KEYENCE

96M16596

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Clamp-on Flow Meter
FD-R Series
Instruction Manual

Read this manual before using the product in order to achieve maximum performance.
Keep this manual in a safe place after reading it so that it can be referenced at any time.
Related instruction manuals and setting files can be downloaded from the KEYENCE website. If you are using the product in an environment in which you cannot download files over the Internet, contact your nearest KEYENCE office.
<KEYENCE website> http://www.keyence.com

■ Symbols

This instruction manual uses the following symbols to alert readers to important messages. Be sure to read these messages carefully.

DANGER	**Indicates a hazardous situation which, if not avoided, will result in death or serious injury.**
WARNING	**Indicates a hazardous situation which, if not avoided, could result in death or serious injury.**
CAUTION	**Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**
NOTICE	**Indicates a situation which, if not avoided, could result in product damage as well as property damage.**

Important **Indicates cautions and limitations that must be followed during operation.**

Point **Indicates additional information on proper operation.**

Reference Indicates tips for better understanding or useful information.

Indicates items and pages in this manual being referenced.

Table of Contents

1. Before Operation

1-1 Safety Precautions

■ General precautions

DANGER	**1. Do not use the FD-R Series out of the specification ranges. Comply with the contents described in this instruction manual when using the product.** **2. Do not use this product for the purpose to protect a human body or a part of a human body.** **3. Do not use this product in an application that may cause death, serious injury or serious property damage due to a failure with this product should occur, such as nuclear power plants, on aircraft, trains, ships, or vehicles, used within medical equipment, playground equipment, roller coasters and other rides, etc.** **4. Do not use this product in a hazardous location and/or potentially explosive atmosphere.**
WARNING	**1. Do not disassemble, modify, or repair the FD-R Series. Doing so may result in fire, electrical shock, equipment failure, or accidents.** **2. If the product is used in a manner not specified by this manual, the protection provided by the product may be impaired.** **3. Use of items outside the product's accessories, optional products, and the prescribed power supply cable may lead to the specifications not being met, which may cause fire, electrical shock, equipment failure, or accidents.** **4. You must perform a sufficient risk assessment for the machine where this product is to be installed prior to installing this product. Provide appropriate protective fail-safe measures on the machine independent from this product in case a failure with this product should occur.**

Important **This product cannot be used as a regular meter for commercial purposes.**

Reference This product has no sanitary specifications.

■ Precautions for handling

WARNING	**1. When installing this product on a high-temperature pipe, the surface temperature of this product rises. Implement sufficient protective countermeasures against burns.** **2. Do not loosen the power supply cover, cable gland, M12 connector port, cable slot cover, thread conversion coupling, or unit connection cable unless absolutely necessary. Doing so may lead to electric shock and damage if insulation defects exist. Also, note the following points when connecting or disconnecting items.** **• Keep this product out of the wind and rain.** **• Connect or disconnect items in the following environment:** **Ambient operating temperature: 5 to 40°C** **Relative humidity: 80% for temperatures up to 31°C decreasing linearly to 50% at 40°C** **• Do not connect or disconnect items in a location where a corrosive atmosphere is present.** **3. Do not drop the FD-R Series, hit it against something, or apply excessive force. Doing so may lead to electric shock and damage.**
NOTICE	**1. Do not use a sharply pointed object to press the setting buttons.**

■ Precautions for detectable fluid

Reference
1. High-viscosity, high-turbidity, or sparkling fluid may cause unstable detection. Keep this in mind before using this product.
2. When the fluid temperature rises or pressure is reduced, air bubbles may form in the fluid within the pipe, resulting in unstable detection.

■ Precautions for installation

WARNING	**1. Do not install the FD-R Series in a location where it may become submerged in a liquid. Doing so may lead to electric shock and damage due to potential insulation defects.** **2. When attaching or removing the metal belt, the tip may move vigorously. Keep your face and other body parts away from the tip.**
NOTICE	**1. Do not install the FD-R Series in locations used as footholds.** **2. Do not install the FD-R Series in a location exposed to radiant heat from a heat source.** **3. When installing the FD-R Series in a location where vibrations occur, fix the pipe with tubes or supports as close to the main unit as possible. Excessive vibration may lead to damage or unstable operation.** **4. Avoid using the product in locations with highly corrosive atmospheres.**

Reference
1. Install the FD-R Series in a location where the inside of the measuring pipe is always filled with fluid.
2. To avoid the effects of air bubbles and to avoid situations where the pipe is not filled with fluid, it is recommended to secure the FD-R Series in a position where the display surface is perpendicular to the ground.
3. When installing the FD-R Series on a vertical pipe, choose a position where the fluid flows in the upward direction.
4. To improve the detection stability, it is recommended that the flow meter be installed in a location with straight sections of pipe both upstream and downstream of it. For details, see “2-1 Selecting the Installation Location.”
5. Install the FD-R Series on a surface with no seams or rust.
6. To avoid interference between detection signals, do not install multiple units closely in series.

■ Precautions for wiring

WARNING	**1. Before performing wiring, check that the main power supply is off. Failure to do so may lead to electric shock.** **2. Do not perform work such as piping and wiring with wet hands. Doing so may lead to electric shock.** **3. Comply with the following points when using this product with an AC power supply. Failure to do so may lead to electric shock or damage.** **• Use a switch or a circuit breaker to cut off the main power supply to the product. Install this switch or circuit breaker in an appropriate manner such that it is located within a range where it can be reached easily.** **• Clearly mark the switch or circuit breaker (or a location close to this device) as the FD-R disconnecting device.** **• Be sure to ground the FD-R Series. At this time, ground the FD-R Series independently from the power grounding.** **4. When supplying AC power to this product, use a cable that complies with the compatible cable outer diameter of the cable gland. Failure to do so may lead to electric shock and damage due to insulation defects.** **5. Ensure that the cable tip is not submerged in water during wiring work.** **6. Use the included cable slot cover to seal the cable slots that are not in use.** **7. When performing conduit wiring, pass the conduit through the cable slot, use the waterproof ground to prevent water from flowing into the case, and then tilt the conduit piping. Failure to do so may lead to electric shock and damage due to insulation defects. Also, install a drainage valve on the rising part of the conduit pipe and periodically drain the fluid.** **8. When the modular cable is connected, the enclosure rating is not satisfied. Fluid intruding into the product may lead to electric shock and damage. Therefore, do not continue to use the product with the modular cable connected. Also, when attaching or removing the power supply cover, follow item 2 under “Precautions for handling.”** **9. Do not connect or disconnect the modular cable while supplying AC power to this product. Doing so may lead to electric shock.** **10. The withstand voltage of OP-26487 (the modular cable) is 150 VAC.** **When supplying AC power, use the product with the cable fixed in place so that OP-26487 does not come in contact with the AC terminal or the AC power supply cable wire.**
NOTICE	**1. Check the wiring examples and perform wiring correctly.** **2. Apply voltage within the rated range for the appropriate connectors and terminals when using this product. Also, do not use a load that exceeds the permitted range.** **3. When using this product with a DC power supply, use an insulated stabilizing power supply.** **4. If the temperature of the pipe exceeds 105°C, implement countermeasures by arranging the unit connection cable so it does not come in contact with the pipe or by using corrugated tubing.** **5. Do not apply excessive tensile force to the cable.** **6. Isolate this product's control I/O lines from power supply lines or power lines when wiring.** **7. Isolate the cable as far away as possible from any source of noise.** **8. When using this product with a DC power supply, do not use a cable with a total length longer than 20 m. When using this product with an AC power supply, do not use a cable with a total length longer than 100 m.** **9. Use a flexible conduit when performing conduit wiring.** **10. When performing conduit wiring with AC power supplied to this product, be sure to wire the I/O cables and the power supply cable in separate conduits.** **11. If this product is at risk of being struck by lightning or similar hazards are present, implement countermeasures such as installing a separate isolator and a lightning arrester.**

■ Other precautions

Reference
1. When power is applied to this product, it enters an approximately 15 second “startup” process before it is ready to use. Do not use the outputs from the product during this period.
2. Initial drift may occur after the power is turned on. To meet the accuracy in the specifications, let the FD-R Series warm up for approximately 15 to 30 minutes before use.
3. If the stability level is low, the measurement accuracy may decrease.
4. Do not bring a strong magnet or magnetic field close to the main body of the FD-R Series.
5. This product has a built-in lithium secondary battery. Comply with the applicable laws and ordinances of the country and area in which this product is used when transporting this product in the air, when disposing of this product, and in similar situations.

1-2 Precautions on Regulations and Standards

■ CE and UKCA Marking

Keyence Corporation has confirmed that this product complies with the essential requirements of the applicable EU Directive(s) and UK regulations, based on the following specifications. Be sure to consider the following specifications when using this product in the Member States of European Union and in the United Kingdom.

● EMC Directive (CE) and Electromagnetic Compatibility Regulations (UKCA)

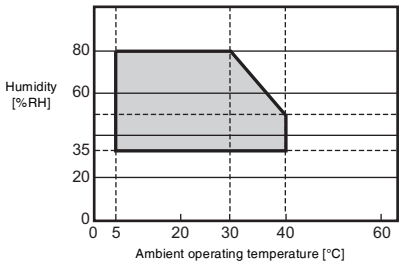
- Applicable Standard (BS)EN61326-1, Class A
  (BS)EN61326-2-3, Class A

Remarks: These specifications do not give any guarantee that the end product with this product incorporated complies with the essential requirements of EMC Directive and Electromagnetic Compatibility Regulations. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive and Electromagnetic Compatibility Regulations.

● Low-Voltage Directive (CE) and Electrical Equipment (Safety) Regulations (UKCA)

- Applicable Standard (BS)EN61010-1
- Overvoltage category I (when supplied from DC power supply)
  II (when supplied from AC power supply)
- Pollution degree 4

Remove the power supply cover, cable gland, M12 connector port, cable slot cover, thread conversion coupling, and unit connection cable in the following environment.
Ambient temperature: 5-40°C
Maximum relative humidity: 80% for temperatures up to 31°C decreasing linearly to 50% at 40°C



- Indoor-Outdoor use
- This product is designed as a Class I equipment. Be sure to connect the protective earthing terminal to the protective earthing conductor in the building installation when this product is supplied from AC power supply.
- Use this product at an altitude of 2000 m or less.
- Install a switch or circuit-breaker to disconnect from supply source where an operator can easily reach it. It shall be marked as the disconnecting device for this product when this product is supplied from AC power supply.

■ CSA Certificate

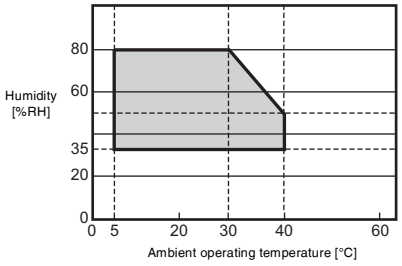
This product complies with the following CSA and UL standards and has been certificated by CSA.

- Applicable Standard CSA C22.2 No. 61010-1
  UL61010-1
  CSA C22.2 No. 94.2, Enclosure Type 4X
  UL50E, Enclosure Type 4X

Be sure to consider the following specifications when using this product as a product certificated by CSA.

- Overvoltage category I (when supplied from DC power supply)
  II (when supplied from AC power supply)
- Pollution degree 4

Remove the power supply cover, cable gland, M12 connector port, cable slot cover, thread conversion coupling, and unit connection cable in the following environment.
Ambient temperature: 5-40°C
Maximum relative humidity: 80% for temperatures up to 31°C decreasing linearly to 50% at 40°C



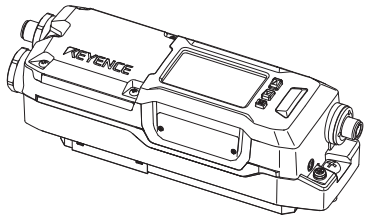
- Indoor-Outdoor use
- This product is designed as a Class I equipment. Be sure to connect the protective earthing terminal to the protective earthing conductor in the building installation when this product is supplied from AC power supply.
- Use this product at the altitude of 2000 m or less.
- Install a switch or circuit-breaker to disconnect from supply source where an operator can easily reach it. It shall be marked as the disconnecting device for this product when this product is supplied from AC power supply.
- Use one of the following types of power supplies when this product is supplied from DC power supply.
  A CSA/UL certificated power supply that provides Class 2 output as defined in the CEC (Canadian Electrical Code) and NEC (National Electrical Code) or a CSA/UL certificated power supply that has been evaluated as a Limited Power Source as defined in CAN/CSA-C22.2 No. 60950-1 / UL60950-1.

■ Best Management Practice for Perchlorate Materials—California only

This product uses components containing perchlorate material. When shipping this product or an end-product containing this device to California, it is necessary to label or mark the following statement on the exterior of all outer shipping packages and on consumer packages or include the following statement in an instruction manual or MSDS accompanied with the product.
“Perchlorate Material—special handling may apply. See www.dtsc.ca.gov/hazardouswaste/perchlorate.”

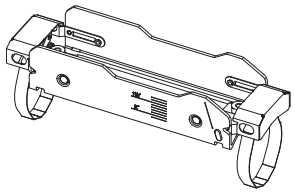
1-3 Accompanying Items

- **Main unit**

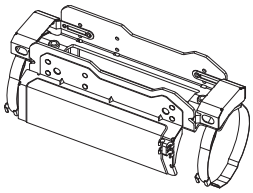


- **Upper bracket**

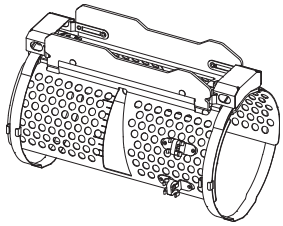
FD-R50



FD-R80

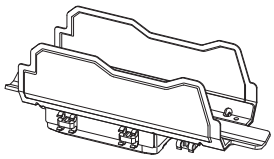


FD-R125/FD-R200

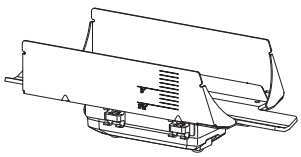


- **Lower bracket (with sub unit)**

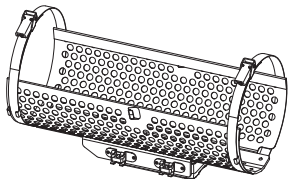
FD-R50



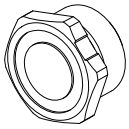
FD-R80



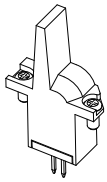
FD-R125/FD-R200



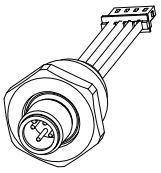
- **Cable slot cover (attached to the main unit)**



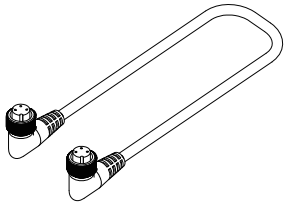
- **Clock battery module (attached to the main unit)**



- **M12 connector port (attached to the main unit)**



- **Unit connection cable**



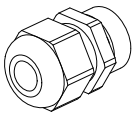
- **Instruction manual**
- **Installation guide**

1-4 Optional Products

- **M12 power supply cable (only applicable when supplying DC power to the unit)**

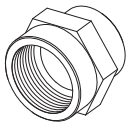
Specifications		Appearance	Length	Model
Indoor use	Standard (PVC)		2 m	OP-75721
			10 m	OP-85502
	Oil resistant (PUR)		2 m	OP-87636
			10 m	OP-87637
Outdoor use			10 m	OP-88196

- **Cable gland (only applicable when supplying AC power to the unit)**
  OP-88199 (2 included)

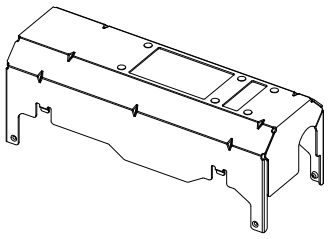


Compatible cable outer diameter: 7 to 12 mm

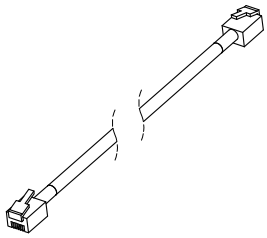
- **Thread conversion coupling (only applicable when supplying AC power to the unit)**

Specifications	Appearance	Model
G1/2 → M20		OP-88200
G1/2 → NPT1/2		OP-88201

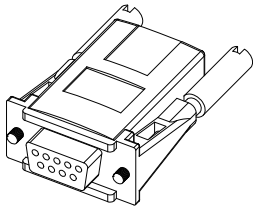
- **Protection cover**
  FD-RP1



- **Modular cable**
  OP-26487
  Cable length: 2.5 m



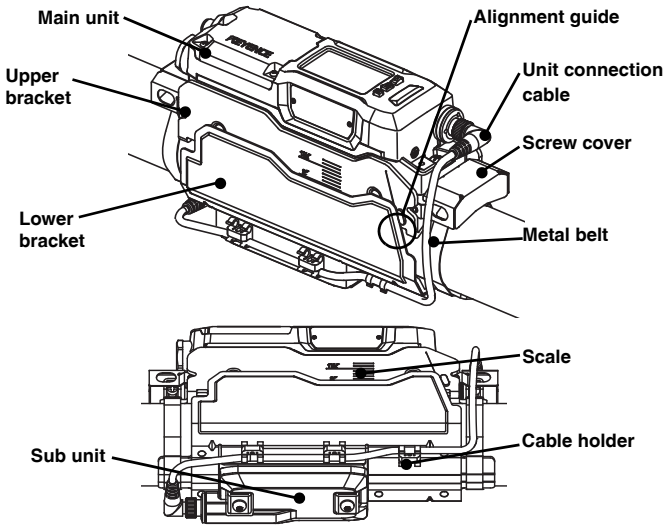
- **RS-232C conversion adapter (9-pin)**
  OP-26401



