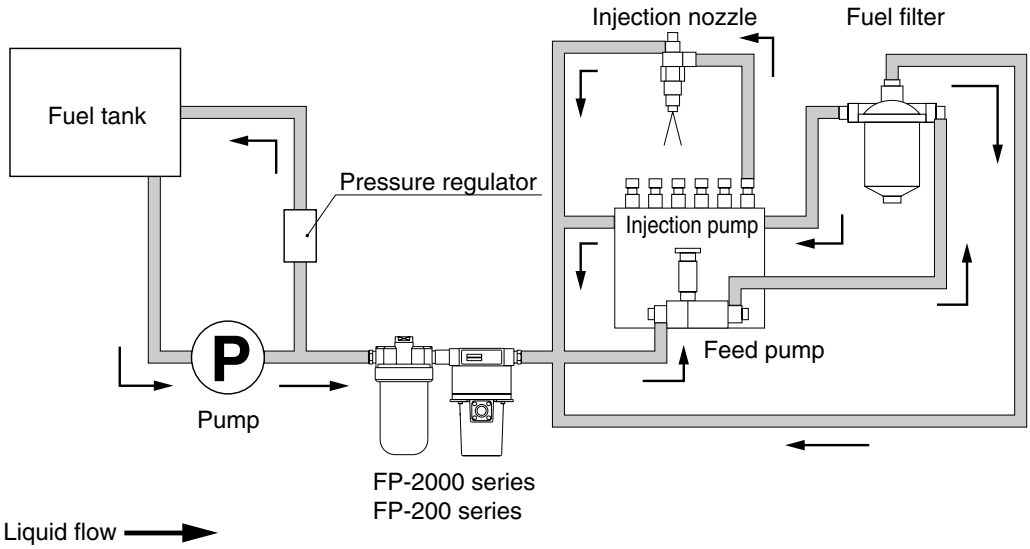


■ **For the measurement of electronic fuel injection cars**

(When the fuel tank for return processing is used)

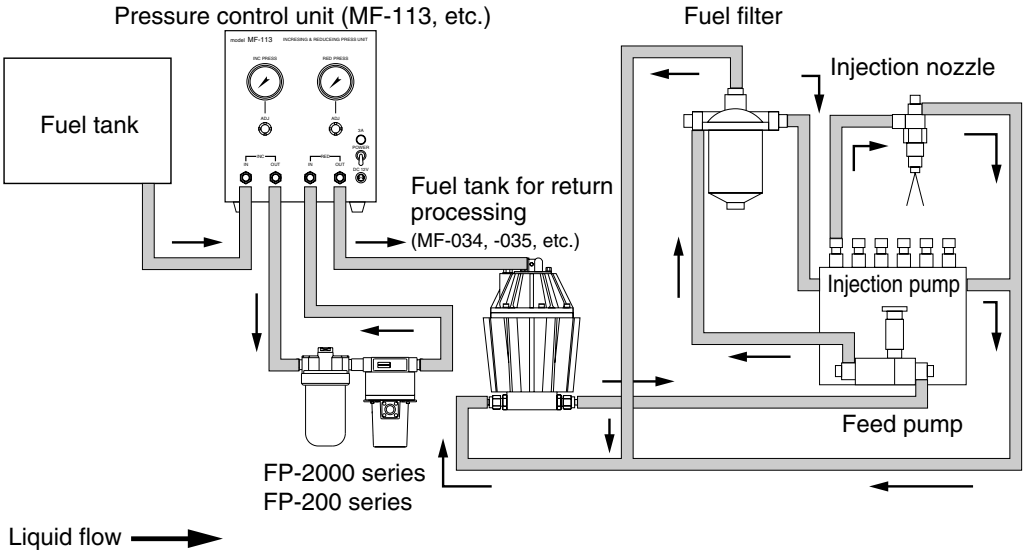


■ **For the measurement of diesel engine cars**



■ **For the measurement of diesel engine cars**

(When the fuel tank for return processing is used)



Chapter 6
CONNECTING THE SIGNAL CABLES

6.1 Connecting the Flow Signal Cable (FP-2000/200 Series)
6.2 Connecting the Temperature Signal Cable (FP-2240HA/2250A)
6.3 Connecting the Pressure Signal Cable (FP-2240HA/2250A)

6.1 Connecting the Flow Signal Cable (FP-2000/200 Series)

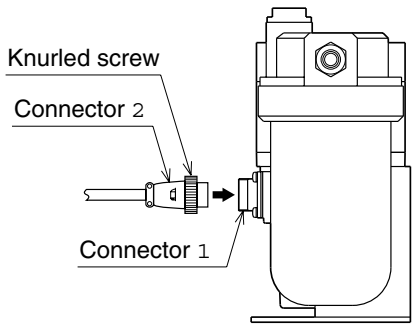
For flow signal cable, 3 types are prepared which differ in cable length: FP-0011 (5 m), FP-0012 (10 m) and FP-0014 (20 m). Select one which best matches your application or purpose.
DF/FM series digital counter and flow signal cables (FP-0011/-0012/-0014) are supplied separately. Order them in addition to the flow detector, when necessary.

Type of detector	Type of flow signal cable	Overall length	FP side connector	DF/FM side connector
FP-2000 series FP-200 series	FP-0011	5m	JMSP-1305F	RM12BPG-5S
	FP-0012	10m		
	FP-0014	20m		

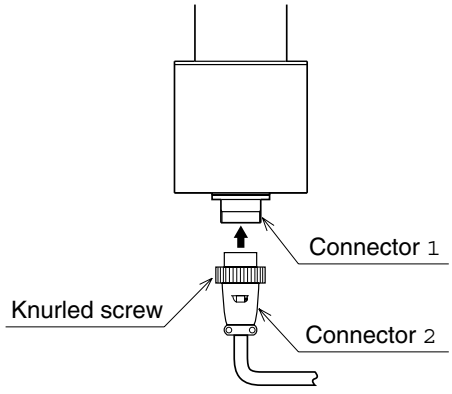
① Connect the flow signal cable to FP-2000/200 Series Positive Displacement Type Flow Detector.
Connect the JMSP-1305F side of the connector of flow signal cable to the flow signal connector provided on the flow detecting section of FP-2000/200 Series Positive Displacement Type Flow Detector.
In connecting them, align the notch provided on the cable side with that provided on the detector, and then insert the connector of the cable into that of the detector. Then turn clockwise the knurled screw provided on the cable side connector to fix it.

② Connect the flow signal cable to DF/FM series digital counter.
First, turn the power of DF/FM series digital counter OFF.
Then connect the RM12BPG-5S side of the connector of flow signal cable to the “FLOW” connector which is provided on the rear panel of the DF/FM series digital counter (SIG IN).

【FP-2140H/2240HA】



【FP-213/215/2250A】



6.2 Connecting the Temperature Signal Cable (FP-2240HA/2250A)

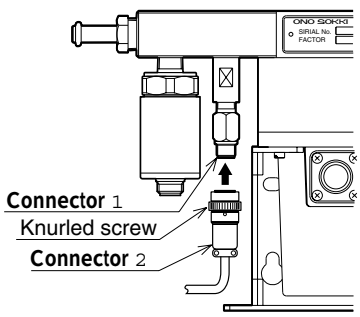
Pressure signal cables are available in three different length types.
Select one which matches your size.
DF/FM series digital counter and temperature signal cables (FP-0025/0026/0027) are supplied separately. Order them in addition to the flow detector, when necessary.

Type of detector	Type of temperature signal cable	Overall length	FP side connector	DF/FM side connector
FP-2240HA FP-2250A	FP-0025	5m	R03PB3F	RM12BPG-4S
	FP-0026	10m		
	FP-0027	20m		

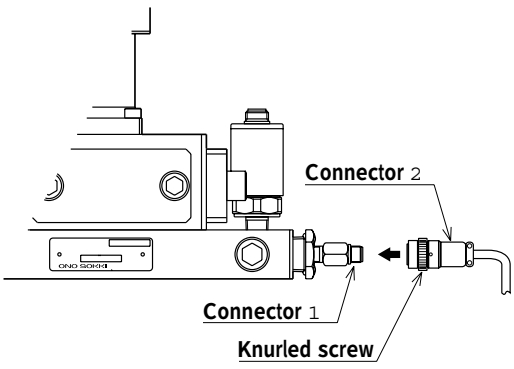
① Connect the temperature signal cable to FP-2240HA/2250A Series Positive Displacement Type Flow Detector.
Connect the R03PB3F side of the connector of the temperature signal cable to the flow signal connector provided on the flow detecting section of FP-2240HA/2250A Series Positive Displacement Type Flow Detector.
In connecting them, align the notch provided on the cable side with that provided on the detector, and then insert the connector of the cable into that of the detector. Then turn clockwise the knurled screw provided on the cable side connector to fix it.