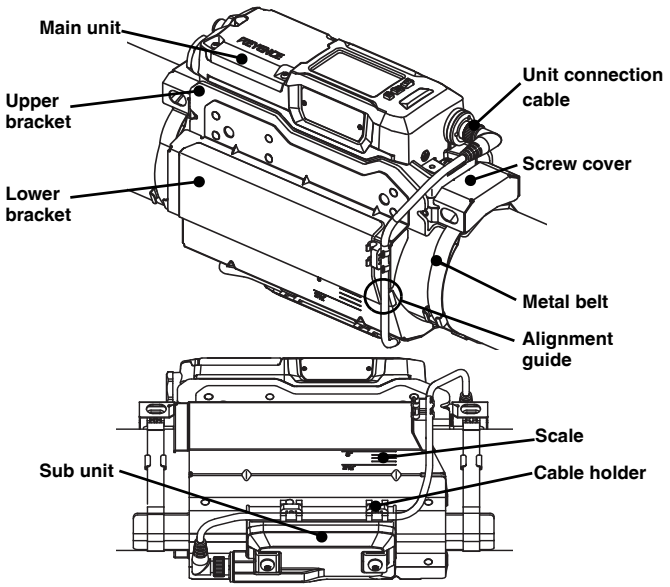
1-5 Part Names and Functions

■ Overall setup

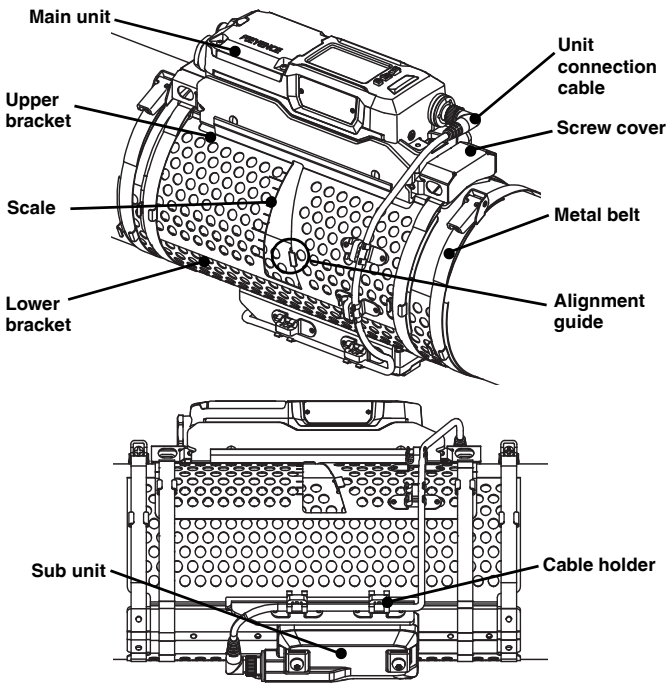
● **FD-R50**



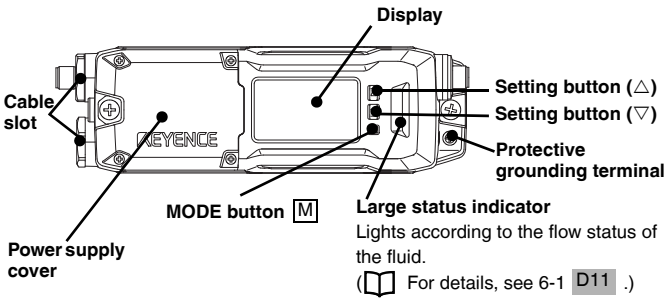
● **FD-R80**



● **FD-R125/FD-R200**



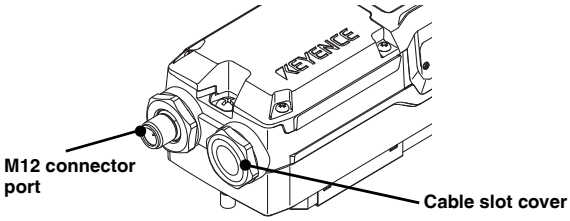
■ Main unit



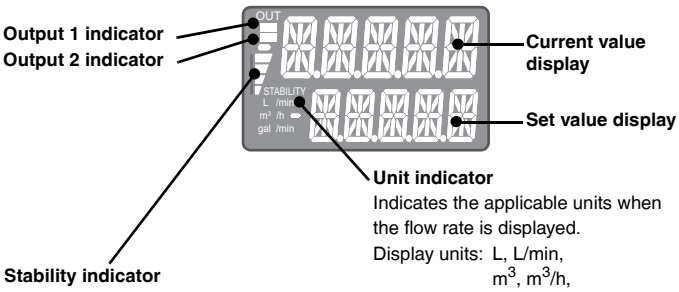
Large status indicator
Lights according to the flow status of the fluid.
(For details, see 6-1 D11 .)

■ Cable slots

When this product is shipped, the M12 connector port and the cable slot cover are attached.
When supplying AC power to this product, see "2-2 Wire Preparations When Supplying AC Power to The Unit".



■ Display



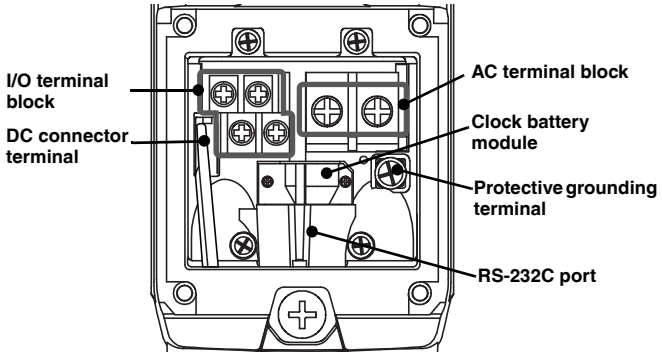
Unit indicator
Indicates the applicable units when the flow rate is displayed.
Display units: L, L/min, m^3, m^3/h, gal, gal/min

Stability indicator
Indicates the approximate stability of the ultrasonic detection.

- 4 indicators lit ⇨ Stable detection is possible.
- 3 indicators lit ⇨ Detection is possible.
- 1 indicator or 2 indicators lit ⇨ Detection is possible, but may be unstable. When changing the actual flow rate, check that the display tracks the change.
- 1 indicator blinking ⇨ Detection is not possible or it is not possible to perform measurements correctly.
- The indicators blink in order (see the following figure) ⇨ Searching for detection condition.

If the detection stability is low, revise the product's installation.
For details, see "11-1 Troubleshooting".

■ Inside the power supply cover

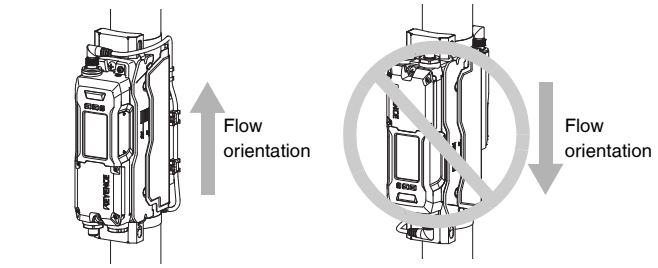


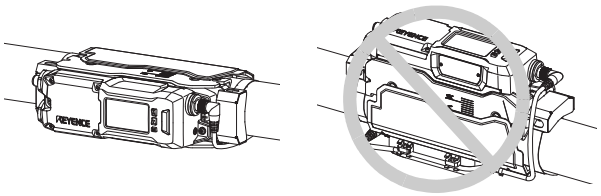
2. Installation and Wiring

2-1 Selecting the Installation Location

● Installation orientation

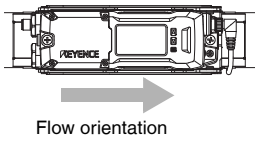
- To avoid the effects of air bubbles and to avoid situations where the pipe is not filled with fluid, it is recommended to secure the FD-R Series in a position where the display surface is perpendicular to the ground.
- When installing the FD-R Series on a vertical pipe, choose a position where the fluid flows in an upward direction.





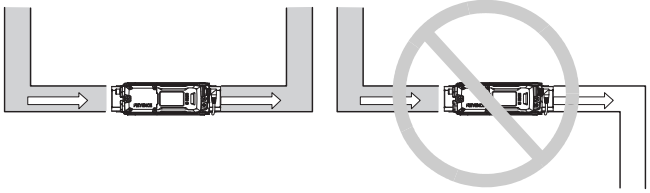
● Flow direction

Use “E. Selecting the flow direction” under “3-1 Initial Settings” or “5-2 Additional Functions Menu” to switch the flow direction of the fluid.
This is set to the direction shown in the figure on the right when the product is shipped.



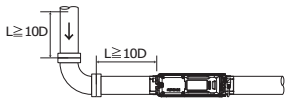
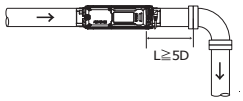
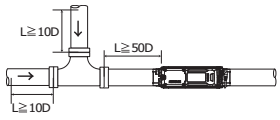
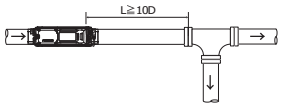
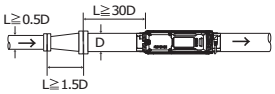
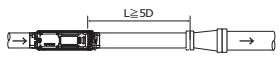
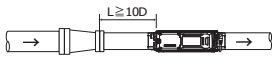
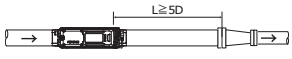
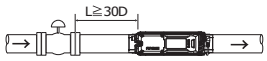
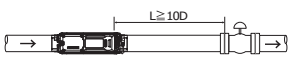
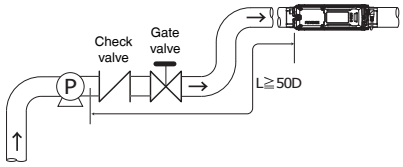
● Main unit installation position

- Install the FD-R Series in a location where the inside of the pipe is always filled with fluid.



- Arrange the piping so that gas does not enter it. When the fluid contains bubbles, the detection performance of the FD-R may be affected.
- Install flow regulating valves and similar pieces of fluid control equipment on the downstream side of the flow meter.
- Install the FD-R Series main/sub units on surfaces with no seams or rust.
- To avoid interference between detection signals, do not install multiple units in close proximity.
- Avoid locations with large pulsation, such as the discharge section of a pump, when installing the FD-R Series.
- When the FD-R Series is installed immediately after a location where fluids with different water quality are mixed, the operation of the FD-R Series may become unstable.

- To improve the measurement accuracy, it is recommended that straight sections of pipe, with lengths based on the table below, exist both upstream and downstream of the unit. (D: Pipe outer diameter)

Characteristic	Straight piping length on upstream side	Straight piping length on downstream side
90° bend		
T-joint		
Expanding pipe		
Shrinking pipe		
Various valves		
Pump		

Source: Japan Electric Measuring Instruments Manufacturers’ Association Standard JEMIS032-1987

* The information given above is a guideline and does not guarantee the accuracy. When the velocity distribution is not uniform, a straight piping length that is greater than or equal to that indicated above is recommended.

2-2 Wire Preparations When Supplying AC Power to The Unit

Point **This work is unnecessary when supplying DC power to the FD-R Series.**

When supplying AC power to the FD-R Series, it is possible to maintain a high level of wiring work efficiency by connecting the cables to the FD-R sensor main unit before installing the FD-R Series on the piping.

■ Preparing the cables

● Cables to use

Use cables with the characteristics shown below with this device.

Cable type	Finished outer diameter [mm]	Nominal cross-sectional area [mm^2]	Number of cable cores
Power supply cable	ø7 to ø12	1.75 mm^2 or more*1	3*1
I/O cable		0.3 mm^2 or more	4*2

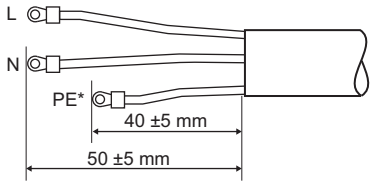
*1 When performing grounding with the protective grounding terminal on the main unit case, prepare a cable with a nominal cross-sectional area of 0.5 mm^2 or more and with 2 or more cable cores.
*2 The number of cable cores is 3 when the ch.2 function is not being used.

NOTICE **Depending on the ambient operating temperature and the fluid temperature, it may be necessary to use cables with heat resistance of 90°C or higher for the power supply cable and the I/O cables.** **For details, see "12-1 Specifications."**

● Processing the cable ends

Power supply cable

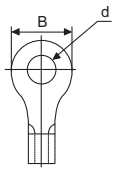
Use M4-type, crimping terminals (round shapes) to process the ends of the power supply cable.



* PE is only required when using the terminal block of the main unit to perform grounding.

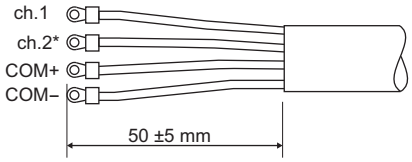
• Round terminal compatible dimensions

B (Outside): 8.5 mm or less
d (Inside): 4.3 mm or more



I/O cable

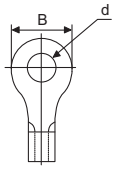
Use M3-type, crimping terminals (round shapes) to process the ends of the I/O cable.



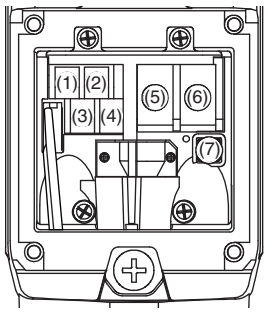
* The ch.2 core wire is not required when ch.2 is not being used.
* The COM+ core wire is not required when only using analog.

• Round terminal compatible dimensions

B (Outside): 5.5 mm or less
d (Inside): 3.2 mm or more



■ Terminal block numbers and functions

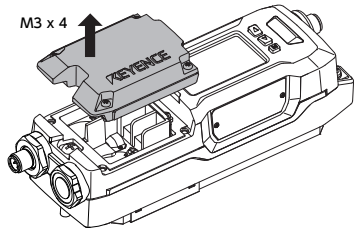


Terminal block number	Terminal signal	Functions
(1)	ch.1	ch.1
(2)	ch.2*1	ch.2
(3)	COM+*2	Common (+)
(4)	COM-	Common (-)
(5)	L	Power supply
(6)	N	
(7)	PE*3	Protective grounding terminal

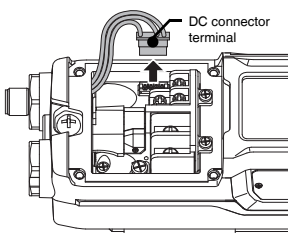
*1 The ch.2 core wire is not required when ch.2 is not being used.
*2 The COM+ core wire is not required when only using analog.
*3 PE is only required when using the terminal block of the main unit to perform grounding.
*4 The I/O terminal block (terminals [1] to [4]) and the AC terminal block (terminals [5] and [6]) are insulated.

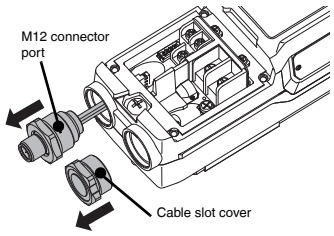
■ Connecting the cables

1 Remove the power supply cover on the main unit.



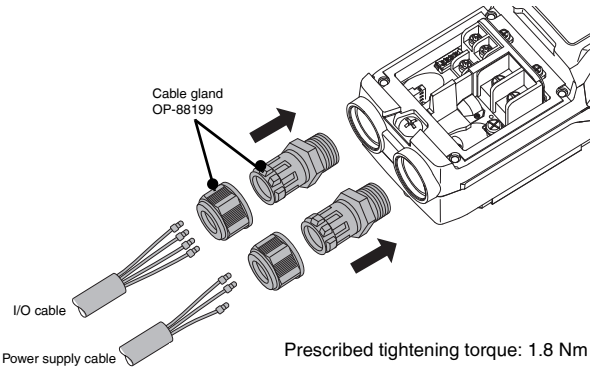
2 After removing the DC connector terminal, remove the M12 connector port and the cable slot cover.





3 Attach the cables and the cable glands (OP-88199) to the main unit.

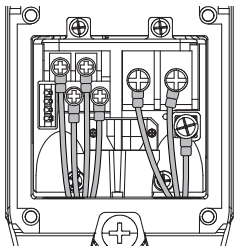
Pass the power supply cable and the I/O cable through the cable glands, and then insert these cables into the main unit.



Prescribed tightening torque: 1.8 Nm

Reference
- If you are using a conduit, see "2-3 Attaching a Conduit (Only When Supplying AC Power to The Unit)" (page 8).
- To convert to a G screw or NPT screw, see "2-4 Thread Conversion of Cable Slot (Only When Supplying AC Power to The Unit)" (page 8).

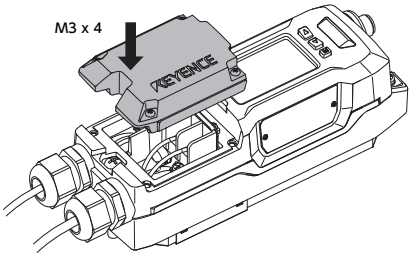
4 Wire the power supply cable and the I/O cable to the terminal block.



Recommended tightening torque:
Power supply cable: 0.8 Nm
I/O cable: 0.4 Nm

* PE is only required when using the terminal block of the main unit to perform grounding.
* The ch.2 core wire is not required when ch.2 is not being used.
* The COM+ core wire is not required when only using analog.

5 Tighten the cable glands, and then attach the power supply cover to the main unit.

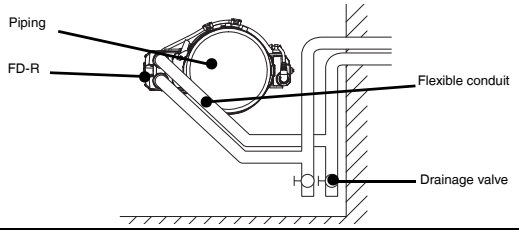


Prescribed tightening torque: Cable glands: 1.8 Nm
Power supply cover: 0.5 Nm

2-3 Attaching a Conduit (Only When Supplying AC Power to The Unit)

If performing conduit wiring when supplying AC power to the unit, connect a waterproof gland to the cable slot, and then connect the conduit.

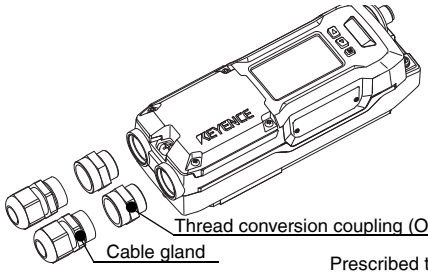
WARNING	• **Pass the conduit through the cable slot, use a waterproof gland to prevent water from flowing in, and then tilt the conduit piping.** • **Install a drainage valve on the rising part of the conduit pipe and periodically drain the fluid.**
NOTICE	• **Use a flexible conduit when performing conduit wiring.** • **When performing conduit wiring, be sure to wire the I/O cable and the power supply cable in separate conduits.**



2-4 Thread Conversion of Cable Slot (Only When Supplying AC Power to The Unit)

The screw type of the cable slot can be converted by using thread conversion coupling OP-88200 (G1/2 → M20) or OP-88201 (G1/2 → NPT1/2).

WARNING	**If the compatible cable outer diameter or the effective thread depth is not appropriate, the specifications of the enclosure rating cannot be met. Therefore, fluid may enter into the product, leading to electric shock and damage.**



Prescribed tightening torque: 2.0 Nm

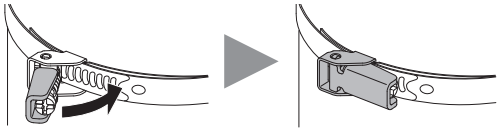
2-5 Unit Installation

The unit installation method varies depending on the model.

NOTICE	**Do not move the special rubber while it is in contact with the pipe. Doing so may deform or tear the special rubber.**

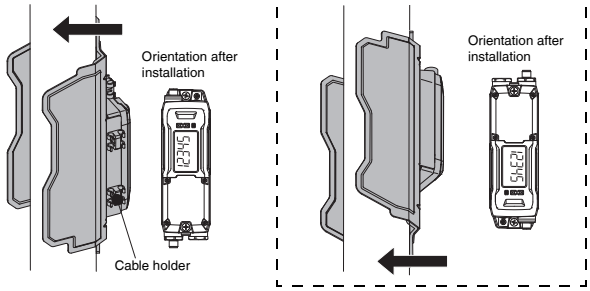
Point

• Attaching the metal belt screw
Insert the metal belt as far as it will go into the screw part, and then fold down the screw.
Then, tighten the screw while holding down the screw part with your finger.
The metal belt tip can be easily inserted and removed by lightly loosening the screw and then raising it up.

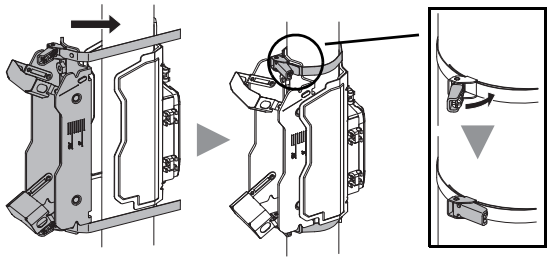


■ Attaching FD-R50/FD-R80 brackets

1 Determine the installation orientation of the lower bracket.
The orientation of the main unit's display is determined by the installation orientation of the lower bracket.



2 Attach the lower bracket and the upper bracket so that they are pressed against the pipe, and then use the metal belts to lightly fix these brackets in place.

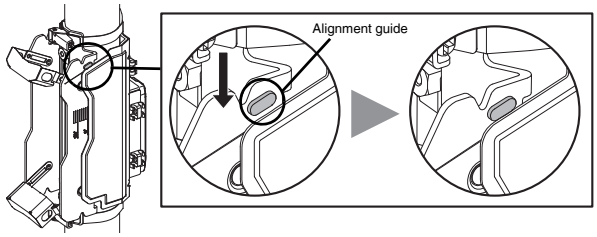


Point

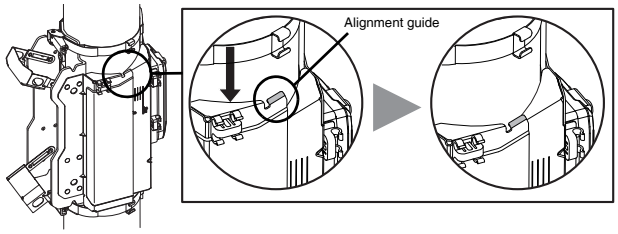
Pay attention to the orientation of the upper bracket when attaching it to the setup.

3 Adjust the position of the upper bracket to align the alignment guide with the lower bracket.

- **FD-R50**

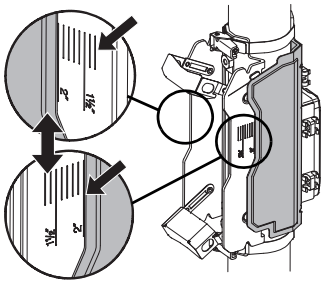


- **FD-R80**

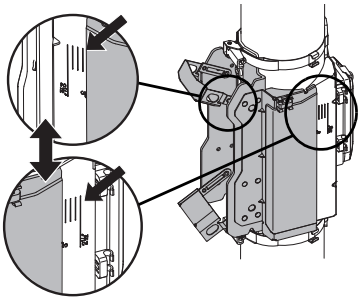


4 Adjust the position of the upper bracket so that the scale position is the same on the left and right.

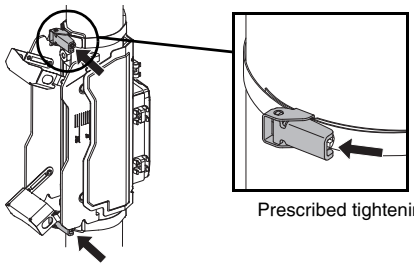
- **FD-R50**



- **FD-R80**



5 Firmly tighten the metal belt screws.

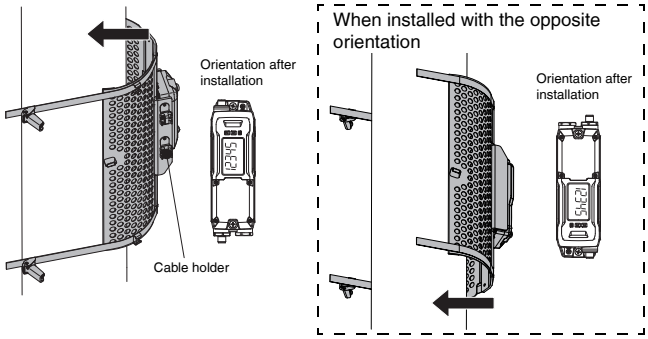


Prescribed tightening torque: 2.0 Nm

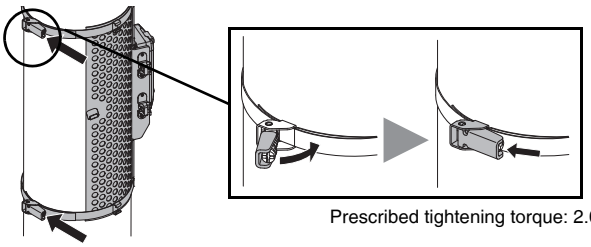
■ Attaching FD-R125/FD-R200 brackets

1 Determine the installation orientation of the lower bracket.

The orientation of the main unit's display is determined by the installation orientation of the lower bracket.

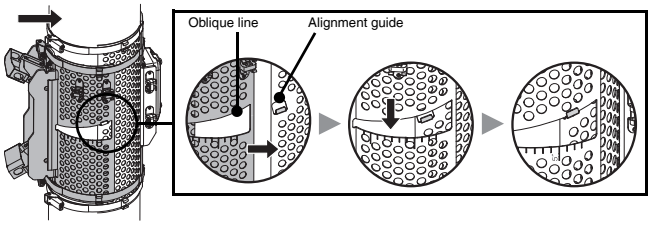


2 Use the metal belt to attach the lower bracket to the pipe.



Prescribed tightening torque: 2.0 Nm

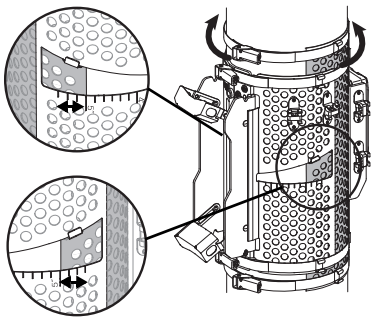
3 Attach the upper bracket so that the left and right alignment guides are aligned with the upper bracket.



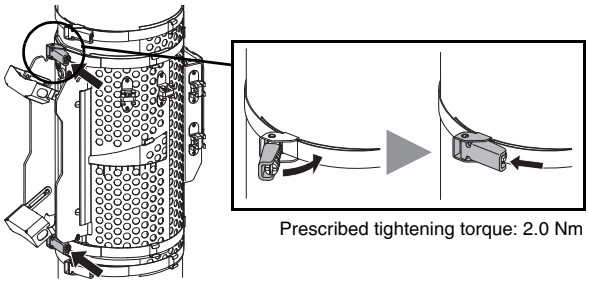
Point

- **Pay attention to the orientation of the upper bracket when attaching it to the setup.**
- **Press the side of the upper bracket to insert the upper bracket into the alignment guide.**

4 Adjust the position of the upper bracket so that the scale position is the same on the left and right.



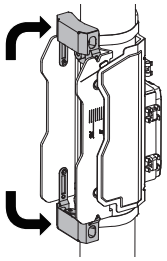
5 Firmly tighten the metal belt screws.



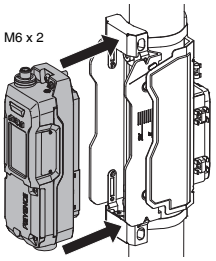
Prescribed tightening torque: 2.0 Nm

■ Attaching the main unit

1 Close the screw covers.



2 Fix the main unit in place on the upper bracket.

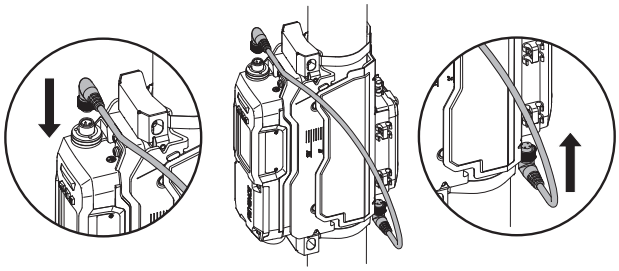


Prescribed tightening torque: 2.0 Nm

Point

Tighten the left and right screws evenly, a little bit at a time.

3 Connect the unit connection cable to the main unit and sub unit.

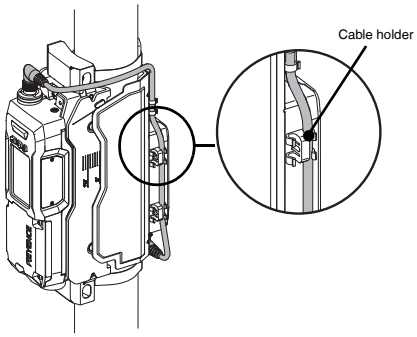


Recommended tightening torque: 0.8 Nm

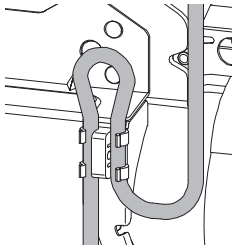
NOTICE

Pay attention to the orientation of connector when connecting it. Failing to do so may lead to damage such as bent pins.

4 Fix the unit connection cable to the cable holders.



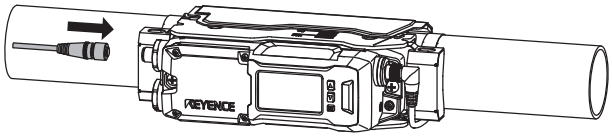
Reference Freely install the cable in the cable holders.



2-6 Wiring

■ Wiring method when supplying DC power to the unit

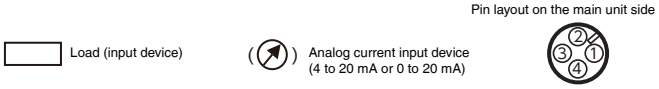
1 Attach an M12 power supply cable to the main unit.



Recommended tightening torque: 0.8 Nm

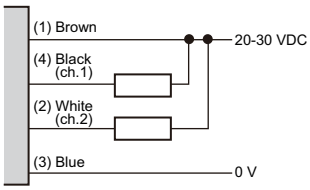
2 Wire the power supply and I/O wires

The wiring varies depending on the selected functions. (See 📖 "3. Initial Settings" (page 11).)
Independently insulate any unused I/O wires.

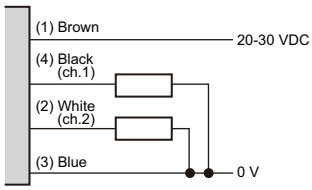


● **When ch.1: OUT, ch.2: OFF or ch.1: OUT, ch.2: OUT are selected**

• NPN



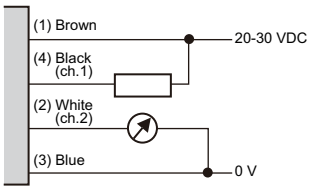
• PNP



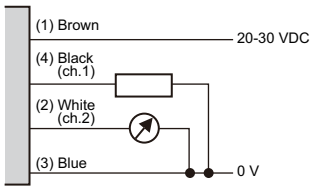
* When you select ch.1: OUT, ch.2: OFF, independently insulate the white line (2).

● **When ch.1: OUT, ch.2: ANLG are selected**

• NPN

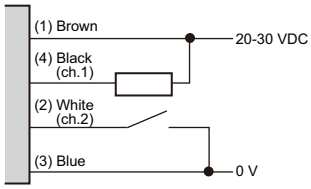


• PNP

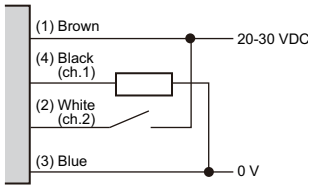


● **When ch.1: OUT, ch.2: INPUT are selected**

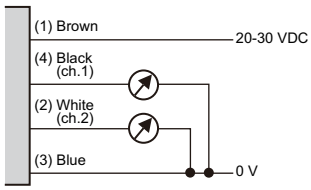
• NPN



• PNP



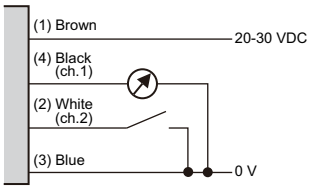
● **When ch.1: ANLG, ch.2: OFF or ch.1: ANLG, ch.2: ANLG are selected**



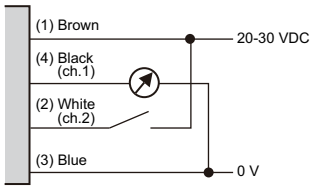
* When you select ch.1: ANLG, ch.2: OFF, independently insulate the white line (2).

● **When ch.1: ANLG, ch.2: INPUT are selected**

• NPN



• PNP



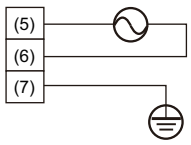
■ Wiring method when supplying AC power to this product

Before performing wiring, perform the procedure under 📖 "2-2 Wire Preparations When Supplying AC Power to The Unit" (page 7)

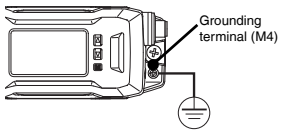
WARNING

To prevent electric shocks and damage to the flow meter, it is necessary to ground the unit when supplying AC power.
Use the protective grounding terminal on the main unit's terminal block or outer case to ground this product as shown in the following figures. Make the grounding wire as short as possible. For the grounding wire, use an IV wire that is 1.75 mm^2 or more. Also, avoid sharing the grounding wire with other devices through which a grounding current flows. (Ground this product independently.)

• Grounding with the main unit's terminal block



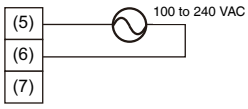
• Grounding with the protective grounding terminal on the main unit case



Recommended tightening torque: 0.8 Nm

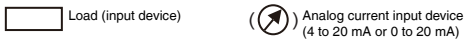
1 Wire the power supply cable.

Wire the power supply cable.



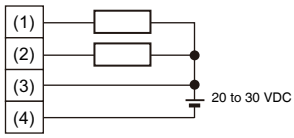
2 Wire the I/O cable.

The wiring varies depending on the selected functions. (See 📖 "3. Initial Settings" (page 11).)
Independently insulate any unused I/O wires.

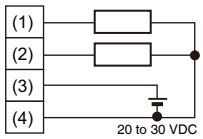


● **When ch.1: OUT, ch.2: OFF or ch.1: OUT, ch.2: OUT are selected**

• NPN



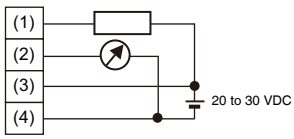
• PNP



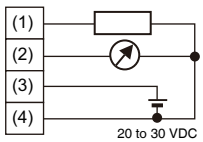
* When you select ch.1: OUT, ch.2: OFF, do not wire (2).

● **When ch.1: OUT, ch.2: ANLG are selected**

• NPN

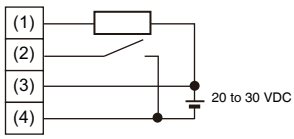


• PNP

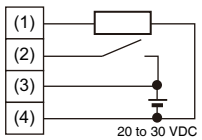


● **When ch.1: OUT, ch.2: INPUT are selected**

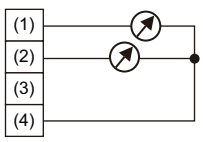
• NPN



• PNP



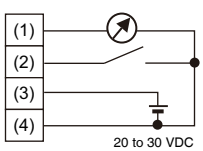
● **When ch.1: ANLG, ch.2: OFF or ch.1: ANLG, ch.2: ANLG are selected**



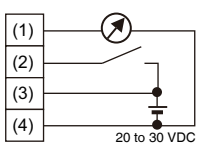
* When you select ch.1: ANLG, ch.2: OFF, do not wire (2).