② Connect the temperature signal cable to DF/FM series digital counter.
First, turn the power of DF/FM series digital counter OFF.
Then connect the RM12BPG-4S side of the connector of the temperature signal cable to the “TEMP” connector which is provided on the rear panel of the DF/FM series digital counter (SIG IN).

【FP-2240HA】



【FP-2250A】



6.3 Connecting the Pressure Signal Cable (FP-2240HA/2250A)

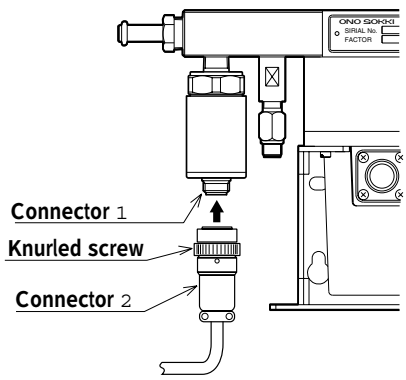
Pressure signal cables are available in three different length types.
Select one which matches your size.
DF/FM series digital counter and pressure signal cables (FP-0035/-0036/-0037) are supplied separately. Order them in addition to the flow detector, when necessary.

Type of detector	Type of pressure signal cable	Overall length	FP side connector	DF/FM side connector
FP-2240HA FP-2250A	**FP-0035**	**5m**	**R03PB6F**	**RM12BPG-6S**
	FP-0036	**10m**		
	FP-0037	**20m**		

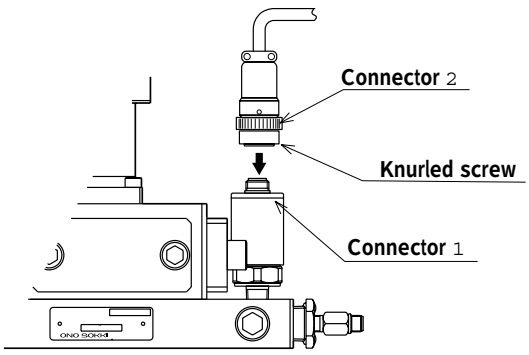
① Connect the pressure signal cable to FP-2240HA/2250A Series Positive Displacement Type Flow Detector.
Connect the R03PB6F side of the connector of the pressure signal cable to the flow signal connector provided on the flow detecting section of FP-2240HA/2250A Series Positive Displacement Type Flow Detector.
In connecting them, align the notch provided on the cable side with that provided on the detector, and then insert the connector of the cable into that of the detector. Then turn clockwise the knurled screw provided on the cable side connector to fix it.

② Connect the pressure signal cable to DF/FM series digital counter.
First, turn the power of DF/FM series digital counter OFF.
Then connect the RM12BPG-6S side of the connector of the pressure signal cable to the “PRESS” connector which is provided on the rear panel of the DF/FM series digital counter (SIG IN).

【FP-2240HA】



【FP-2250A 】

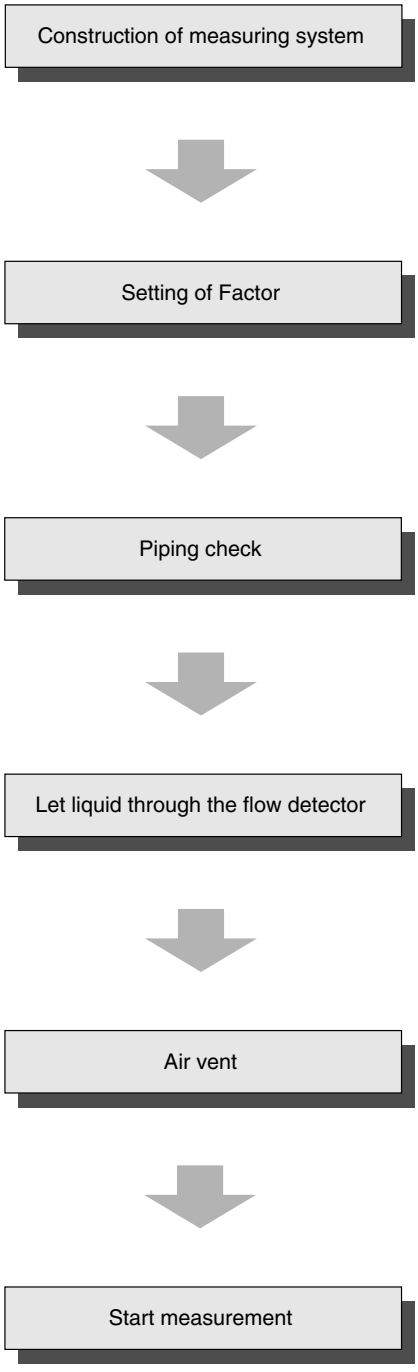


Chapter 7
MEASURING METHOD

7.1 Basic Measuring Procedure
7.2 Setting of Factor
7.3 Piping Check
7.4 Letting Liquid through the Flow Detector
7.5 Air Purging

7.1 Basic Measuring Procedure

This section describes the basic procedure for measuring liquid flow rate with a combination of FP-2000/200 Series Positive Displacement Type Flow Detector and DF series digital counter.



- Construction of the measuring system is the procedure up to connecting the flow signal cable between FP-2000/200 Series Positive Displacement Type Flow Detector and DF/FM series digital counter.

  Refer to '6. CONNECTING THE SIGNAL CABLES'.

- Input (set) value of FACTOR for FP-2000/200 Series Positive Displacement Type Flow Detector in DF/FM series digital counter.

- Before letting liquid through FP-2000/200 Series Positive Displacement Type Flow Detector, be sure again that piping were performed correctly.

- Let liquid through FP-2000/200 Series Positive Displacement Type Flow Detector.

- Before starting measurement, purge air from the piping as well as the positive displacement type flow detector.
  Incomplete air purging may result in inaccurate measurement or fluctuation of the indication of instantaneous flow rate.

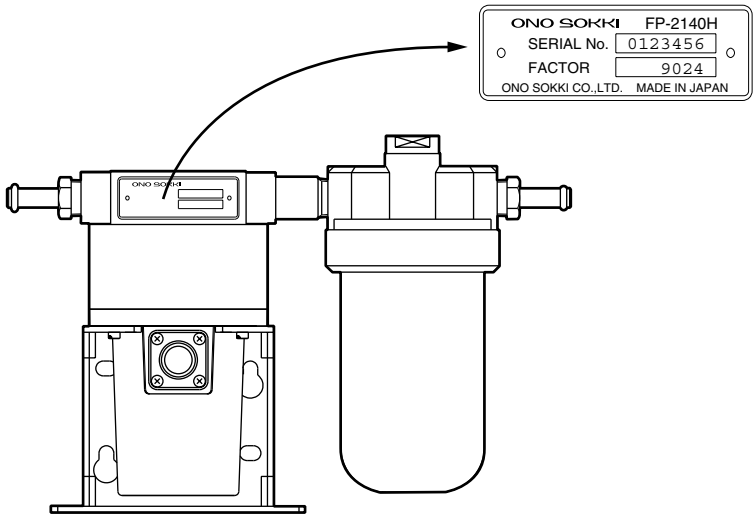
- When all preparations and procedures are finished, measurement can be started.

7.2 Setting of Factor

Factor has a peculiar (4-digit) value for each of positive displacement type flow detectors. These values must be input (set) in DF/FM series digital counter before measurement is started.
For how to set factor values, see the instruction manual for your DF/FM series digital counter.

■ Check the factor value

Value of the factor for your flow detector is marked on the nameplate which is stuck on the body of the corresponding FP-2000/200 Series Positive Displacement Type Flow Detector.



7.3 Piping Check

Before letting liquid through the flow detector, check again the propriety of piping.

- Be sure that each pipe is correctly and surely connected.
- When connection is made by hose, be sure that the hose is surely fixed on the joint by hose band.
- Carefully check that no liquid is leaking or oozing from any part of the piping.

7.4 Letting Liquid through the Flow Detector

In the following procedure, let the liquid to be measured through FP-2000/200 Series Positive Displacement Type Flow Detector.

① Turn the power of DF/FM series digital counter ON.
② Let the liquid through the flow detector at low rate (5 ℓ/h or less).
③ After checking that the flow detector is filled with the liquid, gradually increase flow rate.