● **When ch.1: ANLG, ch.2: INPUT are selected**

• NPN



• PNP

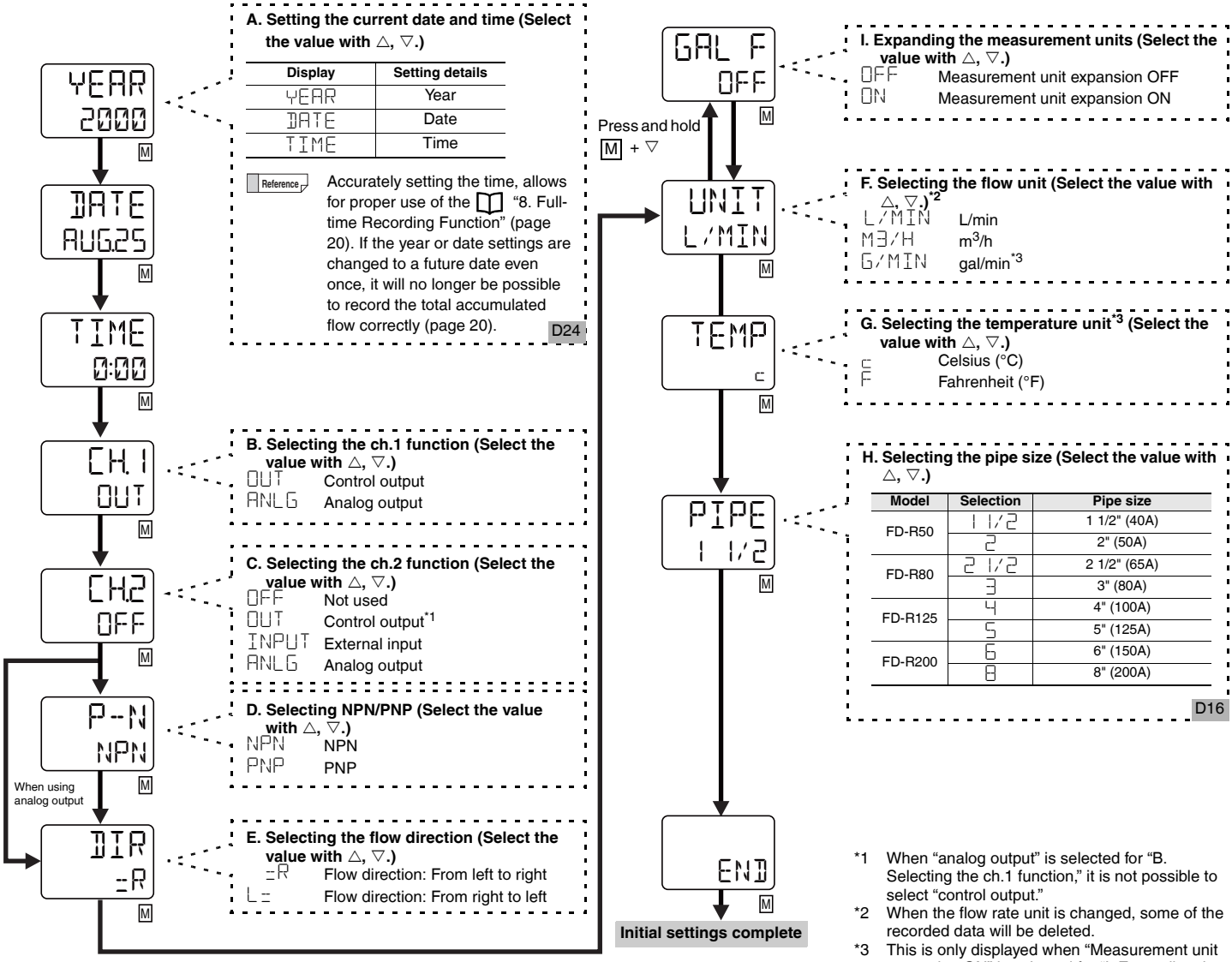


3. Initial Settings

3-1 Initial Settings

Use this section to configure important settings related to the detection performance and the output method.
The following screens are displayed when the power is supplied to the unit for the first time or after the procedure in "7-5 Initialization" (page 19) is executed.

Reference
- Press M + △ when an item is being set to return to the previous screen.
- Press M + △ + ▽ when an item other than those under "A. Setting the current date and time" is being set to enter a quick setting code. (See "7-4 Quick Setting Code" (page 19).)



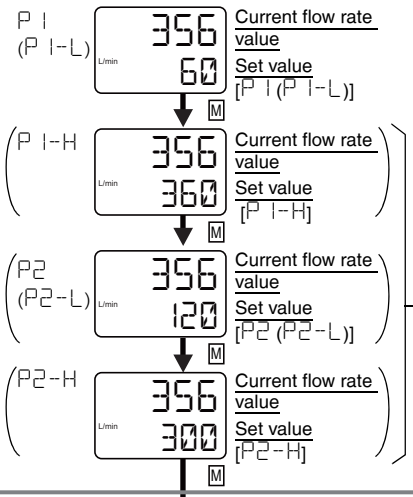
*1 When "analog output" is selected for "B. Selecting the ch.1 function," it is not possible to select "control output."
*2 When the flow rate unit is changed, some of the recorded data will be deleted.
*3 This is only displayed when "Measurement unit expansion ON" is selected for "I. Expanding the measurement units".

4. Display Settings

4-1 Switching the Display and Configuring Settings

It is possible to check the current flow rate value and temperature and change the set values. To view the recorded data, see "8. Full-time Recording Function" (page 20).

● Instantaneous flow rate display (Change the set value with △, ▽.)



The current instantaneous flow rate value is displayed.

Model	Setting range		
	L/min	m^3/h	gal/min
FD-R50	0 to 999.9	0 to 99.99	0 to 999.9
FD-R80	0 to 9999	0 to 999.99	0 to 999.9
FD-R125	0 to 9999	0 to 999.9	0 to 9999.9
FD-R200	0 to 99999	0 to 999.9	0 to 9999

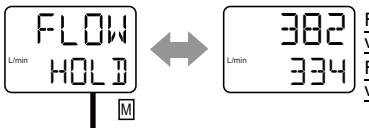
Set value display conditions

Set value	Meaning	Display condition
P1	Output 1 set value	When ch.1 is set to OUT (control output) and instantaneous flow rate mode is selected
P1-L	Output 1 lower limit value	When ch.1 is set to OUT (control output) and area mode is selected
P1-H	Output 1 upper limit value	
P2	Output 2 set value	When ch.2 is set to OUT (control output) and instantaneous flow rate mode is selected
P2-L	Output 2 lower limit value	When ch.2 is set to OUT (control output) and area mode is selected
P2-H	Output 2 upper limit value	

* If none of the above conditions are satisfied, "- - - -" is displayed for the instantaneous flow rate set value.

Reference For information on instantaneous flow rate mode and area mode, see "D1 Control output mode" under "6. Setting Descriptions".

● Instantaneous flow rate hold values



The flow rate peak and bottom values from time the power was turned ON to the current time are displayed.

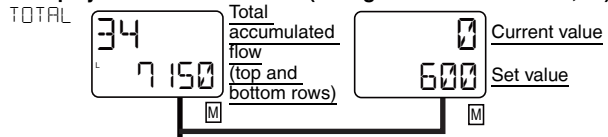
Reference
- Reset the hold values by pressing and holding △ + ▽.
- The hold values are reset when the power turns OFF.

Conditions other than those shown on the right

ch.1 is OUT and TOTAL.

● Total accumulated flow display

● Integrated flow display (Change the set value with △, ▽.)



	Total accumulated flow display	Integrated flow display
Description	The total accumulated flow is displayed.	The integrated flow count is displayed.
Unit	This uses the flow unit set in "F. Selecting the flow unit" under "3-1 Initial Settings."	This is based on the value set in "11. Integrated flow unit" under "5-1 Basic Settings."
Display range	Maximum: 9 digits This is reset to 0 if the display range is exceeded.	5-digits "FFFFF" is displayed if the display range is exceeded.
Setting range	-	0 to 99999

Reference
- Reset the display by pressing and holding △ + ▽ or by using the external input to reset the integrated flow.
- These values are recorded in the internal memory once every 10 seconds.

● Conditional monitoring display

Only when "7-3 Conditional Monitoring Function" is enabled

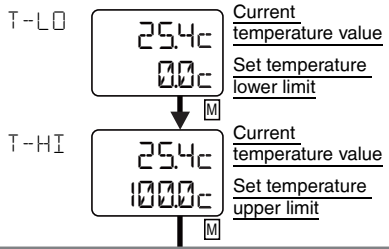
The relative value, compared to the 100% flow rate value registered using the conditional monitoring function, is displayed.

Reference
- When you are using this function, see "7-3 Conditional Monitoring Function" (page 19)
- Since the purpose of this function is monitoring, you cannot change the set values from this screen. Setting changes are based on the P1 (P1-L) value when the instantaneous flow rate is displayed.

● Flow/Temperature display

The current instantaneous flow rate and temperature are displayed.
Set values cannot be changed from this screen.

● Temperature display (Change the set value with △, ▽.)



Only when OUT2 is TEMP or T+ERR

The current temperature and set values are displayed.
Press △ or ▽ to change the set value of the temperature alarm.

Unit	Setting range
°C	-20.0 to 120.0
°F	-5.0 to 250.0

● Temperature hold display

The temperature peak and bottom values from the time power was turned ON to the current time are displayed.

Reference
- Reset the hold values by pressing and holding △ + ▽.
- The hold values are reset when the power turns OFF.

5. Detailed Settings

5-1 Basic Settings Symbols

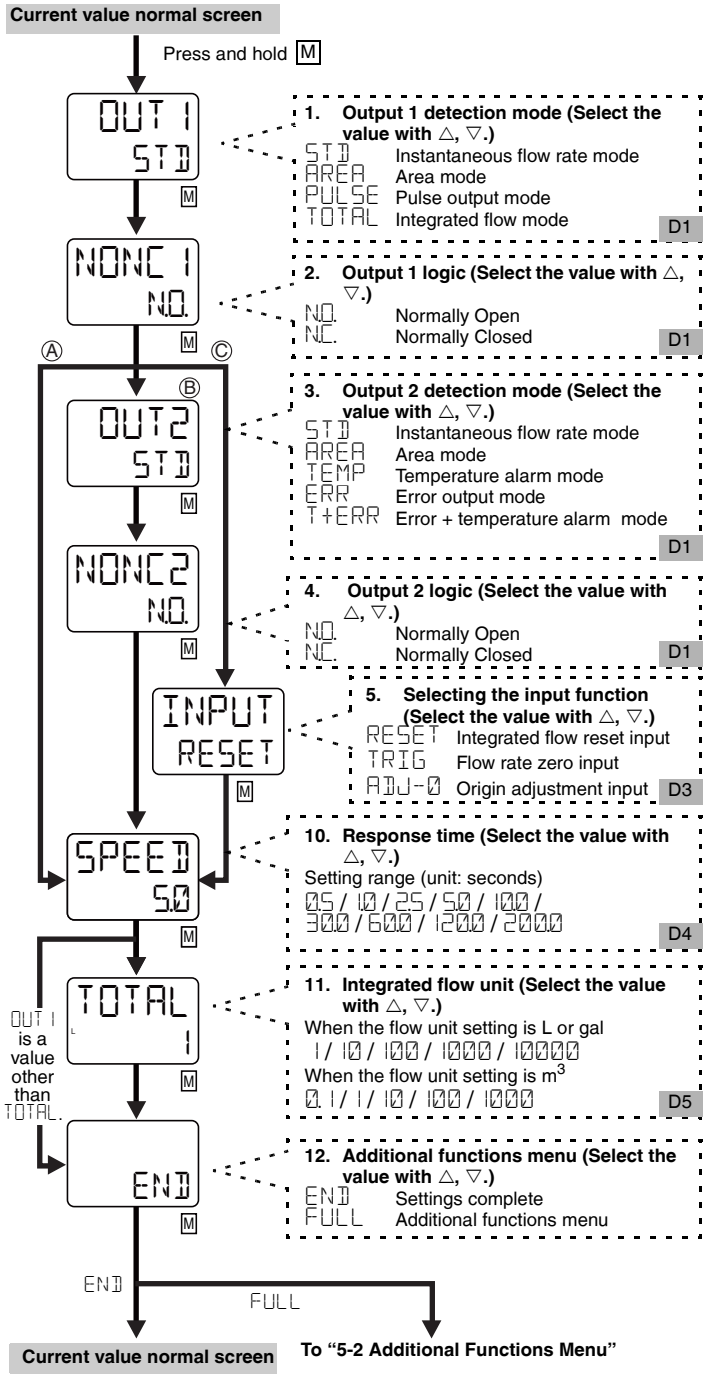
D1 to D5 correspond to the numbers in "6. Setting Descriptions."

Reference
- For definitions of the basic settings, see "6. Setting Descriptions" (page 16).
- Press M + △ when an item is being set to return to the previous screen.

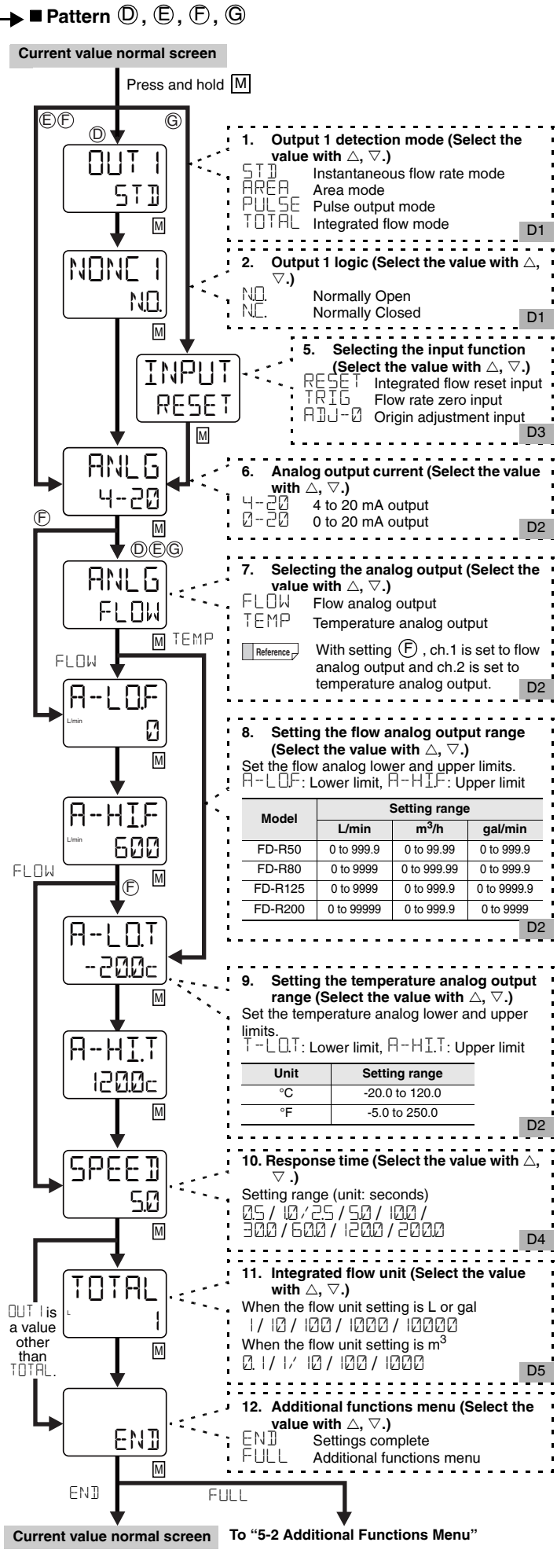
The setting items vary depending on the functions that were set for ch.1 and ch.2 under "3-1 Initial Settings" (page 11).

Pattern	Ch.1 setting	Ch.2 setting
Ⓐ	OUT	OFF
Ⓑ	OUT	OUT
Ⓒ	OUT	INPUT
Ⓓ	OUT	ANLG
Ⓔ	ANLG	OFF
Ⓕ	ANLG	ANLG
Ⓖ	ANLG	INPUT

■ Pattern Ⓐ, Ⓑ, Ⓒ



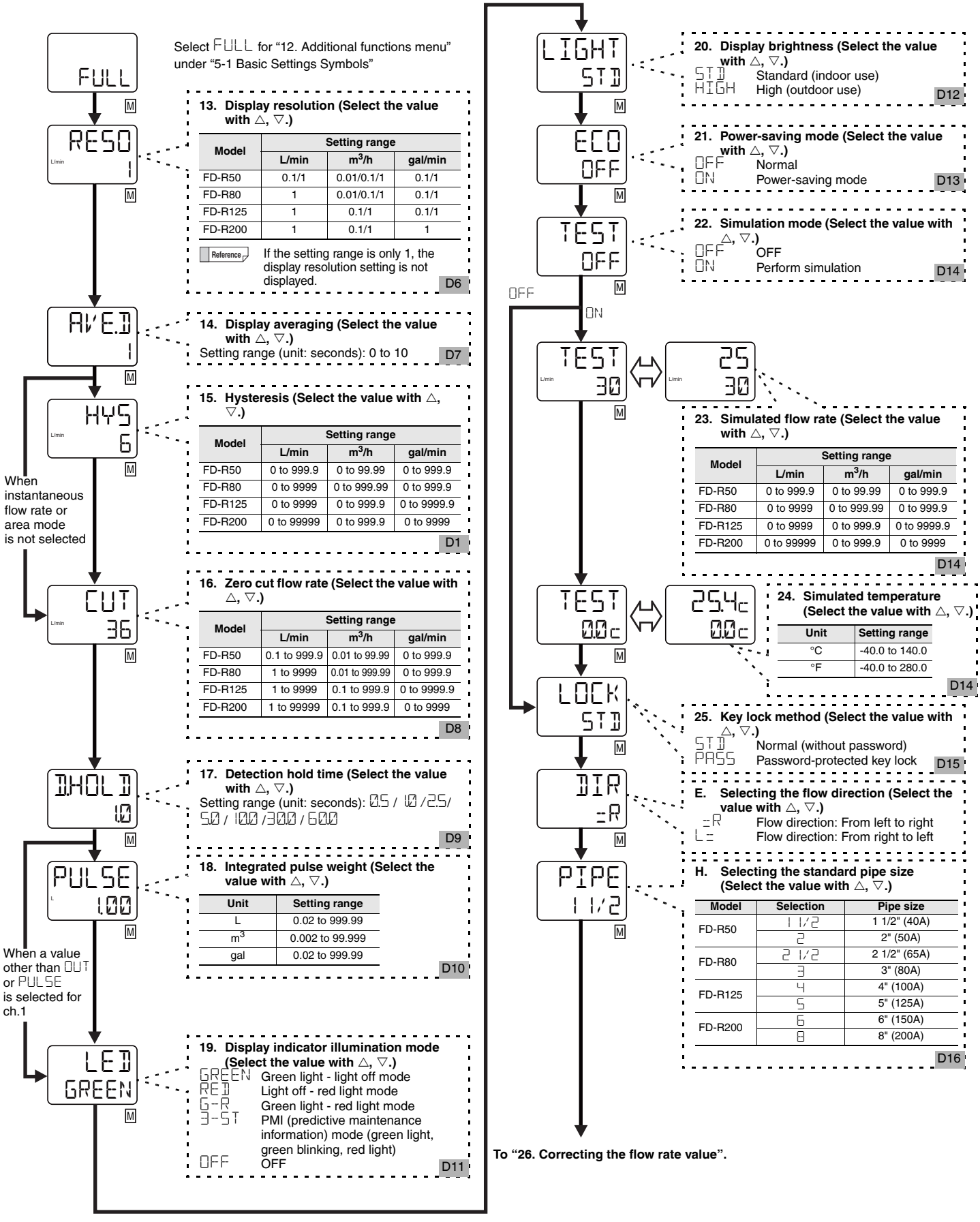
■ Pattern Ⓓ, Ⓔ, Ⓕ, Ⓖ



5-2 Additional Functions Menu

D1 to D17 correspond to the numbers in "6. Setting Descriptions."