<Note>

Since the moving parts of FP-2000/200 Series Positive Displacement Type Flow Detector are lubricated by the fluid to be measured, the liquid must be let through the detector at low rate (5ℓ/h or less) at the beginning.

If the liquid to be measures is let through FP-2000/200 Series Positive Displacement Type Flow Detector at high rate before the detector is filled with the liquid, malfunction may occur.

7.5 Air Purging

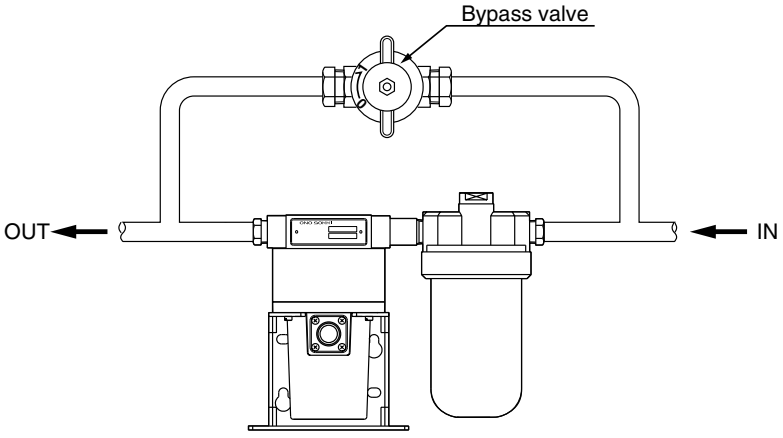
Before starting measurement, completely purge air from the piping and the flow detector. Insufficient purging may cause measurement error or fluctuation of the indication of instantaneous flow rate. Be careful that air purging procedure differs with the existence of bypass valve.

■ Air purging procedure for a system with bypass valve

① Purge air from the piping
First, with the bypass valve fully opened, let the liquid to be measured through the piping and detector. Then, with the bypass valve kept opened, continue to let the liquid through the measuring system to purge air from the pipes in front and in the rear of the detector.

② Purge air through the air vent
With a spanner or the like, loosen the air vent provided at the top of the filter to purge air. Then, after checking that air is completely purged, surely tighten the loosened air vent. To prevent the liquid from spouting, it is recommended to cover the air vent with rug or the like while turning the air vent. During measurement, be sure that the air vent is tightened firmly.

③ Purge air from the flow detector
After checking that the air was purged from the piping as well as the filter, slowly shut the bypass valve. Thus air is completely purged from the flow detector. In purging air from the detector, be careful not to let the liquid through it at high rate. Carefully adjust the closing state of the bypass valve while checking the indication of instantaneous flow rate on the DF/FM series digital counter. And finally shut the bypass valve completely. Above is the whole procedure for air purging.



<Note>

In letting the liquid through the detector, the indication of instantaneous flow rate on the DF/FM series digital counter may fluctuate to a large extent. This occurs when air purging is incomplete. In such cases, re-execute air purging according to the above procedure.

■ Air purging procedure for a system with no bypass valve

① Purge air through the air vent

Let the liquid to be measured through the piping and detector while checking the indication of instantaneous flow rate on the DF/FM series digital counter to prevent flow rate from becoming too high.

With a spanner or the like, loosen the air vent provided at the top of the filter to purge air.

Then, after checking that air is completely purged, surely tighten the loosened air vent.

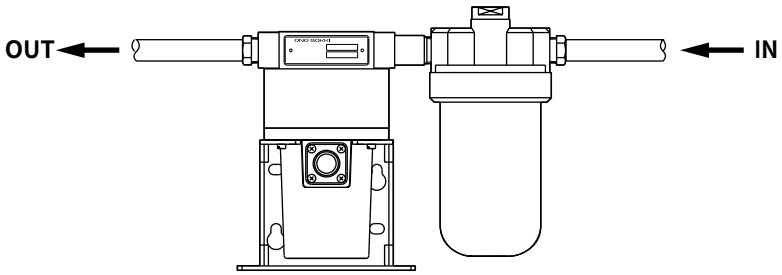
To prevent the liquid from spouting, it is recommended to cover the air vent with rug or the like while turning the air vent.

During measurement, be sure that the air vent is tightened firmly.

② Purge air from the flow detector

Then slowly increase the flow rate carefully so that it does not become too high.

Finally, with the flow rate kept high, continue to let the liquid to be measured through the detector. Above is the whole procedure for air purging.



<Note>

In letting the liquid through the detector, the indication of instantaneous flow rate on the DF/FM series digital counter may fluctuate to a large extent. This occurs when air purging is incomplete.

In such cases, re-execute air purging according to the above procedure.

Chapter 8 MAINTENANCE AND MANAGEMENT

8.1 Periodic Inspection and Calibration
8.2 Inspection and Cleaning of Filter and the Element
8.3 Storing a Positive Displacement Type Flow Detector

8.1 Periodic Inspection and Calibration

To show high performance for a long time, FP-2000/200 Series Positive Displacement Type Flow Detector needs to periodically be inspected and calibrated.
For periodic inspection and calibration, contact the vendor from which you purchased the product or a nearby ONO SOKKI sales office.

8.2 Inspection and Cleaning of Filter and the Element

For FP-2000/200 Series Positive Displacement Type Flow Detector, two types of filter element are prepared: stainless steel micro mesh type and paper type. In order that FP-2000/200 Series Positive Displacement Type Flow Detector shows high performance for a long time, the filter element needs to regularly be inspected or, if necessary, cleaned.

Type	Filter	Filter element
FP-213	EH-106	—
FP-2140H/2240HA	EH-1050	EH-015
FP-215/2250A	EH-101	EH-011

■ FP-213

Filter element for FP-213 is of stainless steel micro mesh type which can be used repeatedly. Inspect the filter periodically and clean the filter element if necessary. Clean the filter element, caring the following matters:

- In setting the element in the filter, or in mounting the filter case, be careful not to allow dust or dirt to enter it.
- Set O-ring correctly. If the O-ring is damaged, such as flawed, replace it with new one.

■ FP-215/2250A

Filter element for FP-215/2250A is of paper type. Replace the element if necessary.

■ FP-2140H/2240HA

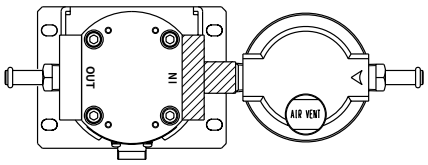
Filter element for FP-2140H/2240HA is of paper type. Replace the element if necessary.

■ Removing/reassembling the flange

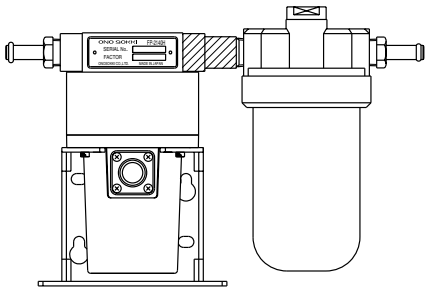
To replace the filter element, it is necessary to remove the flange (shaded section in the figure below) in advance.

● FP-2140H

[Top view]

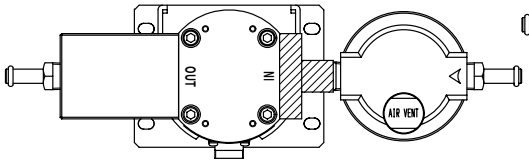


[Front view]

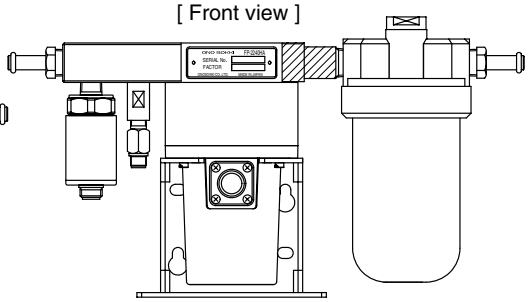


● FP-2240HA

[Top view]



[Front view]

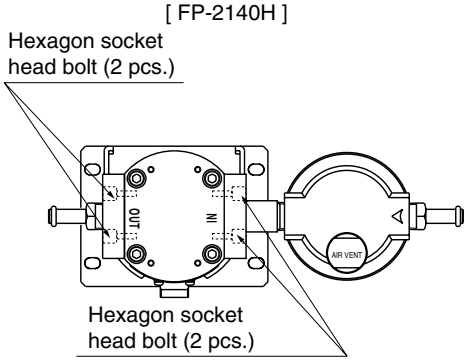


■ How to remove and reassemble the flange

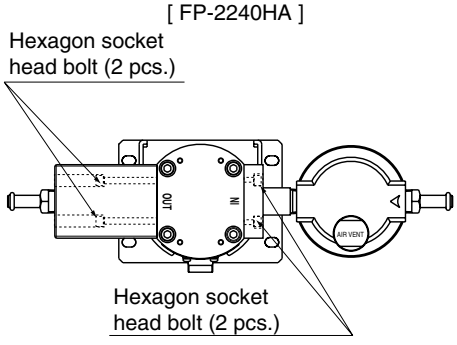
First, with an Allen wrench having 4 mm width across flats, remove the hexagon socket head bolts of the flow detector and then the flange. Then replace the filter element.

After the replacement of element, reassemble the flange in the reverse order of removal. Before reassembling the flange, be sure that O-ring is surely set in the groove provided on the flange.

[FP-2140H]



[FP-2240HA]



<Notes>

- If the O-ring is damaged or deformed, replace it with a new one.
- When the flange was removed and reassembled for the replacement of element, check each part of the flow detector for leakage before starting measurement.

8.3 Storing a Positive Displacement Type Flow Detector

When measurement ends, or when FP-2000/200 Series Positive Displacement Type Flow Detector is not used for a long time, store it according to the following procedure.

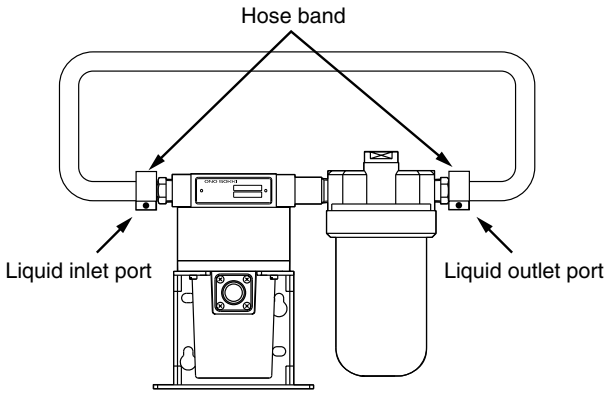
■ Purpose of storage

For the following purposes, FP-2000/200 Series Positive Displacement Type Flow Detector needs to be stored in the specified procedure.
Carefully read this section, and follow the specified procedure and method to store the detector.

- To prevent foreign matter from entering through the liquid inlet or outlet port
- To prevent leakage
- To prevent the liquid contained in the detector from evaporating or drying and thus to keep a good lubrication inside the detector

■ Storing procedure

Connect the liquid inlet and outlet ports by a hose.
Here, in order to prevent the hose from coming out of the joint, surely fix it by hose band.



<Note>

To store the flow detector after letting a volatile liquid, such as gasoline, through it, first fill the detector with a liquid which hardly evaporate, such as light oil, and then follow the above procedure for storage.

Chapter 9
APPENDIX

9.1 Troubleshooting
9.2 Specifications (FP-213/2140H/215/2240HA/2250A)
9.3 Dimensional Outline Drawing (FP-213/2140H/215/2240HA/2250A)

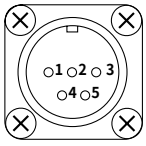
9.1 Troubleshooting

Phenomena	Cause	Remedy
Indication of instantaneous flow rate fluctuates	Air contained in the piping or detector is not completely purged.	• Purge air. See “5. MEASURING METHOD”
	Supply pressure is too low, compared with flow rate.	• Increase supply pressure. • Recheck the piping.
	Liquid in the piping or detector is vaporized.	• Keep the piping and detector away from the heat source.
	Detector ripple adjustment is not correct.	(Repair)
Liquid does not flow smoothly	Piping is throttled in the middle.	• Remove the cause of throttling.
	Filter element is clogged.	• Replace the filter element, or clean the filter element (when it can be used repeatedly).
Counter indicates zero although liquid is flowing	Connection of flow signal cable is loose.	• Surely connect the flow signal cable.
	Connection to the detector inlet and outlet ports is reversed.	• Correctly connect pipes to the inlet and outlet ports of the detector.
	Counter FACTOR value is set to zero.	• Correctly set counter FACTOR value.
	Bypass valve (when installed) is open.	• Shut the bypass valve.
Liquid does not flow	Liquid supply pressure is zero.	• Increase supply pressure.
	Poor lubrication of the flow rate-rotation converter of the detector	(Repair)
Counter indicates zero when flow rate is low; a low value when high	Bypass valve is open.	• Shut the bypass valve.
Indication fluctuates when flow rate is low	Poor lubrication of the flow rate-rotation converter of the detector.	(Repair)
Measurement is different from actual flow rate	Counter FACTOR value is not set correctly.	• Correctly set counter FACTOR value.
	Return flow rate is included in measurement due to wrong piping.	• Recheck the piping and correct it, if wrong.

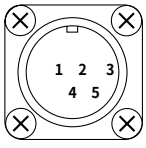
(Repair): Contact the vendor from which you purchased the product or a nearby ONO SOKKI sales office.

9.2 Specifications (FP-213)

<table>
<tr><td>Item to be measured</td><td>Flow rate</td></tr>
<tr><td>Detecting method</td><td>Positive displacement type (piston type)</td></tr>
<tr><td>Applicable liquid

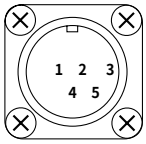
•</td><td>• Standard specification: Gasoline (unleaded and leaded), fuel oil A, kerosene, engine oil, petroleum type general hydraulic oil
Alcohol adapted specification (option): Methanol, ethanol, mixture of alcohol and gasoline, brake oil, etc.</td></tr>
<tr><td>Material of parts coming in contact with liquid</td><td>• Flow detecting section:
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Body, side plate, connecting rod, crankshaft, bearing case, pin, top plate</td><td>SUS303</td></tr>
<tr><td>Piston</td><td>SUS303 (Hard chromium plating)</td></tr>
<tr><td>Bearing, crank pin</td><td>SUS440C</td></tr>
<tr><td>Magnet coupling</td><td>MAP-100</td></tr>
<tr><td>E-ring</td><td>SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
</table>
• Filter section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Case</td><td>ZDC2 ADC12 FPM SS41 SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Element</td><td>SUS303 SUS304 Ni plating</td></tr>
</table></td></tr>
<tr><td>Measuring range</td><td>0.06 to 60 ℓ/h</td></tr>
<tr><td>Measuring accuracy</td><td>• In 0.06-0.18 ℓ/h range: ±0.0009 ℓ/h or less
• In 0.18-60 ℓ/h range: ±0.5% or less of indication</td></tr>
<tr><td>Pressure loss</td><td>8 kPa/40 ℓ/h or less (gasoline)</td></tr>
<tr><td>Minimum resolution</td><td>0.01 mℓ</td></tr>
<tr><td>Line filter (accessory)</td><td>• Filtering capacity: 5 μm (Type EH-106)
• Filter element: Integrated in filter</td></tr>
<tr><td>Applicable counter</td><td>DF/FM series digital counter</td></tr>
<tr><td>Output signal (flow rate)</td><td>• Cable: FP-0011 (5 m), FP-0012 (10 m), FP-0014 (20 m)
• Connector: JMR-1305 (detector side)/JMSP-1305 (cable side)
• Pin arrangement: ① SIG 1
② SIG 2
③ COMMON
④ Shield COMMON
⑤ 12 VDC power supply (8 to 12 V)
 
</td></tr>
<tr><td>Inlet and outlet joints</td><td>• Liquid inlet: R1/4 ø9 hose joint
• Liquid outlet: R1/8 ø9 hose joint</td></tr>
<tr><td>General specifications</td><td>• Maximum working pressure: 980 kPa (withstand pressure of line filter)
(Withstand pressure of flow detector: 6.86 MPa)
• Working temperature range: 0 to +65 °C. (both ambient temp. and liquid temp.)
• Input supply voltage: 12 VDC (8 to 15 V) supplied from DF/FM series digital counter
• Mass: Approx. 2.0 kg (including line filter)
• Accessories: Line filter (integrated into detector)
Instruction manual (this document)</td></tr>
</table>