Reference
- For definitions of the basic settings, see "6. Setting Descriptions."
- Press M + △ when an item is being set to return to the previous screen.



Model	Setting range		
	L/min	m^3/h	gal/min
FD-R50	0.1/1	0.01/0.1/1	0.1/1
FD-R80	1	0.01/0.1/1	0.1/1
FD-R125	1	0.1/1	0.1/1
FD-R200	1	0.1/1	1

Reference If the setting range is only 1, the display resolution setting is not displayed.

D6

Model	Setting range		
	L/min	m^3/h	gal/min
FD-R50	0 to 999.9	0 to 99.99	0 to 999.9
FD-R80	0 to 9999	0 to 999.99	0 to 999.9
FD-R125	0 to 9999	0 to 999.9	0 to 9999.9
FD-R200	0 to 99999	0 to 999.9	0 to 9999

D1

Model	Setting range		
	L/min	m^3/h	gal/min
FD-R50	0.1 to 999.9	0.01 to 99.99	0 to 999.9
FD-R80	1 to 9999	0.01 to 999.99	0 to 999.9
FD-R125	1 to 9999	0.1 to 999.9	0 to 9999.9
FD-R200	1 to 99999	0.1 to 999.9	0 to 9999

D8

Unit	Setting range
L	0.02 to 999.99
m^3	0.002 to 99.999
gal	0.02 to 999.99

D10

Model	Setting range		
	L/min	m^3/h	gal/min
FD-R50	0 to 999.9	0 to 99.99	0 to 999.9
FD-R80	0 to 9999	0 to 999.99	0 to 999.9
FD-R125	0 to 9999	0 to 999.9	0 to 9999.9
FD-R200	0 to 99999	0 to 999.9	0 to 9999

D14

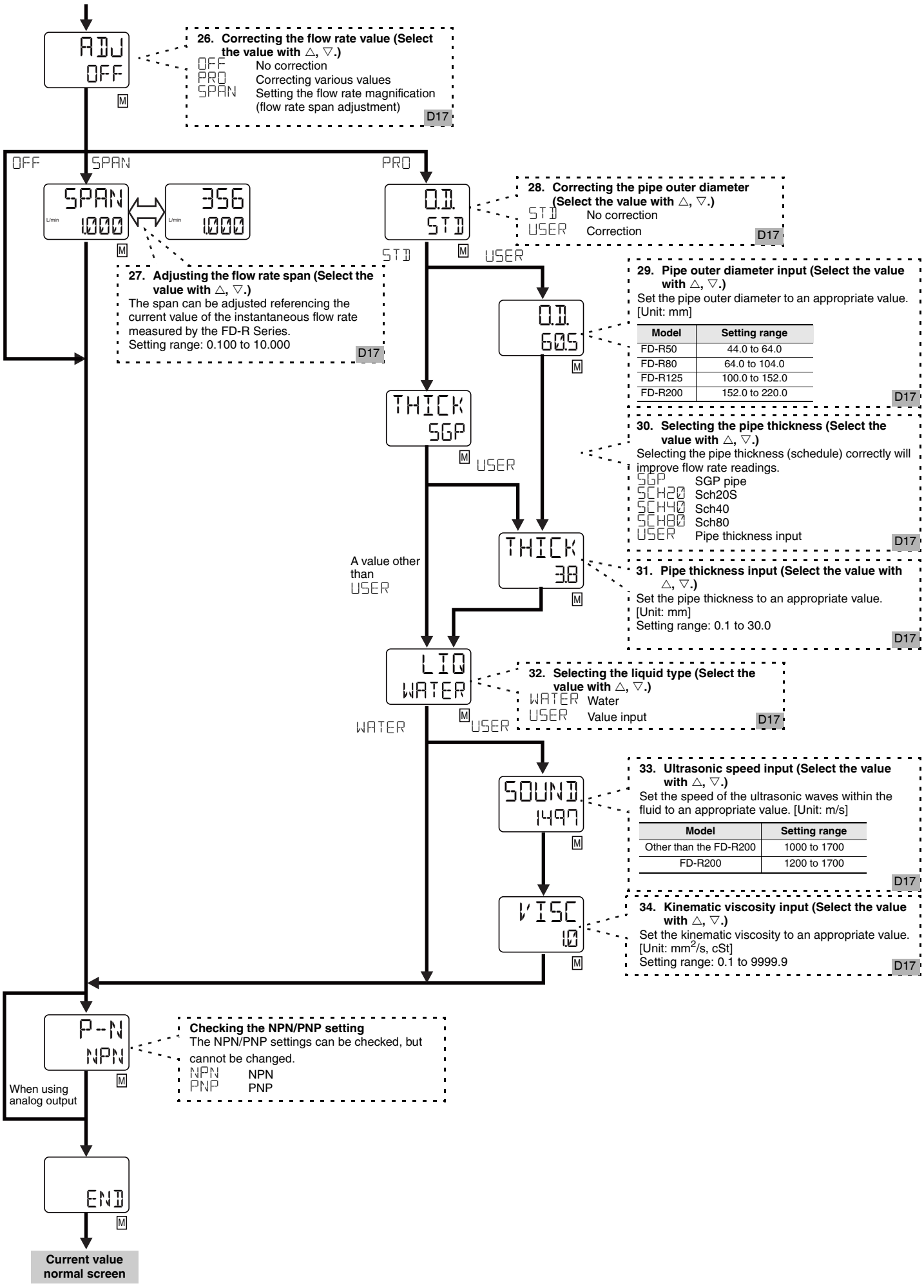
Unit	Setting range
°C	-40.0 to 140.0
°F	-40.0 to 280.0

D14

Model	Selection	Pipe size
FD-R50	1 1/2	1 1/2" (40A)
	2	2" (50A)
FD-R80	2 1/2	2 1/2" (65A)
	3	3" (80A)
FD-R125	4	4" (100A)
	5	5" (125A)
FD-R200	6	6" (150A)
	8	8" (200A)

D16

From "H. Selecting the standard pipe size".



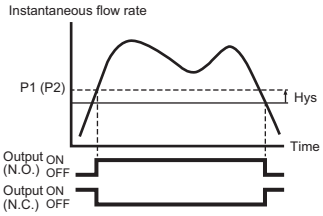
6. Setting Descriptions

6-1 Descriptions of Detailed Settings

D1 Control output mode

■ Instantaneous flow rate mode [STD] For ch.1 and ch.2

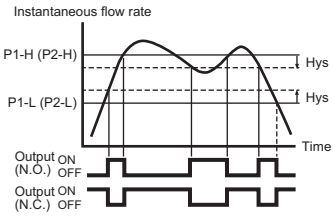
When the instantaneous flow rate exceeds the set value, the output is switched.
This mode can be used to detect drops in the supply flow rate.



Reference
- The settings can be used to switch the N.O./N.C. operation of the output.
- It is possible to adjust the hysteresis value with “5-2 Additional Functions Menu”.

■ Area mode [AREA] For ch.1 and ch.2

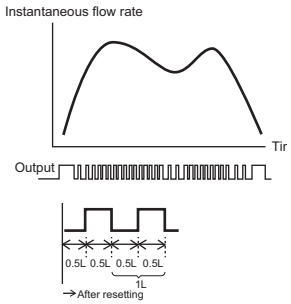
When the instantaneous flow rate is outside of a certain window, the output is switched.
This mode can be used to detect excessive or insufficient supply flow rates.



Reference
- The settings can be used to switch the N.O./N.C. operation of the output.
- It is possible to adjust the hysteresis value with “5-2 Additional Functions Menu”

■ Pulse output mode [PULSE] For ch.1 only

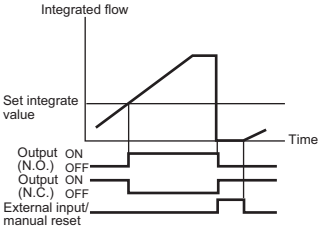
This outputs 1 pulse per integrated pulse weight.
This is useful when controlling or displaying the total accumulated flow rate on an external device such as a counter or touch panel.



Reference
- The total accumulated flow rate display will be reset to 0 automatically if it exceeds the display limit.
- The output pulse turns ON/OFF every half value of the integrated pulse weight. (Figure on the right: integrated pulse weight set to 1 L and output logic set to N.O.)
- If the pulse response frequency exceeds approximately 200 Hz, ERP is displayed.

■ Integrated flow mode [TOTAL] For ch.1 only

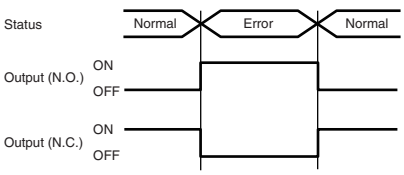
An output is generated when the integrated flow reaches the set value.
This is useful when detecting if a certain amount of fluid has passed through the pipe.



Reference
- The integrated flow display will show FFFFF if it exceeds the display limit.
- The current integrated flow value can be reset to zero by setting the function selection of ch.2 to external input and assigning it the integrated flow reset input.
- While the integrated flow reset input signal is applied, the integrated flow value is fixed to 0.

■ Error output mode [ERR] For ch.2 only

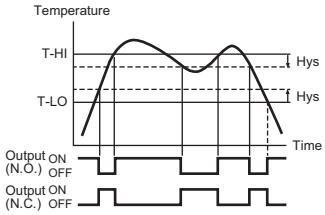
An output occurs when any of the following errors occur on the flow meter.
- ERE EEPROM error
- ERP Pulse error
- REV Counter flow error
- ---- Detection not possible error



Reference For details on each error, see “11-1 Troubleshooting” (page 24).

■ Temperature alarm mode [TEMP] For ch.2 only

When the pipe temperature is outside of a certain range, the output is switched.
This can be used to detect abnormal temperatures in the fluid being monitored.



Reference
- The settings can be used to switch the N.O./N.C. operation of the output.
- The hysteresis value is fixed to 1.0°C (2.0°F).

■ Error + temperature alarm mode [T+ERR] For ch.2 only

The output switches when at least one of the following conditions is met.
• An output condition is met for the error output mode.
• An output condition is met for the temperature alarm mode.

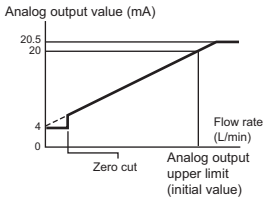
Reference The settings can be used to switch the N.O./N.C. operation of the output.

D2 Analog output mode

The set values for the lower and upper limits of analog output can be configured.
The analog output can be used to represent the instantaneous flow rate or the pipe temperature.
When the functions of ch.1 and ch.2 are both assigned to analog output, instantaneous flow rate is assigned to ch.1 and pipe temperature is assigned to ch.2.
In addition, the analog current output type can be selected from 4-20 mA and 0-20 mA.

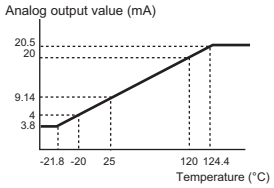
■ Default settings

● **Instantaneous flow rate**



Model	Upper limit (initial value)		
	L/min	m^3/h	gal/min
FD-R50	600.0	36.00	150.0
FD-R80	1500	90.00	390.0
FD-R125	3700	220.0	990.0
FD-R200	9500	570.0	2500

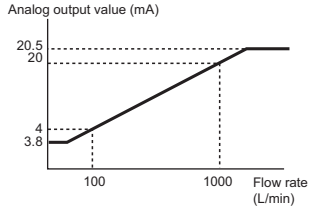
● **Pipe temperature**



■ When the settings are changed

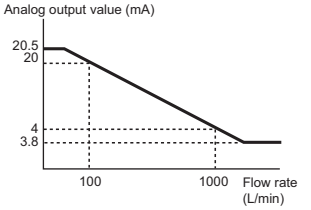
Example 1

Analog output upper limit	1000 (L/min)
Analog output lower limit	100 (L/min)



Example 2

Analog output upper limit	100 (L/min)
Analog output lower limit	1000 (L/min)



Reference
- When the analog output is assigned to instantaneous flow rate and a counter flow error (REV) or a detection not possible error (----) occurs, the analog output will be 3.5 mA (when 4-20 mA is set) or 0 mA (when 0-20 mA is set).
- The update cycle of the analog output is shown below.
  Flow rate: 300 ms, pipe temperature: 120 ms

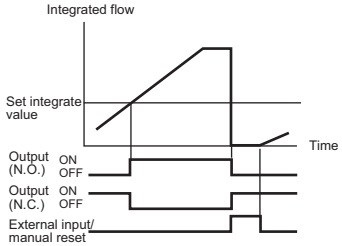
WARNING	**If the temperature output range is exceeded, the output will be fixed to the maximum output range. Note that the actual pipe temperature may exceed the value output from the FD-R.**

D3 External input

When “external input” is chosen as the function for ch.2, the signal can be chosen to represent “integrated flow reset input,” “flow rate zero input,” or “origin adjustment input.”

■ Integrated flow reset input [RESET]

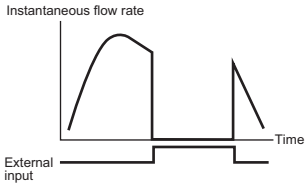
Resets the total accumulated flow display and/or the integrated flow display to 0.
While the integrated rate reset input signal is applied, the display is fixed to 0.



Reference
- The minimum input time is 20 ms.
- External input is enabled regardless of what is displayed on the current value normal screen.

■ Flow rate zero input [TRIG]

This forcibly sets the instantaneous flow rate to zero while the external input signal is applied.
This is useful in preventing the flow rate from being displayed and output at an unnecessary time, such as when the pipe is not filled with fluid.



Reference
- The minimum input time is 20 ms.
- While this signal is applied, the total accumulated flow display and the integrated flow display are not incremented.

■ Origin adjustment input [ADJ-0]

This external input can be used to perform the operations in “7-1 Origin Adjustment.”

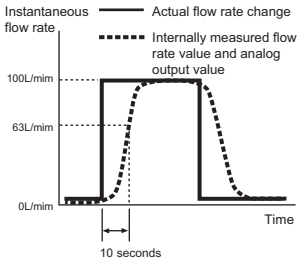
Reference
- Origin adjustment input can only be used on the current value normal screen.
- The minimum input time is 20 ms.
- It takes approximately 20 seconds to complete the origin adjustment.

D4 Response time

The response time is the time required for the flow rate internal evaluation value and the analog output to register/display at least 63% of the change in the instantaneous flow rate.

Reference The temperature response time is fixed to approximately 1 second (63% response).

(Example) When the response time is 10 seconds, if the actual flow rate increased from zero to 100 L/min instantaneously, the instantaneous flow rate value of the flow meter will show 63 L/min or more within 10 seconds (63 L/min is 63% of 100 L/min).



D5 Integrated flow unit

This is the unit with which the integrated flow display is incremented.

D6 Display resolution

Set the display resolution related to the instantaneous flow rate.

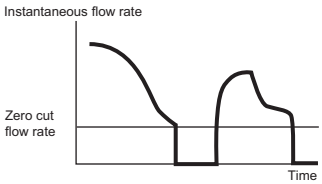
D7 Display averaging

This function averages the instantaneous flow rate value and displays the average. As this set value becomes larger, the display becomes more stable.

Reference Display averaging affects only the instantaneous flow rate display. The control output or analog output evaluation and the full-time recording function are not affected.

D8 Zero cut flow rate

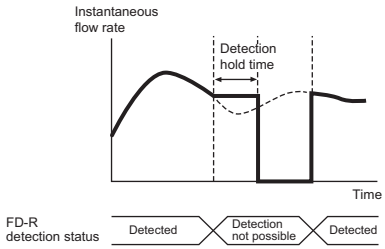
If the instantaneous flow rate is less than a certain value, the flow meter is forced to recognize the instantaneous flow rate as 0. This value is called the “zero cut flow rate.”
If the zero cut flow rate is set to OFF, the zero cut is not performed and a negative value is displayed when a counter flow occurs.



Reference When the instantaneous flow rate is less than the zero cut flow rate value, the control output, analog output, total accumulated flow, and integrated flow treat the flow rate as 0.

D9 Detection hold time

Set the length of time to maintain the previous display status and output status when it is no longer possible for the FD-R Series to receive the ultrasonic signal. This is useful in situations where detection becomes unstable due to air bubbles or similar factors.

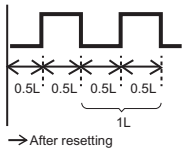


D10 Integrated pulse weight

In pulse output mode, the output pulse turns ON/OFF every half value of the integrated pulse weight.

(Figure on the right: when set to 1 pulse per 1 L)

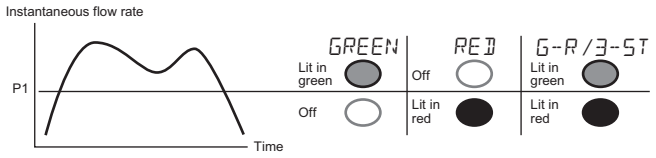
Reference If the pulse response frequency exceeds approximately 200 Hz, ERP is displayed.



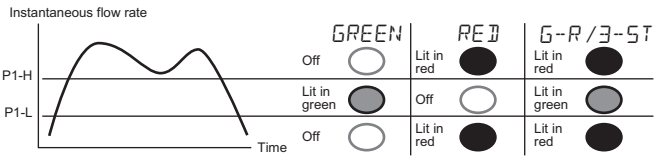
D11 Display indicator illumination mode

When the ch.1 function is “control output” and is assigned to “instantaneous flow rate mode” or “area mode,” the illumination mode for the large status indicator can be changed.
The illumination status is linked with the ch.1 set value P1 (P1-L/P1-H).

● In instantaneous flow rate mode



● In area mode

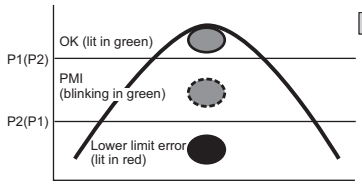


Reference
- The large status indicator is independent of the output logic N.O./N.C.
- When ch.1 is set to pulse output mode/integrated flow mode/analog output, the illumination status is linked with the zero cut flow rate (not with P1).

■ Predictive maintenance indicator (PMI; 3-ST)

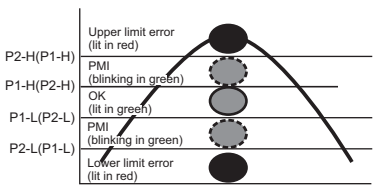
If “3-ST” is selected and either of the following conditions is fulfilled, the large status indicator can be used as a PMI.
1) Both output 1 and output 2 are in the “instantaneous flow rate mode.”
2) Both output 1 and output 2 are in the “area mode.”