9.2 Specifications (FP-2140H)

<table>
<tr><td>Item to be measured</td><td>Flow rate</td></tr>
<tr><td>Detecting method</td><td>Positive displacement type (piston type)</td></tr>
<tr><td>Applicable liquid</td><td>• Standard specification: Gasoline (unleaded and leaded), fuel oil A, kerosene, engine oil, petroleum type general hydraulic oil
• Alcohol adapted specification (option): Methanol, ethanol, mixture of alcohol and gasoline, brake oil, etc.</td></tr>
<tr><td>Material of parts coming in contact with liquid</td><td>• Flow detecting section:
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Body, connecting rod, crankshaft, bearing case, pin, top plate</td><td>SUS303</td></tr>
<tr><td>Piston</td><td>SUS303 (Hard chromium plating)</td></tr>
<tr><td>Bearing, crank pin</td><td>SUS440C</td></tr>
<tr><td>Magnet coupling</td><td>MAP-100</td></tr>
<tr><td>E-ring sealing</td><td>SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Joint flange</td><td>C3604 Ni plating</td></tr>
</table>
• Filter section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Case</td><td>ADC12 SPC SWC</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Element</td><td>SPC Ni plating
SECC Ni plating
Cotton</td></tr>
</table></td></tr>
<tr><td>Measuring range</td><td>0.3 to 120 ℓ/h</td></tr>
<tr><td>Measuring accuracy</td><td>±0.2% or less of indication (entire measuring range)</td></tr>
<tr><td>Pressure loss</td><td>2 kPa/60 ℓ/h or less (gasoline)</td></tr>
<tr><td>Minimum resolution</td><td>0.1 mℓ</td></tr>
<tr><td>Line filter (accessory)</td><td>• Filtering capacity: 5 µm (Type EH-1050)
• Replacement filter element: 5 µm (Type EH-015)</td></tr>
<tr><td>Applicable counter</td><td>DF/FM series digital counter</td></tr>
<tr><td>Output signal (flow rate)</td><td>• Cable: FP-0011 (5 m), FP-0012 (10 m), FP-0014 (20 m)
• Connector: JMR-1305M (detector side)/JMSP-1305F (cable side)
• Pin arrangement: ① SIG 1
② SIG 2
③ COMMON
④ Shield COMMON
⑤ 12 VDC power supply (8 to 15 V)
 
</td></tr>
<tr><td>Inlet and outlet joints</td><td>• Liquid inlet: R3/8 ø9 hose joint
• Liquid outlet: R3/8 ø9 hose joint</td></tr>
<tr><td>General specifications</td><td>• Maximum working pressure: 980 kPa (withstand pressure of line filter)
(Withstand pressure of flow detector: 6.86 MPa)
• Working temperature range: 0 to +65 °C. (both ambient temp. and liquid temp.)
• Input supply voltage: 12 VDC (8 to 15 V) supplied from DF/FM series digital counter
• Mass: Approx. 4.5 kg (including line filter)
• Accessories: Line filter (integrated into detector)
Instruction manual (this document)</td></tr>
</table>

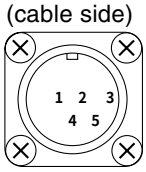
9.2 Specifications (FP-215)

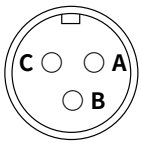
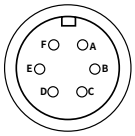
<table>
<tr><td>Item to be measured</td><td>Flow rate</td></tr>
<tr><td>Detecting method</td><td>Positive displacement type (piston type)</td></tr>
<tr><td>Applicable liquid

•</td><td>• Standard specification: Gasoline (unleaded and leaded), fuel oil A, kerosene, engine oil, petroleum type general hydraulic oil
Alcohol adapted specification (option): Methanol, ethanol, mixture of alcohol and gasoline, brake oil, etc.</td></tr>
<tr><td>Material of parts coming in contact with liquid</td><td>• Flow detecting section:
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Body, connecting rod, crankshaft, side plate, bearing case, pin, top plate</td><td>SUS303</td></tr>
<tr><td>Piston</td><td>SUS303 (Hard chromium plating)</td></tr>
<tr><td>Bearing, crank pin</td><td>SUS440C</td></tr>
<tr><td>Magnet coupling</td><td>MAP-100</td></tr>
<tr><td>E-ring</td><td>SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
</table>
• Filter section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Case</td><td>ADC12 C3604 SWP SS41</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Element</td><td>SPC (Ni plating)
SECC (Ni plating)
Cotton</td></tr>
</table></td></tr>
<tr><td>Measuring range</td><td>1 to 1440 ℓ/h</td></tr>
<tr><td>Measuring accuracy</td><td>• In 1-3.6 ℓ/h range: ±0.018 ℓ/h or less
• In 3.6-1440 ℓ/h range: ±0.5% or less of indication</td></tr>
<tr><td>Pressure loss</td><td>7.4 kPa/500 ℓ/h or less (gasoline)</td></tr>
<tr><td>Minimum resolution</td><td>1 mℓ</td></tr>
<tr><td>Line filter (accessory)</td><td>• Filtering capacity: 10 μm (Type EH-101)
• Replacement filter element: 10 μm (Type EH-011)</td></tr>
<tr><td>Applicable counter</td><td>DF/FM series digital counter</td></tr>
<tr><td>Output signal (flow rate)</td><td>• Cable: FP-0011 (5 m), FP-0012 (10 m), FP-0014 (20 m)
• Connector: JMR-1305M (detector side)/JMSP-1305F (cable side)
• Pin arrangement: ① SIG 1
② SIG 2
③ COMMON
④ Shield COMMON
⑤ 12 VDC power supply (8 to 15 V)
 
</td></tr>
<tr><td>Inlet and outlet joints</td><td>• Liquid inlet: R1/2 ø12 hose joint
• Liquid outlet: R1/2 ø12 hose joint</td></tr>
<tr><td>General specifications

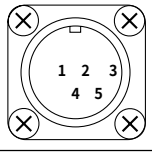
00•
Line filter (integrated into detector)</td><td>• Maximum working pressure: 980 kPa (withstand pressure of line filter)
(Withstand pressure of flow detector: 6.86 MPa)
• Working temperature range: 0 to +65 °C. (both ambient temp. and liquid temp.)
• Input supply voltage: 12 VDC (8 to 15 V) supplied from DF/FM series digital counter
• Mass: Detector: Approx. 11 kg ; Line filter: Approx. 3 kg
Accessories:
Instruction manual (this document)</td></tr>
</table>

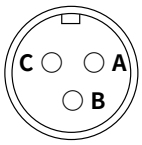
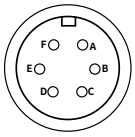
9.2 Specifications (FP-2240HA)

<table>
<tr><td>Item to be measured</td><td>Flow rate, temperature, pressure</td></tr>
<tr><td>Detecting method</td><td>• Flow rate: Positive displacement type (piston type)
• Temperature: Resistance bulb (Pt 100 Ω)
• Pressure: Semiconductor type</td></tr>
<tr><td>Applicable liquid</td><td>• Standard specification: Gasoline (unleaded and leaded), fuel oil A, kerosene, engine oil, petroleum type general hydraulic oil
• Alcohol adapted specification (option): Methanol, ethanol, mixture of alcohol and gasoline, brake oil, etc.</td></tr>
<tr><td>Material of parts coming in contact with liquid</td><td>• Flow detecting section:
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Body, connecting rod, crankshaft, top plate, bearing case, pin, manifold</td><td>SUS303</td></tr>
<tr><td>Piston</td><td>SUS303 (Hard chromium plating)</td></tr>
<tr><td>Bearing, crank pin</td><td>SUS440C</td></tr>
<tr><td>Magnet coupling</td><td>MAP-100</td></tr>
<tr><td>E-ring sealing</td><td>SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Joint flange</td><td>C3604 Ni plating</td></tr>
</table>
• Filter section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Case</td><td>ADC12 SPC SWC</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Element</td><td>SPC (Ni plating)
SECC (Ni plating)
Cotton</td></tr>
</table>
• Temperature detecting section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Sheath</td><td>SUS316</td></tr>
<tr><td>Joint</td><td>SUS304</td></tr>
</table>
• Pressure detecting section: SUS316</td></tr>
<tr><td>Measuring range</td><td>• Flow rate: 0.3 to 120 ℓ/h
• Temperature: 0 to 99.9 °C.
• Pressure: 0 to 981 kPa</td></tr>
<tr><td>Measuring accuracy</td><td>• Flow rate: ±0.2% or less of indication (entire measuring range)
• Temperature: Class B
• Pressure: ±0.5% FS</td></tr>
<tr><td>Pressure loss</td><td>2 kPa/60 ℓ/h or less (gasoline)</td></tr>
<tr><td>Minimum resolution</td><td>0.1 mℓ</td></tr>
<tr><td>Line filter (accessory)</td><td>• Filtering capacity: 5 µm (Type EH-1050)
• Replacement filter element: 5 µm (Type EH-015)</td></tr>
<tr><td>Applicable counter</td><td>DF/FM series digital counter</td></tr>
<tr><td>Output signal (flow rate)</td><td>• Cable: FP-0011 (5 m), FP-0012 (10 m), FP-0014 (20 m)
• Connector: JMR-1305M (detector side)/JMSP-1305F (cable side)
• Pin arrangement: ① SIG 1
② SIG 2
③ COMMON
④ Shield COMMON
⑤ 12 VDC power supply (8 to 15 V)
 
</td></tr>
</table>

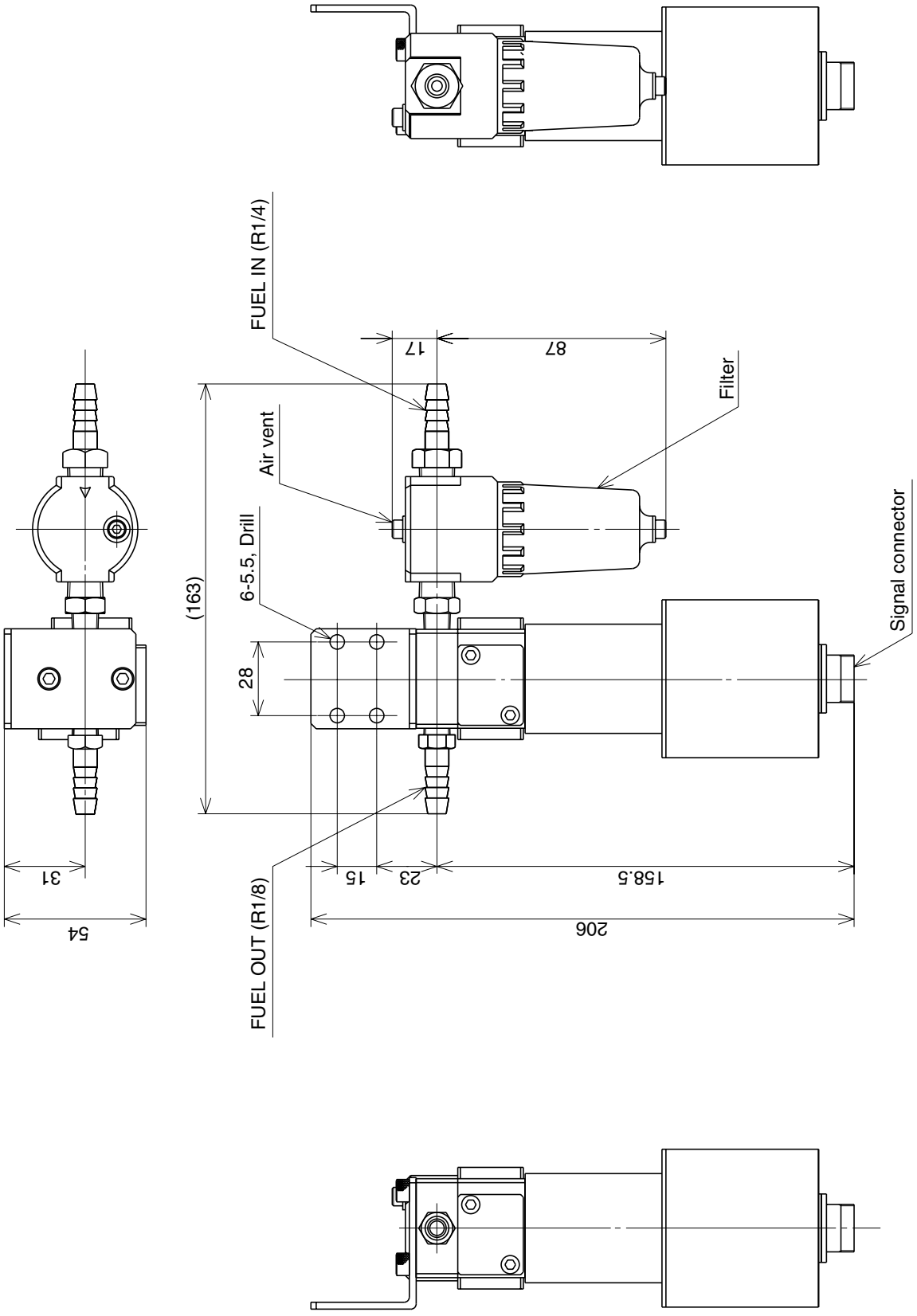
Output signal (temperature)	• Cable: FP-0025 (5 m), FP-0026 (10 m), FP-0027 (20 m) • Connector: R03PB3F (cable side) • Pin arrangement: A SIG 1 B SIG 2 C SIG 3 
Output signal (pressure)	• Cable: FP-0035 (5 m), FP-0036 (10 m), FP-0037 (20 m) • Connector: R03PB6F (cable side) • Pin arrangement: A Power supply (+15 V) B SIG H C SIG L D Power supply (0 V) E NC F NC 
Inlet and outlet joints	• Liquid inlet: R3/8 ø9 hose joint • Liquid outlet: R3/8 ø9 hose joint
General specifications	• Maximum working pressure: 980 kPa (withstand pressure of line filter) (Withstand pressure of flow detector: 6.86 MPa) • Working temperature range: 0 to +65 °C. (both ambient temp. and liquid temp.) • Input supply voltage: 12 VDC (8 to 15 V) supplied from DF/FM series digital counter • Mass: Approx. 5.0 kg (including line filter) • Accessories: Line filter (integrated into detector) Instruction manual (this document)