When both output 1 and output 2 are in the “instantaneous flow rate mode”



Reference If the flow rate value exceeds both P1 and P2, the status indicator lights in green. If it is between P1 and P2, the status indicator blinks in green. If it falls below both P1 and P2, the status indicator lights in red.

When both output 1 and output 2 are in the “area mode”
Set the output 1 area inside the output 2 area.



Reference If the flow rate value is in both the output 1 area and the output 2 area, the status indicator lights in green. If it is only in the output 2 area, the status indicator blinks in green. If it is out of both areas, the status indicator lights in red.

D12 Display brightness

The brightness of the display and the large status indicator on the main unit can be changed to best fit the location of use (indoors or outdoors).

D13 Power-saving mode

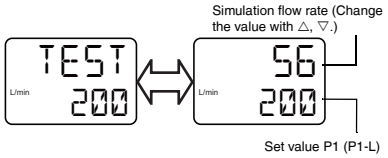
This mode reduces the power consumption.
Only the output indicator and stability indicator operate normally. The other indicators turn off.
Approximately 10 seconds after the completion of a button operation, the display turns off.

D14 Simulation mode

An arbitrary simulation value can be entered for the instantaneous flow rate or pipe temperature.
Use simulation mode to check the outputs of the flow meter and the operation of the indicators.
This is useful when checking the wiring and the operation prior to passing fluid through the pipe and when isolating problems.

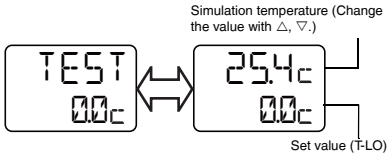
- **Checkable items based on the simulation flow rate**

1. Output signals for outputs 1 and 2
2. Output 1 and 2 indicators
3. Analog output value
4. Pulse output
5. Large status indicator



- **Checkable items based on the simulation temperature**

1. Output signal for output 2
2. Output 2 indicator
3. Analog output value



Reference
- When you are using the simulation mode, you cannot change the following items.
  - Total accumulated flow display
  - Integrated flow display
  - Recorded data of the full-time recording function
- External inputs are invalid during the simulation mode.

D15 Key lock method

If the key lock method is set to “password-protected key lock,” a 4-digit password is required when setting or canceling the key lock. (See “7-2 Key Lock” (page 19).)
This is an effective way to allow only a specific administrator to change the settings on the units.

D16 Standard pipe size

The FD-R Series maintains the following pipe outer diameter parameters internally and calculates the flow rate on the basis of these values.

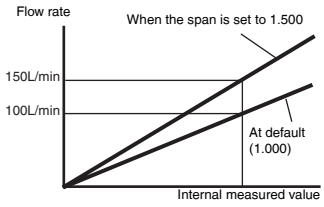
Model	Selection	Pipe size	Outer diameter (internal value)
FD-R50	1 1/2	1 1/2" (40 A)	48.6 mm
	2	2" (50 A)	60.5 mm
FD-R80	2 1/2	2 1/2" (65 A)	76.3 mm
	3	3" (80 A)	89.1 mm
FD-R125	4	4" (100 A)	114.3 mm
	5	5" (125 A)	139.8 mm
FD-R200	6	6" (150 A)	165.2 mm
	8	8" (200 A)	216.3 mm

D17 Correcting the flow rate value

This function corrects the instantaneous flow rate value to improve the measurement accuracy of the flow rate value.
Performing corrections with SPAN is useful when the instantaneous flow rate or the actual flow rate (both of which will be the master value) is known.
PRO is useful when the fluid information and the pipe information is known.
SPAN and PRO cannot be set at the same time. When selecting SPAN, the PRO settings are disabled. Also, when selecting PRO, the SPAN settings are disabled.

■ Adjusting the flow rate span (SPAN)

Perform the span adjustment on the internal measured value over the range of 0.100x to 10.000x.



■ Correcting various values (PRO)

Correct the measured value by entering the pipe size and the characteristics of the fluid being measured.

- **Pipe size**

Input the outer diameter and the thickness of the actual pipe being used.
For pipe schedules other than SGP, enter the correct pipe outer diameter and thickness. Then, the flow rate value is corrected according to the internal diameter.
The FD-R Series maintains the following thickness parameters internally and calculates the flow rate value on the basis of these values.

Model	Pipe size	Thickness (internal value)			
		SGP	SCH20	SCH40	SCH80
FD-R50	1 1/2" (40 A)	3.5 mm	3.0 mm	3.7 mm	5.1 mm
	2" (50 A)	3.8 mm	3.5 mm	3.9 mm	5.5 mm
FD-R80	2 1/2" (65 A)	4.2 mm	3.5 mm	5.2 mm	7.0 mm
	3" (80 A)	4.2 mm	4.0 mm	5.5 mm	7.6 mm
FD-R125	4" (100 A)	4.5 mm	4.0 mm	6.0 mm	8.6 mm
	5" (125 A)	4.5 mm	5.0 mm	6.6 mm	9.5 mm
FD-R200	6" (150 A)	5.0 mm	5.0 mm	7.1 mm	11.0 mm
	8" (200 A)	5.8 mm	6.5 mm	8.2 mm	12.7 mm

- **Characteristics of the fluid being measured**

The FD-R Series calculates the flow rate with the fluid being measured set as water.
If the fluid being measured is not water and if you know the ultrasonic transmission speed and kinematic viscosity of the fluid, enter these values to improve the measurement accuracy.

• SOUND Enter the ultrasonic speed within the fluid being measured. General data is shown below.

Ultrasonic speed (typical)

Liquid	Ultrasonic speed [m/s]
Water (25°C)	1497
Ocean water (concentration: 3.5%)	1510
Water-soluble coolant	1490
Oil-based coolant	1250
Ethylene glycol (concentration: 100%)	1650

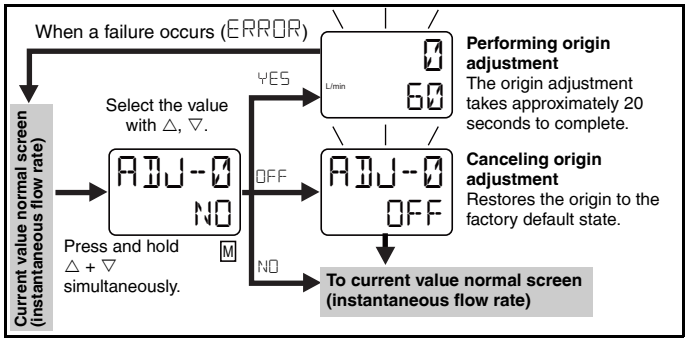
• VISC Enter the kinematic viscosity of the fluid being measured.

7. Useful Functions

7-1 Origin Adjustment

When the origin adjustment is performed, it adjusts the instantaneous flow rate value to "zero."
When the installation is complete and the initial settings have been completed, perform an origin adjustment.

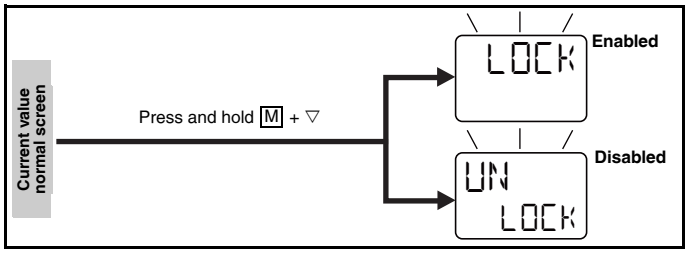
Point **Perform this function when the pipe is filled with fluid and the fluid is not moving.**



7-2 Key Lock

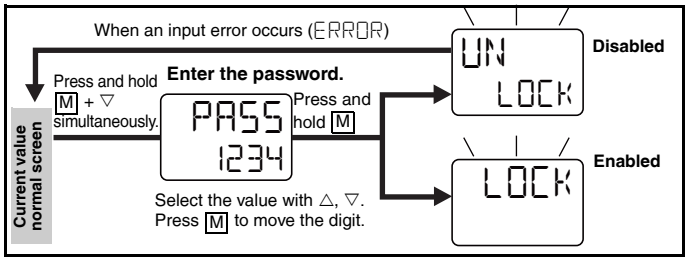
This function prevents operation mistakes by locking/disabling key operations.
This is effective in preventing the settings from being changed easily.

■ Enabling/disabling the key lock



■ Enabling/disabling the password-protected key lock

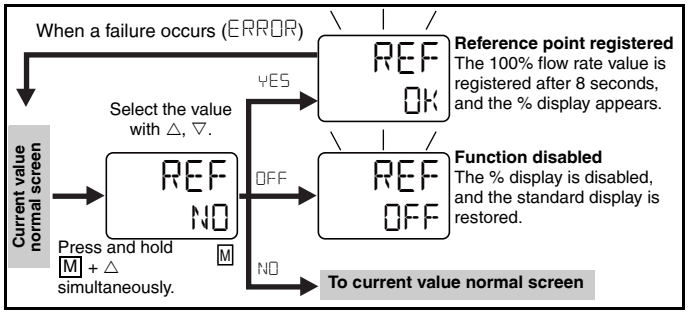
Reference When "25 Key lock method" (page 14) under "5-2 Additional Functions Menu" is set to PASS, this function can be used.



7-3 Conditional Monitoring Function

This function registers the instantaneous flow rate value at the time that the conditional monitoring function is executed as 100% and displays the instantaneous flow rate value relative to this base flow rate value.
This is an effective way to easily check the amount of change from the base flow rate value.

Point
- **Execute the conditional monitoring function with the fluid flowing at the base flow rate that should be represented as 100%.**
- **The set value is linked with the instantaneous flow rate display P1 (P1-L) setting.**



Reference
- After executing this function, the absolute value can be checked by pressing M.
  (See "4. Display Settings" (page 12).)
- The conditional monitoring function is effective only for the instantaneous flow rate value.
- Registering the reference point in a low flow rate area may lead to the value being unstable.

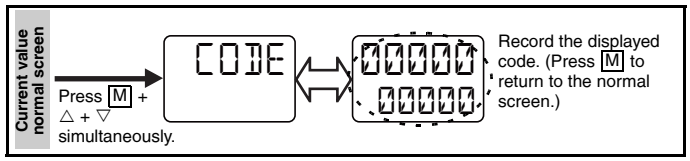
7-4 Quick Setting Code

With this function, multiple setting parameters can be restored instantaneously by entering a 10-digit setting code recorded on the FD-R Series main unit.
This is convenient when applying the same settings to multiple FD-R Series units.

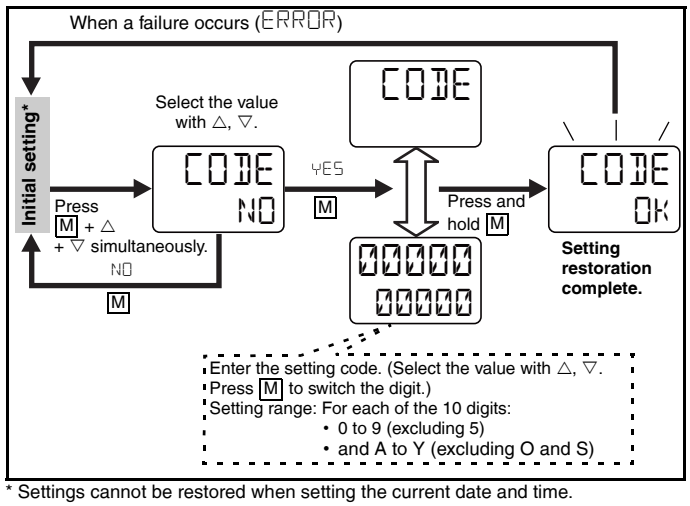
NOTICE **Entering the code also restores the settings for the control output and external input.**
If a wrong code is entered, an unexpected operation may occur.
Note that entering a wrong code with an external device connected to the flow meter may lead to damage.

Point **This function cannot restore certain items such as set values. Separately record them as necessary. (See "12-3 Default Settings/Values List" (page 27).)**

■ Checking the current setting code



Restoring the settings by entering the code (Perform this from the initial setting screen*.)

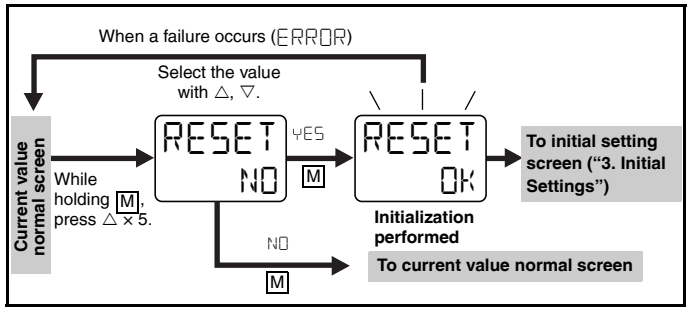


* Settings cannot be restored when setting the current date and time.

Reference The initial setting screen is displayed when "7-5 Initialization" (page 19) is performed or when the power is turned on for the first time.

7-5 Initialization

This restores the settings to their factory default values.
This is effective in situations where the status of the settings is not known.



Reference The time settings, unit settings, and recorded data are not initialized.

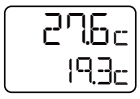
8. Full-time Recording Function

The FD-R Series records measured results on the main unit at all times.
This function can be used to check the recorded data shown below.

- FLOW **(instantaneous flow rate hold values)**

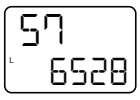
Displays the hold values for the instantaneous flow rate for every 5 minutes after the values started being displayed.
Top row: Instantaneous flow rate peak value
Bottom row: Instantaneous flow rate bottom value

- TEMP **(temperature hold values)**



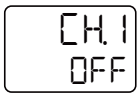
Displays the hold values for the pipe temperature for every 5 minutes after the values started being displayed.
Top row: Temperature peak value
Bottom row: Temperature bottom value

- TOTAL **(total accumulated flow)**



The top and bottom rows are used to display the total accumulated flow within the display time interval after the values started being displayed.
The flow unit is based on the flow unit setting.

- EVENT **(event)**



The top and bottom rows are used to display the events that occured on the FD-R. The time at which the event occurred is displayed on the time screen.
The types of events that are displayed are shown below.

Event type	Top row display	Bottom row display
Control output change*	CH.1 or CH.2	ON or OFF
Overcurrent error	ERC	(None)
EEPROM error	ERE	(None)
Pulse error	ERP	(None)
Counter flow error	REV	(None)
Detection not possible	STAB	0
Stability indicator change	STAB	(Number of stability bars)

* Nothing is recorded when using pulse output mode or integrated flow mode.

Reference After a certain period has elapsed, the recorded data is overwritten.

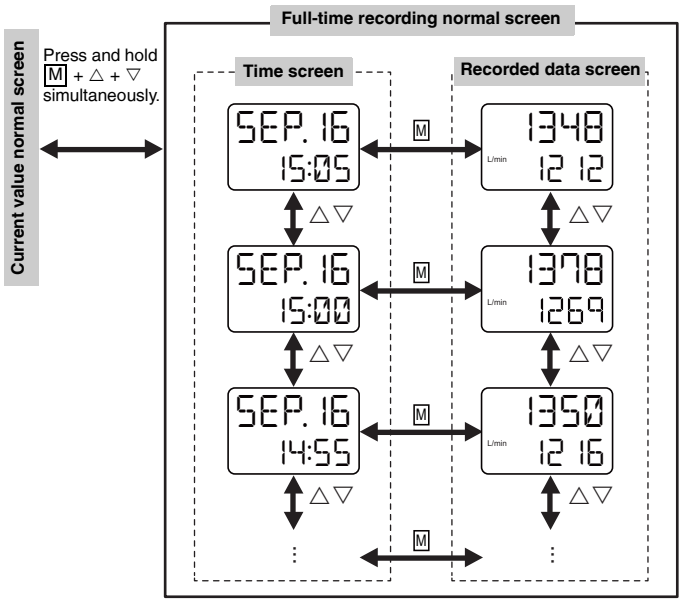
Logging data type		Data storage period
FLOW	(instantaneous flow rate hold values)	1 month or more*
TEMP	(temperature hold values)	1 month or more*
TOTAL	(total accumulated flow)	Approx. 10 years worth
EVENT	(event)	219 events total

* This is the storage period when the power supply is continually left on for the whole day. The storage period varies depending on the length of time that the power supply is left on.

8-1 Full-time Recording Function Display

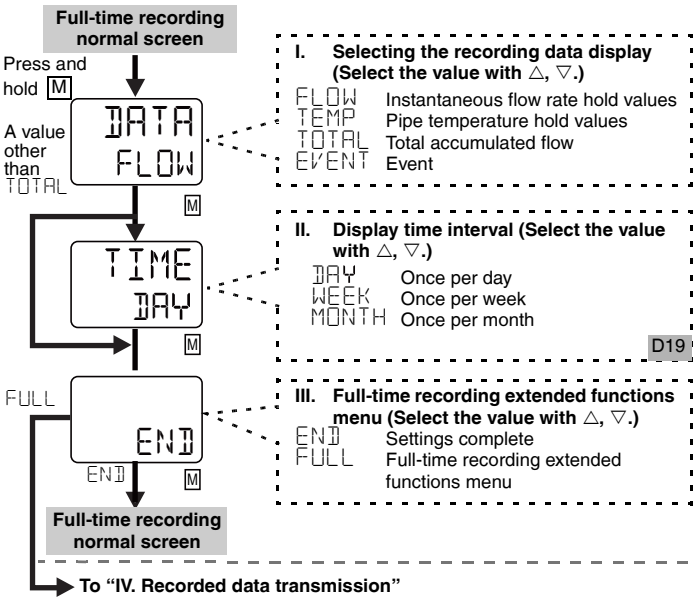
The full-time recording normal screen is composed of a time screen and a recorded data screen.

The settings can be used to change the display time interval on the time screen and the display details on the recorded data screen. (See 📖 "8-2 Full-time Recording Function Settings".)



8-2 Full-time Recording Function Settings

Reference
- For definitions of the basic settings, see 📖 "8-3 Full-time Recording Function Descriptions".
- Press M + △ when an item is being set to return to the previous screen.