9.2 Specifications (FP-2250A)

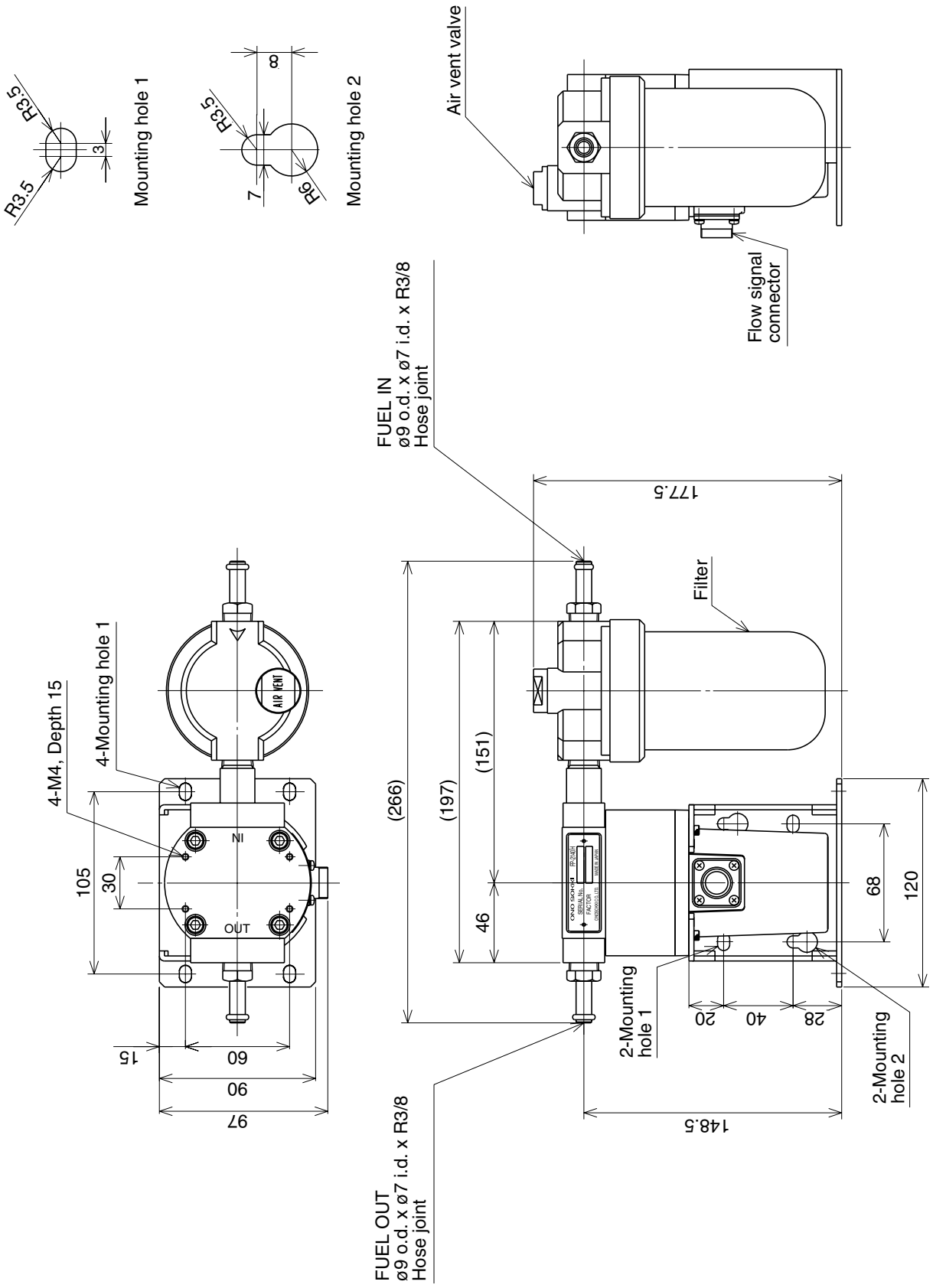
<table>
<tr><td>Item to be measured</td><td>Flow rate, temperature, pressure</td></tr>
<tr><td>Detecting method</td><td>• Flow rate: Positive displacement type (piston type)
• Temperature: Resistance bulb (Pt 100 Ω)
• Pressure: Semiconductor type</td></tr>
<tr><td>Applicable liquid</td><td>• Standard specification: Gasoline (unleaded and leaded), fuel oil A, kerosene, engine oil, petroleum type general hydraulic oil
• Alcohol adapted specification (option): Methanol, ethanol, mixture of alcohol and gasoline, brake oil, etc.</td></tr>
<tr><td>Material of parts coming in contact with liquid</td><td>• Flow detecting section:
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Body, connecting rod, crankshaft, top plate, bearing case, pin, manifold</td><td>SUS303</td></tr>
<tr><td>Piston</td><td>SUS303 (Hard chromium plating)</td></tr>
<tr><td>Bearing, crank pin</td><td>SUS440C</td></tr>
<tr><td>Magnet coupling</td><td>MAP-100</td></tr>
<tr><td>E-ring</td><td>SUS304</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
</table>
• Filter section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Case</td><td>ADC12 SPC SWC</td></tr>
<tr><td>O-ring</td><td>FPM</td></tr>
<tr><td>Element</td><td>SPC (Ni plating)
SECC (Ni plating)
Cotton</td></tr>
</table>
• Temperature detecting section
<table>
<tr><th>Part</th><th>Material</th></tr>
<tr><td>Sheath</td><td>SUS316</td></tr>
<tr><td>Joint</td><td>SUS304</td></tr>
<tr><td>Cotter</td><td>C3604 Ni plating</td></tr>
</table>
• Pressure detecting section: SUS316</td></tr>
<tr><td>Measuring range</td><td>• Flow rate: 1 to 1440 ℓ/h
• Temperature: 0 to 99.9 °C.
• Pressure: 0 to 981 kPa</td></tr>
<tr><td>Measuring accuracy</td><td>• Flow rate: ±0.018 ℓ/h or less (in 1-3.6 ℓ/h range)
±0.5% or less of indication (in 3.6-1440 ℓ/h range)
• Temperature: Class B
• Pressure: ±0.5% FS</td></tr>
<tr><td>Pressure loss</td><td>7.4 kPa/500 ℓ/h or less (gasoline)</td></tr>
<tr><td>Minimum resolution</td><td>1 mℓ</td></tr>
<tr><td>Line filter (accessory)</td><td>• Filtering capacity: 5 μm (Type EH-1050)
• Replacement filter element: 5 μm (Type EH-015)</td></tr>
<tr><td>Applicable counter</td><td>DF/FM series digital counter</td></tr>
<tr><td>Output signal (flow rate)</td><td>• Cable: FP-0011 (5 m), FP-0012 (10 m), FP-0014 (20 m)
• Connector: JMR-1305M (detector side)/JMSP-1305F (cable side)
• Pin arrangement: ① SIG 1
② SIG 2
③ COMMON
④ Shield COMMON
⑤ 12 VDC power supply (8 to 15 V)
 
</td></tr>
</table>

Output signal (temperature)	• Cable: FP-0025 (5 m), FP-0026 (10 m), FP-0027 (20 m) • Connector: R03PB3F (cable side) • Pin arrangement: A SIG 1 B SIG 2 C SIG 3 
Output signal (pressure)	• Cable: FP-0035 (5 m), FP-0036 (10 m), FP-0037 (20 m) • Connector: R03PB6F (cable side) • Pin arrangement: A Power supply (+15 V) B SIG H C SIG L D Power supply (0 V) E NC F NC 
Inlet and outlet joints	• Liquid inlet: R1/2 ø12 hose joint • Liquid outlet: R1/2 ø12 hose joint
General specifications	• Maximum working pressure: 980 kPa (withstand pressure of line filter) (Withstand pressure of flow detector: 6.86 MPa) • Working temperature range: 0 to +65 °C. (both ambient temp. and liquid temp.) • Input supply voltage: 12 VDC (8 to 15 V) supplied from DF/FM series digital counter • Mass: Detector: Approx. 11 kg Line filter: Approx. 3 kg • Accessories: Line filter (integrated into detector) Instruction manual (this document)

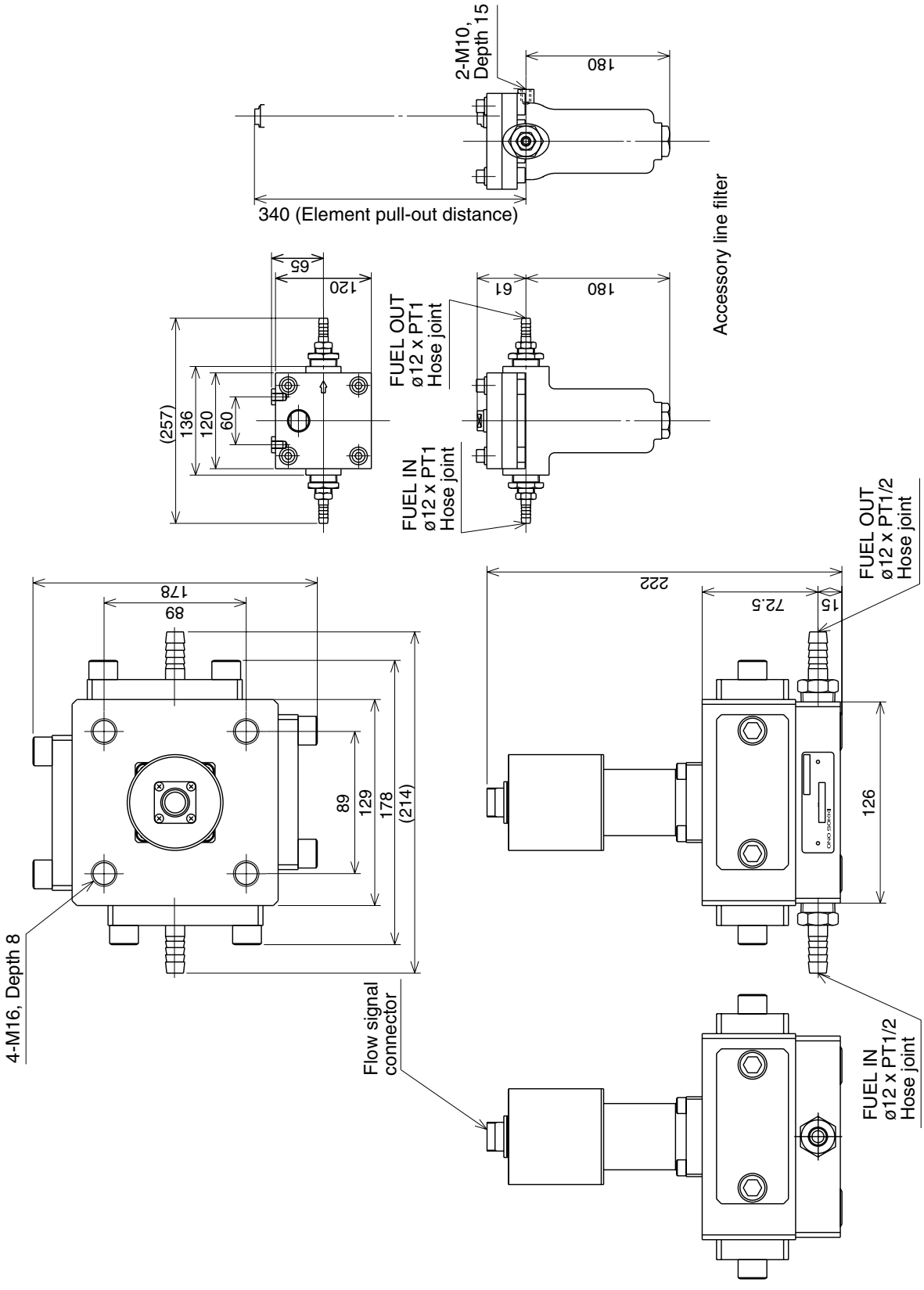
9.3 Dimensional Outline Drawing (FP-213)



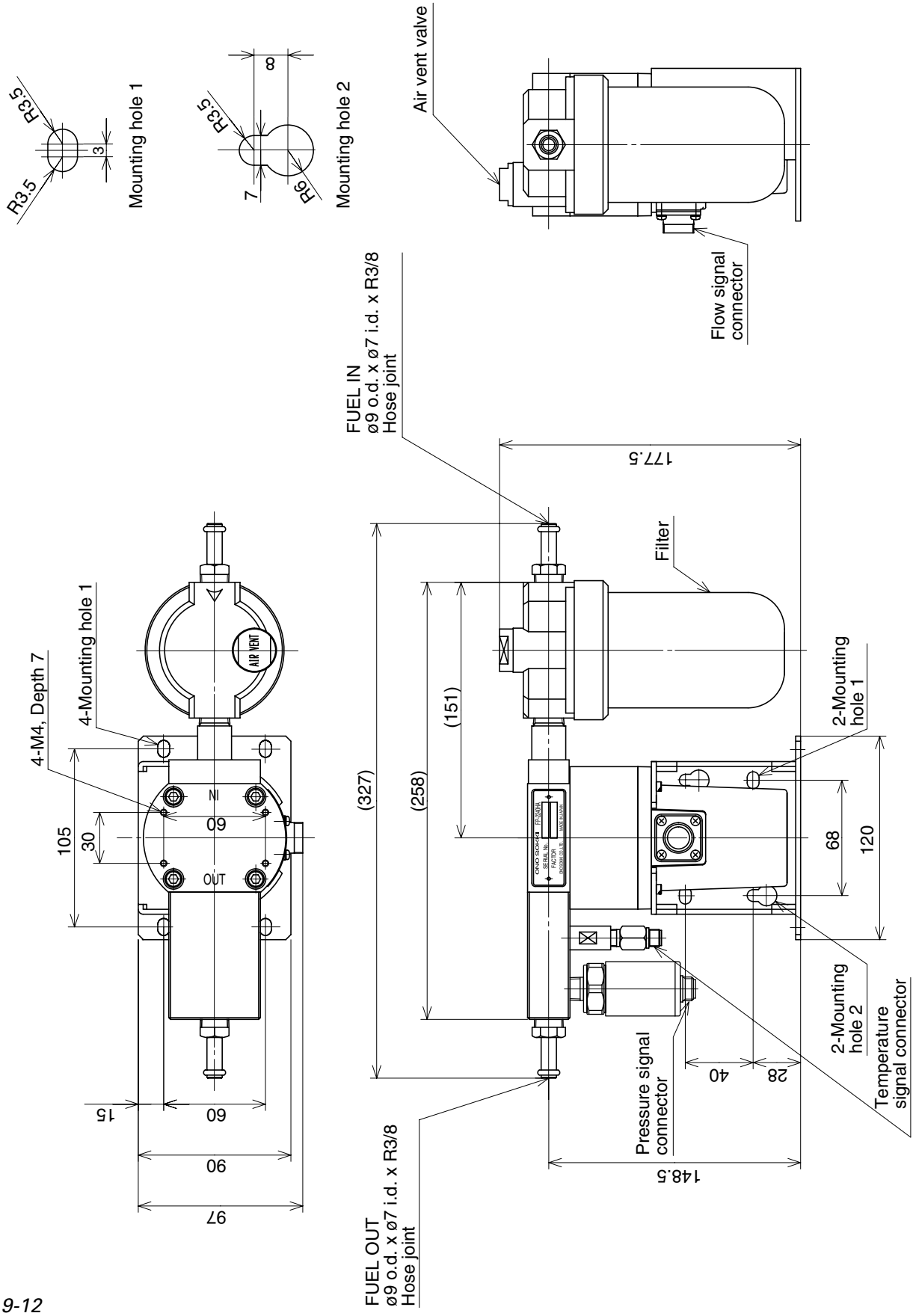
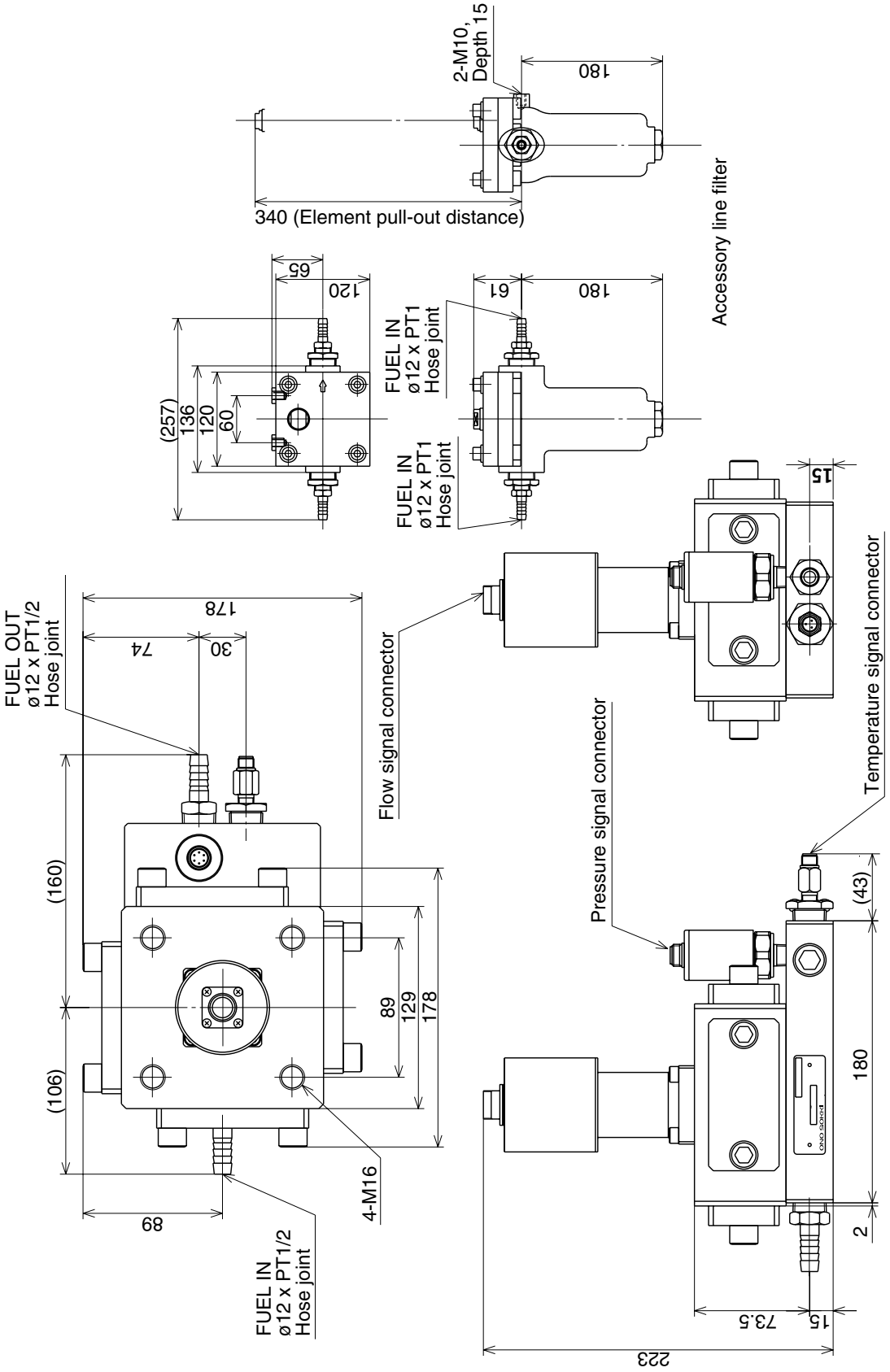
9.3 Dimensional Outline Drawing (FP-2140H)



9.3 Dimensional Outline Drawing (FP-215)



9.3 Dimensional Outline Drawing (FP-2240HA)



9.3 Dimensional Outline Drawing (FP-2250A)