Point

- **FLOW (instantaneous flow rate hold values)/TEMP (pipe temperature hold values) recording**
  Every five minutes, the peak and bottom values within those five minutes are recorded as a single piece of data.
  The data from these five minutes is not recorded in the following situations.
  - **During data transmission**
    Perform data transmission when it will have no effect on the data recording.
  - **When the time is being set**
    Change the time settings when it will have no effect on the data recording.

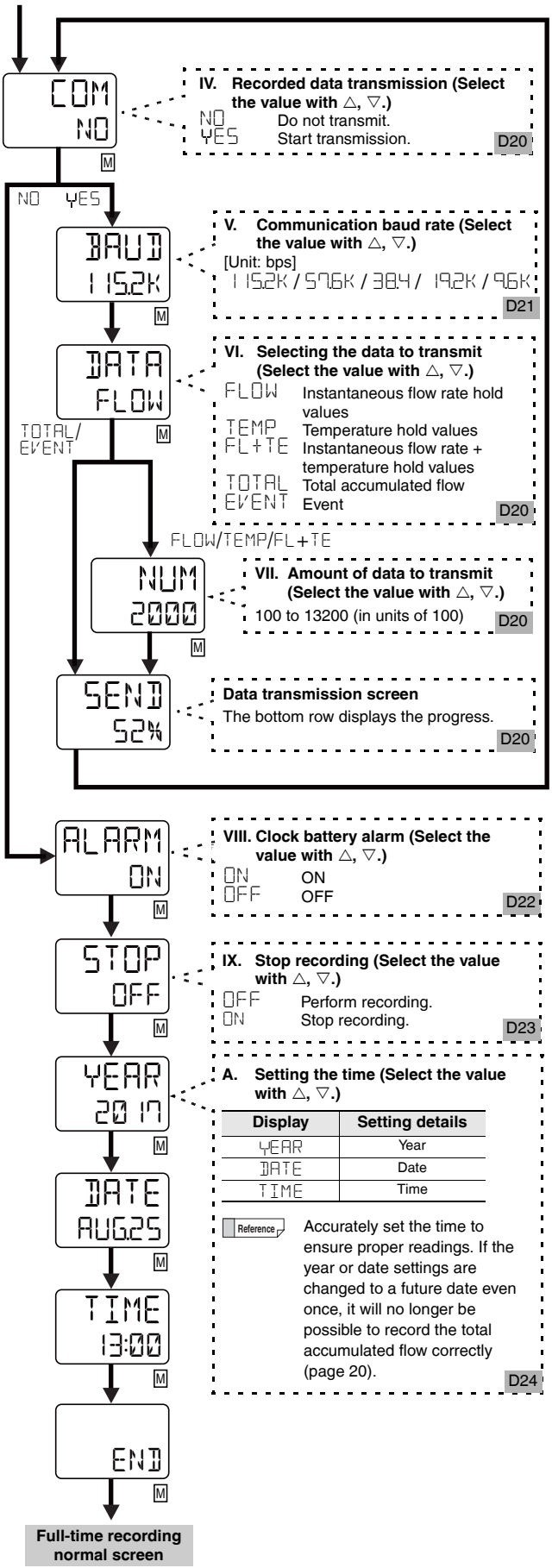
- **TOTAL (total accumulated flow) recording**
  The difference between the total accumulated flow the last time that recording was executed and the current total accumulated flow is used to calculate the total accumulated flow during that time interval.
  If the year or date settings are changed to a future date even once, it will no longer be possible to record the total accumulated flow correctly. After outputting the data that has been recorded up to this point, delete this recorded data.

- **EVENT (event) recording**
  Each time that an event occurs, the details of the event and the time that the event occurred are recorded.
  Data is not recorded in the following situations.
  - **During data transmission**
    Perform data transmission when it will have no effect on the data recording.
  - **When the time is being set**
    Change the time settings when it will have no effect on the data recording.

  Events can be saved 10 million times (this is a reference value with a pipe temperature of 60°C).
  If events are saved more times than the upper limit given above, event data may not be saved correctly.
  (Other functions such as detection and setting are not affected.)

● **Full-time recording extended functions menu**

From "III. Full-time recording extended functions menu"



8-3 Full-time Recording Function Descriptions

D19 Display time interval

This determines the time interval when the △ or ▽ buttons are pressed on the full-time recording screen.
When EVENT (event) is selected, the time at which the event occurred is displayed on the full-time recording time screen.
When FLOW (instantaneous flow rate hold values) or TEMP (temperature hold values) is selected, the time interval is fixed to 5 minutes.

D20 Recorded data transmission

This sends the recorded data accumulated with the full-time recording function to a PC by way of RS-232 communication. The data is transmitted in order, starting with the oldest data.
The types and details of the data to send are shown below.

- **FLOW (Instantaneous flow rate hold values)/TEMP (Temperature hold values)/FL+TE (Instantaneous flow rate + temperature hold values)**
  - Time
  - The instantaneous flow rate hold values, the temperature hold values, or both during each time period

The amount of data to transmit during data transmission can be selected. The specified number of data entries are transmitted from the newest data.

- **TOTAL (total accumulated flow)**
  - Time
  - The total accumulated flow during each time period

  All recorded data is transmitted during each display time interval.
- **EVENT (event)**
  - Time when the event occurred
  - Event details

  All recorded data is transmitted each time an event occurs.

Reference **Estimated transmission time (at 115.2 kbps)**
FLOW/TEMP/FL+TE 2000 data entries being transmitted (approximately 1 week worth of data*): Approximately 60 seconds
At maximum capacity of TOTAL data: Approximately 90 seconds
At maximum capacity of EVENT data: Approximately 5 seconds
* This is the storage period when the power supply is left on for the whole day.

D21 Communication baud rate

This sets the baud rate to use when outputting the data recorded with the full-time recording function by way of RS-232C communication.

D22 Clock battery alarm

If the clock battery module is drained completely when the power is turned ON, the time used by the full-time recording function is initialized and the clock battery alarm (SET CLOCK) is displayed.
If not using the full-time recording function, set this to OFF to forcibly prevent the clock battery alarm from occurring.

D23 Stop recording

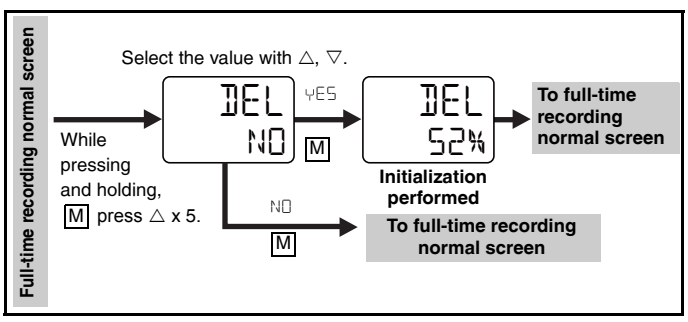
Stop the recording performed by the full-time recording function.
This is useful when a record of data is not needed or wanted.

D24 Setting the time

This sets the current time.
The time used by the full-time recording function operates according to the time that is set here.
By accurately setting the time, the full-time recording function can be used correctly.

8-4 Deleting Recorded Data

Deletes all the recorded data accumulated within the FD-R Series.
This is useful to initialize the recorded data.



9. RS-232C Communication

The data accumulated with the full-time recording function can be sent to a PC or other external device. Data is sent when "Recorded data transmission" under "8-2 Full-time Recording Function Settings" is executed. It is not possible to apply a transmission trigger from an external source or to transmit data automatically.

9-1 Communication Specifications

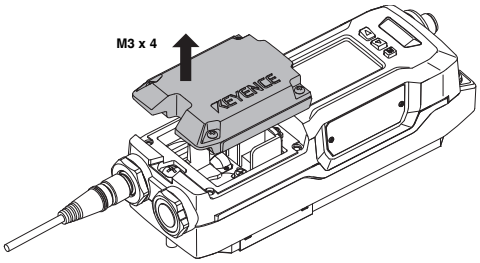
Item	Specifications
Transmission method	Full duplex
Synchronization between the transmitter and receiver	Asynchronous
Transmission code	ASCII
Communication speed	Selectable (115.2, 57.6, 38.4, 19.2, 9.6 kbps)
Data bit length	8 bits
Parity check	EVEN
Stop bit length	1 bit
Data separator	Fixed to CR + LF

9-2 Connection Method

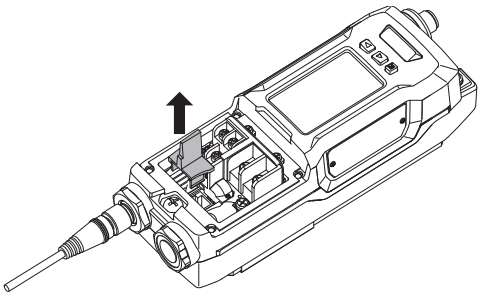
WARNING

- **When the modular cable is connected, the enclosure rating is not satisfied. Fluid intruding into the product may lead to electric shock and damage to the flow meter. Therefore, do not continue to use the product with the modular cable connected.**
- **Do not connect or disconnect the modular cable while supplying AC power to this product. Doing so may lead to electric shock.**
- **The withstand voltage of OP-26487 (the modular cable) is 150 VAC. When supplying AC power, use the product with the cable fixed in place so that OP-26487 does not come in contact with the AC terminal or the AC cable wire.**

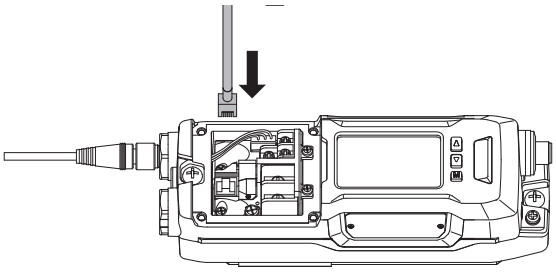
1 Remove the power supply cover on the main unit.



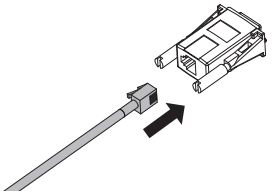
2 Remove the RS-232C port cover.



3 Connect OP-26487 (the modular cable) to the RS-232C port.



4 Attach OP-26401 (the RS-232C conversion adapter [9-pin]).



9-3 Transmission Data Format

When you perform "Recorded data transmission" under "8-2 Full-time Recording Function Settings" the FD-R Series automatically transmits data according to ASCII code.

Reference

- Commas (,) are used to separate the pieces of data.
- A line break (CR + LF) is inserted after the header part and after each data part.
- The data is transmitted with the flow rate matching the current resolution setting and with the temperature fixed to 0.1°C or 0.1°F.
- The transmitted data is composed of a header part and a data part, which follows the header.

[Basic format]

Header part (character string)		[CR+LF]
Data part (numeric value)	Checksum	[CR+LF]
Data part (numeric value)	Checksum	[CR+LF]

⋮

- **Instantaneous flow rate hold values (FLOW)/temperature hold values (TEMP)/instantaneous flow rate + temperature hold values (FL + TE)**

Header part	YEAR	MONTH	DAY	HOUR	MINUTE	*	CHECK SUM	[CR+LF]
Data example	2017,	8,	4,	17,	16,	*	182	[CR+LF]
(Meaning)	Year	month	day	hour	Minute		Checksum	Line break

Header	FLOW_PEAK	FLOW_BOTTOM	TEMP_PEAK	TEMP_BOTTOM
Data example	424,	322,	34.2,	-10.8,
(Meaning)	Instantaneous flow rate peak value	Instantaneous flow rate bottom value	Temperature peak value	Temperature bottom value
select FLOW	✓	✓	—	—
select TEMP	—	—	✓	✓
select FL+TE	✓	✓	✓	✓

- **Total accumulated flow (TOTAL)**

The daily, weekly, and monthly data is transmitted in order. Therefore, three types of header parts and three types of data parts are transmitted.

Header part	YEAR	MONTH	DAY	*	CHECK SUM	[CR+LF]
Data part	2017,	8,	4,	*	157	[CR+LF]
(Meaning)	Year	month	day		Checksum	Line break

Header part	TOTAL_PER_DAY	TOTAL_PER_WEEK	TOTAL_PER_MONTH
Data part	1456,	7362,	30578,
(Meaning)	Total accumulated flow per day	Total accumulated flow per week	Total accumulated flow per month
Each day	✓	—	—
Each week	—	✓	—
Each month	—	—	✓

- **Event (EVENT)**

Header part	YEAR	MONTH	DAY	HOUR	MINUTE	EVENT	CHECK SUM	[CR+LF]
Data part	2017,	10,	12,	8,	13,	CH1_ON,	17	[CR+LF]
(Meaning)	Year	month	day	hour	Minute	Event details	Checksum	Line break

Reference

About the checksum

- The checksum is calculated as follows: all the pieces of data are added together excluding the delimiter (comma) for each piece of data and the checksum, this total is divided by 256, and then the remainder of the division is used as the checksum.
  Example: Given the data below, the checksum is 188: (2017 + 8 + 4 + 1231)/256 results in a remainder of 188.

Header	YEAR	MONTH	DAY	TOTAL_PER_DAY
Data	2017,	08,	04,	1231,

- The decimal point is ignored for flow rate and temperature values.
  Example: If the data is 12.3, it is used in the checksum calculation as 123.
- Negative temperature values are subtracted from 65536 and the resulting values are used in the calculation.
  Example: If the data is -12.3, it is used in the checksum calculation as 65536 - 123 = 65413.
- Events are converted into values according to the following table and are then used in the calculation.

Display	Calculated checksum value
ERE	0
ERC	1
ERP	2
STAB_0	3
REV	4
CH1_ON	5
CH1_OFF	6

Display	Calculated checksum value
CH2_ON	7
CH2_OFF	8
STAB_1	9
STAB_2	10
STAB_3	11
STAB_4	12

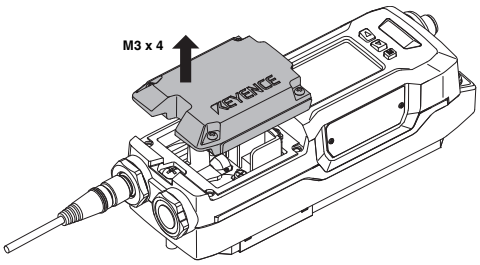
10. Maintenance

10-1 Replacing the Clock Battery Module

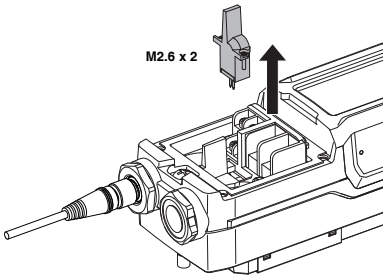
The time settings used by the full-time recording function are maintained by the clock battery module. The time settings will be cleared if the FD-R is left for a long time with the power off. In this situation, the clock battery alarm (SET CLOCK) will be displayed when the FD-R turns on.
If the clock battery alarm (SET CLOCK) occurs each time that a unit is powered ON, the capacity of the clock battery module may have decreased.
To make the full-time recording function use correctly, replace the clock battery module (OP-88206).

WARNING	**Be sure to turn off the power supply before replacing the clock battery module. Failure to do so may lead to electric shock and damage.**

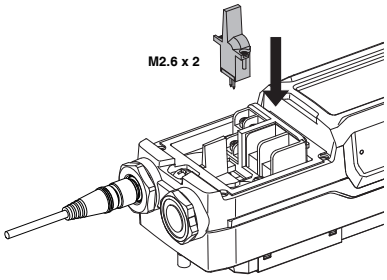
1 **Remove the power supply cover on the main unit.**



2 **Remove the clock battery module.**



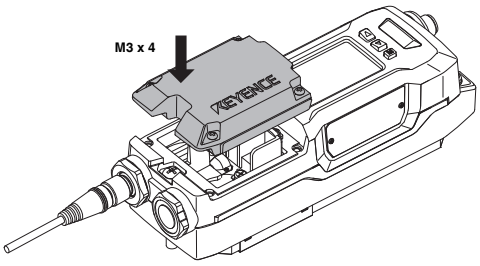
3 **Attach a new clock battery module.**



Recommended tightening torque: 0.3 Nm

Point	**Exercise caution to avoid bending the clock battery module pins.**

4 **Attach the power supply cover.**



Prescribed tightening torque: 0.5 Nm

11. Troubleshooting

11-1 Troubleshooting

Problem	Cause	Solution
ERC is displayed.	Excessive current (overcurrent) is flowing through control output 1 or control output 2.	• Check if the output wires are connected correctly and are not in contact with other wires. • Check if the load is within the rated range.
ERE is displayed.	The memory has reached the end of its service life or the flow meter is malfunctioning.	Perform initialization. If the problem persists, contact your nearest KEYENCE office.
ERP is displayed.	The response frequency of the integrated pulse output has exceeded 200 Hz.	Increase the integrated pulse weight value.
• REV is displayed. • A negative instantaneous flow rate is displayed.	The fluid flows in the opposite direction of the setting or is convecting.	Set the flow direction according to the correct fluid flow direction.
	The origin is offset by a large amount.	Adjust the origin with the pipe full with non-flowing fluid.
	The instantaneous flow rate has greatly exceeded the rated flow rate.	Use this product within the rated flow rate range that can be displayed normally.
	The zero cut flow rate is set to OFF (when a negative instantaneous flow rate is displayed).	Set the zero cut flow rate to a value other than OFF.
SET CLOCK is displayed.	The clock battery module has been fully discharged or there is no battery capacity.	• Use the product normally and observe how the product behaves. • If this problem occurs each time that you restart the product, there may be no battery capacity in the clock battery module. If using the full-time recording function, replace the clock battery module. If not using the full-time recording function, set the clock battery alarm to OFF.
FFFFF is displayed.	The integrated flow display has exceeded the display range.	• Perform an integrated flow reset. • Change the integrated flow unit to a more appropriate setting or use an external counter.
LOCK is displayed.	The key lock function is active.	Disable the key lock function when you want to change the settings. (See "7-2 Key Lock") If you have forgotten the key lock password, contact your nearest KEYENCE office.
H.TEMP or L.TEMP is displayed.	The pipe temperature is less than -40°C or is higher than 140°C.	Use this product within the specified temperature range.
--- is displayed. • The instantaneous flow rate occasionally becomes "0." • One stability indicator or two stability indicators are lit. • One stability indicator blinks. • The stability indicators blink in order.	• The lower bracket or the upper bracket is not properly fixed in place. • The main unit is not properly fixed in place. • The pipe is not filled with fluid. • The detection signal is obstructed. • The special rubber on the main unit or on the rear surface of the sub unit is deformed. • The sensor is affected by pulsation or air bubbles.	• Tighten the metal belt screw until the detecting surface is firmly in contact with the pipe. • Check whether the installation orientation and order of the upper and lower brackets are correct. • Check whether the unit connection cable is connected correctly. • Check that the main unit, upper bracket, and lower bracket have not been partially tightened or are not loose. • Install the sensor so that the display is perpendicular, not parallel, to the ground. • Remove the main unit and the brackets from the pipe, and then attach them in a different location. • If there is rust or dirt on the pipe surface, avoid this area when installing the sensor. • If there is a seam on the pipe where the back side of the sensor main unit or sensor sub unit comes in contact with the pipe, move the sensor main unit or sensor sub unit away from the seam before installation. • If air bubbles or foreign particles are expected to be present inside the pipe, change the installation location or remove these items by way of high-pressure washing. • If the special rubber is deformed, contact your nearest KEYENCE office. • Increase the response time. • Set a longer detection hold time. If the problem persists, the fluid or the pipe may be causing detection issues or the flow meter may be damaged.
The instantaneous flow rate is not stable.	• The pipe is not filled with fluid. • The sensor is affected by pulsation or air bubbles. • Cavitation is occurring due to pressure changes.	• Install the sensor so that the display is perpendicular, not parallel, to the ground. • Increase the response time. • Set a longer detection hold time.
	The flow velocity distribution is not uniform over time.	• Increase the response time. • Install the sensor on as straight a section of pipe as possible. • Avoid installing the sensor just after a bore conversion section or a valve.
The instantaneous flow rate does not change from "0."	The total accumulated flow display or the integrated flow display has been set.	Press the MODE button to switch the screen and check if the total accumulated flow display or the integrated flow display is set.
	When using the external input function, the flow rate zero input (TRIG) is selected and the external input is being applied.	• Check if the wiring arrangement is correct. • If the input wire and output wire are in contact, separate them. • If the flow rate zero input (TRIG) has been set accidentally, select a different option.
	The fluid is not flowing.	Check whether valves are open or closed and check the pipe and the filter for clogging.
	The fluid is flowing. However, the flow rate value is less than the zero cut flow rate.	Adjust the zero cut flow rate.
	The fluid is flowing in the incorrect direction.	When a minor counter flow occurs, 0 is displayed, not REV. Set the zero cut flow rate to OFF.
The flow rate differs greatly from the actual flow rate value.	The product has not been installed correctly.	Check whether the positions of the alignment guide and the scale are correct.
	The pipe size and the pipe thickness selected with the settings differ from those of the actual pipe.	Set the pipe size and the pipe thickness correctly. Alternatively, adjust the flow rate span according to the actual flow rate value.
	Use of seamless piping.	The piping thickness is not uniform, adjust the flow rate span.
	The origin adjustment has not been performed correctly.	Perform the origin adjustment again when the pipe is filled with fluid and the fluid is still.
	The characteristics of the fluid largely differ from those of water.	• Adjust the flow rate span according to the actual flow rate value. • Enter the ultrasonic speed and the kinematic viscosity.
	The flow velocity distribution is not uniform due to factors such as a laminar flow and drift.	• Change the installation position. • Adjust the flow rate span according to the actual flow rate value. • Install the sensor so that the alignment guide position does not line up with the brackets.
The instantaneous flow rate is displayed even though no fluid is flowing through the pipe.	The origin adjustment has not been performed correctly.	Perform the origin adjustment again when the pipe is filled with fluid and the fluid is still.
	The pipe is not filled with fluid.	• Install the pipe in a manner so that it is always filled with fluid. • Install the sensor so that the display is perpendicular, not parallel, to the ground.
	The zero cut flow rate setting is too small.	• Increase the response time. • Increase the zero cut flow rate. • Make the display averaging time longer.
The display turns on and off.	• The power is not turned on. • The connector cable is damaged. • The unit is in the power-saving mode.	• Check the power capacity. • Check the wiring for crossed wires or loose connections. • Replace the connector cable with a spare. • Check if the sensor is in the power-saving mode.

11-2 Output Status during Errors

Display	Control output	Analog output	Recorded data	Large status indicator
ERC	OFF	Normal operation	Normal operation	Blinks in red
ERE	Normal operation	Normal operation	Does not operate	Blinks in red
ERP	ON*	Normal operation	Normal operation	Blinks in red
REV	Operates as if the flow rate is zero	When 4-20 mA is set: 3.5 mA When 0-20 mA is set: 0 mA	Records as if the flow rate is zero	Operates as if the flow rate is zero
SET CLOCK	Normal operation	Normal operation	Only sets the correct time and does not operate	Normal operation
L.TEMP	Operates as if the temperature is -40.1°C	Outputs as if the temperature is -40.1°C	-40.1	Normal operation
H.TEMP	Operates as if the temperature is 140.1°C	Outputs as if the temperature is 140.1°C	140.1	Normal operation
---	Operates as if the flow rate is zero	When 4-20 mA is set: 3.5 mA When 0-20 mA is set: 0 mA	Records as if the flow rate is zero	Operates as if the flow rate is zero

* Pulses cannot be tracked accurately during pulse output mode.

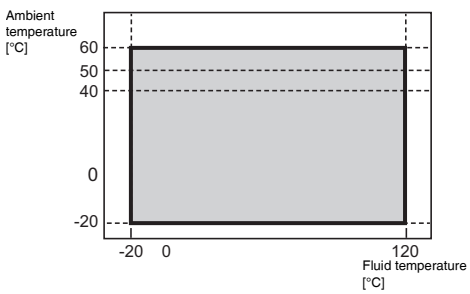
12. Specifications

12-1 Specifications

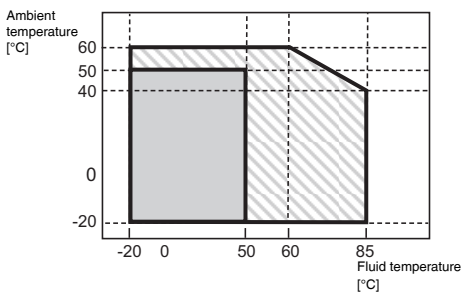
Model		FD-R50		FD-R80		FD-R125		FD-R200	
Supported pipe diameter	DN (Diameter Nominal)	40A	50A	65A	80A	100A	125A	150A	200A
	NPS (Nominal Pipe Size)	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
	Outer diameter of pipe (mm)	ø44 to ø55	ø55 to ø64	ø64 to ø83	ø83 to ø100	ø100 to ø127	ø127 to ø152	ø152 to ø191	ø191 to ø220
Supported pipe materials		Metal/resin *1							
Supported fluids		Various liquids (i.e. water, oils, chemicals) *1							
Fluid temperature		-20 to +120°C (no freezing on the pipe surface) *2							
Rated flow velocity range		5.0 m/s							
	Flow rate range (typical)	(400L/min 24m³/h 100gal/min)	(600L/min 36m³/h 150gal/min)	(1000L/min 60m³/h 260gal/min)	(1500L/min 90m³/h 390gal/min)	(2500L/min 150m³/h 660gal/min)	(3700L/min 220m³/h 990gal/min)	(5500L/min 330m³/h 1400gal/min)	(9500L/min 570m³/h 2500gal/min)
Zero cut (default) *3		0.3 m/s							
	Flow rate range (typical)	(36L/min 2.4m³/h 9gal/min)		(90L/min 5.4m³/h 24gal/min)		(220L/min 12m³/h 60gal/min)		(570L/min 36m³/h 150gal/min)	
Display method		Dual row, 5-digit display with white, 14-segment LED; Large status indicator, Output indicators, Stability indicator, Unit indicator							
Display update cycle		Approx. 3 Hz							
Display resolution		0.1/1 (L/min)		1 (L/min)					
Response time		0.5 s/1.0 s/2.5 s/5.0 s/10.0 s/30.0 s/60.0 s/120.0 s/200.0 s (variable)							
Measurement accuracy	Between 20 and 100% of F.S.	±2.0% of RD *4, 5							
	Between 6 and 20% of F.S.	±0.4% of F.S. *4, 5							
Zero point error		±0.5% of F.S. *4, 6							
Hysteresis		Variable							
Flow units		L/min, m³/h, gal/min							
Integrated flow unit display		1/10/100/1000/10000 (L)							
Pipe temperature measurement accuracy (ambient operating temperature of 25°C) *4		±3°C, ±5.4°F (pipe temperature: -20°C to +50°C), ±5°C, ±9°F (pipe temperature: 50°C to 120°C)							
Wiring specifications	Power supply	DC power supply: M12 4-pin connector/AC power supply: M4 screw terminal block (selectable)							
	I/O	When using a DC power supply: M12 4-pin connector/when using an AC power supply: M3 screw terminal block							
I/O (selectable)	Control output (ch.1/ch.2)	Control output/Integrated pulse output/Error output/Temperature alarm, NPN/PNP setting switchable, open collector output 30 VDC or less, max. 100 mA/ch., residual voltage: 2.5 V or less							
	Analog output (ch.1/ch.2)	Flow rate analog output/Temperature analog output and 4-20 mA/0-20 mA (selectable), load resistance: 500 Ω or less							
	External input (ch.2)	Integrated flow reset input/Flow rate zero input/Origin adjustment input (selectable), short-circuit current: 1.5 mA or less, input time: 20 ms or more							
Rating	Power supply voltage	20 to 30 VDC including 10% ripple (P-P), Class 2/100 to 240 VAC - 15% or + 10% (50/60Hz)							
	Current consumption	When using a DC power supply: 200 mA or less (load current excluded),400 mA or less (load current included) When using an AC power supply: 15 VA or less							
Protection circuit		Power supply reverse connection protection, Power supply surge protection, Short-circuit protection for each output, Surge protection for each output							
Environmental resistance	Enclosure rating	IP65/67(IEC60529), IP69K(ISO20653), Enclosure Type 4X(NEMA250)							
	Ambient temperature	-20 to +60°C (no freezing) *2							
	Ambient humidity	5 to 90%RH (no condensation)							
	Vibration resistance	10 to 55 Hz, compound amplitude 1.5 mm, XYZ axes 2 hours for each axis							
	Shock resistance	100 m/s², 16 ms pulse, XYZ axes, 1000 times for each axis							
Material	Main unit	Body: aluminum die-casting + coating/PPS, display: reinforced glass, connectors: SUS304-equivalent							
	Unit rear surface	Rubber							
	Upper/lower bracket	SUS304							
Weight	Main unit	Approx. 1 kg							
	Upper/lower bracket (including sub unit)	Approx. 1.5 kg		Approx. 2.0 kg		Approx. 2.3 kg		Approx. 2.5 kg	
Main unit size		218.5mm × 66.9mm × 70.7mm							

*1 Liquid must allow for the passage of an ultrasonic pulse, as well as not contain large air pockets or excessive bubbles.Detection may be unstable due to the type and status of the pipes.
*2 Perform derating depending on the ambient temperature and liquid temperature when using an AC power supply.
*3 The zero cut flow rate can be changed in the settings.
*4 This value is guaranteed by KEYENCE inspection facilities. Errors will be introduced by the type and status of the pipes the type and temperature of the liquid, and the zero cut flow rate.
*5 This is the value when considering linearity + span error + repeatability in a stable environment of 25°C.
*6 It is possible to enhance the precision of zero point error by performing an origin adjustment.
*7 IO-Link : Compatible with specification v1.1/COM2 (38.4kbps). The setting file can be downloaded from the KEYENCE website (http://keyence.com).
If using the unit in an environment where downloading the file in not accessible via Internet, contact your nearest KEYENCE office.
IO-Link is either registered trademarks of PROFIBUS Nutzerorganisation e.V. (PNO).

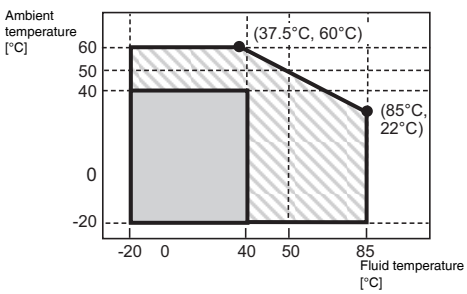
Temperature range when supplying DC power to the unit



Temperature range when supplying AC power to the unit



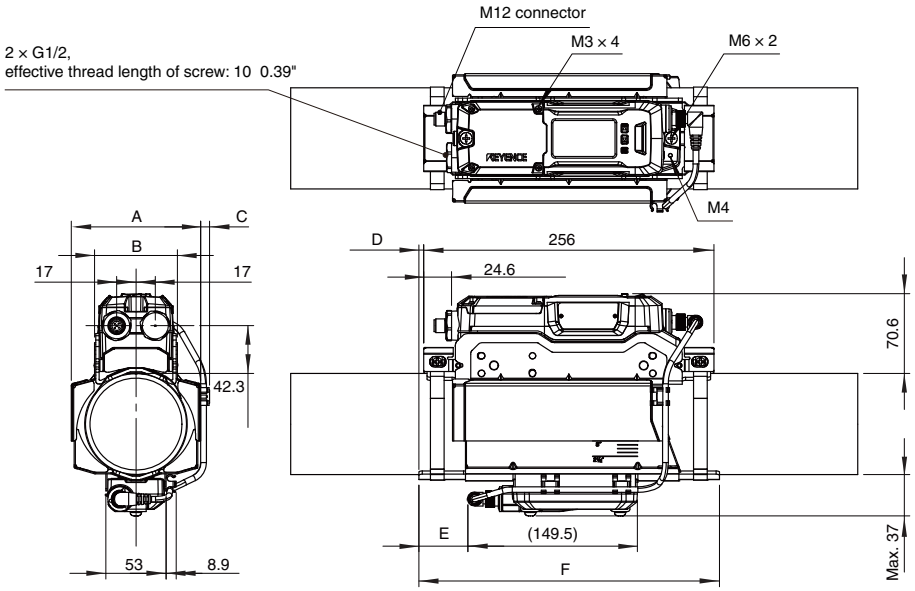
Temperature range when supplying AC power to the unit and being exposed to radiation such as direct sunlight.



When using the FD-R Series in the temperature condition shown by oblique lines, use cables with heat resistance of 90°C or higher for the power cables and the I/O cables.

12-2 Dimensions

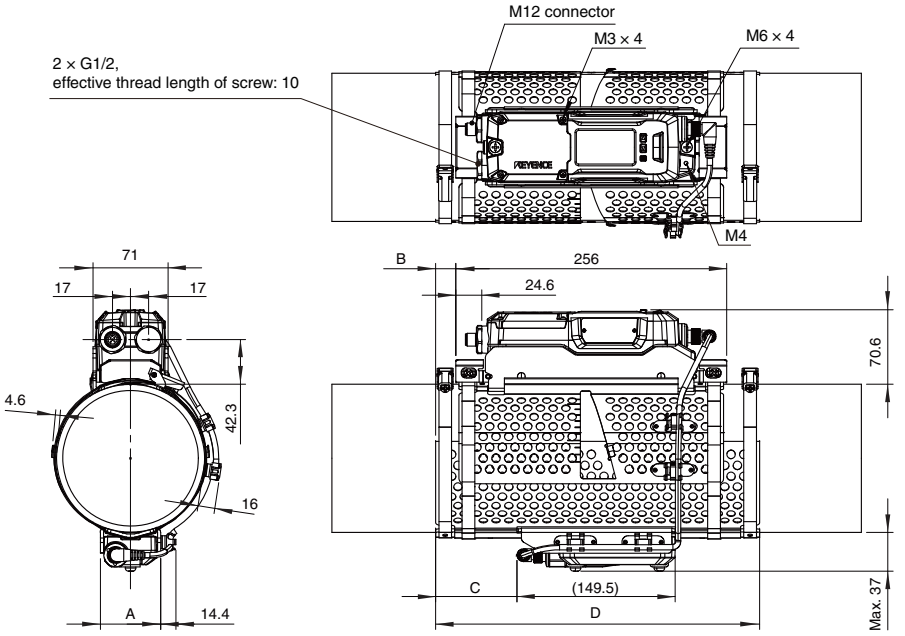
● **FD-R50/FD-R80**



	FD-R50	FD-R80
A	76	114
B	71	73
C	0	7.9
D*	-7.9 to -1.1 1 1/2" (40A): -2.6 2" (50A): -6.7	-1.6 to 14.1 2 1/2" (65A): 9.3 3" (80A): 4.3
E	(4.4)	(43.2)
F	247	265

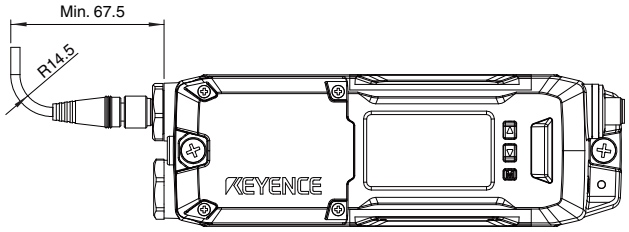
* The correct orientation is one in which the upper bracket is to the right of the lower bracket.

● **FD-R125/FD-R200**

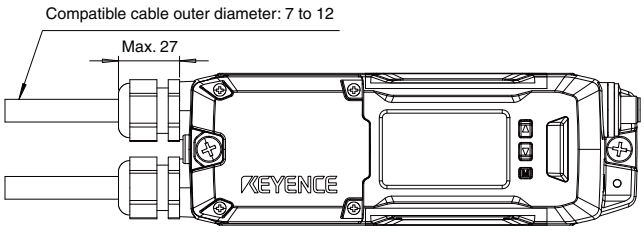


	FD-R125	FD-R200
A	57	62
B	14.1 to 34.6 4" (100A): 29 5" (125A): 19	17.1 to 42.9 6" (150A): 37.6 8" (200A): 18.5
C	(76.9)	(104.3)
D	306	315

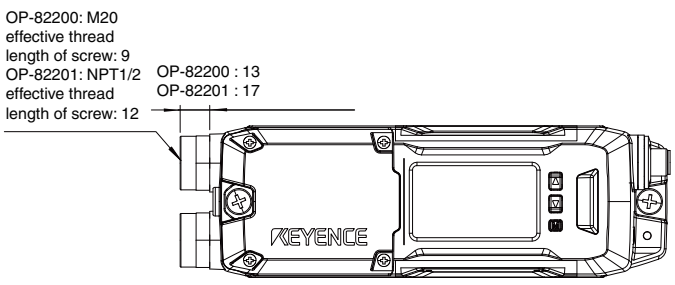
● **When the M12 power supply cable is attached**



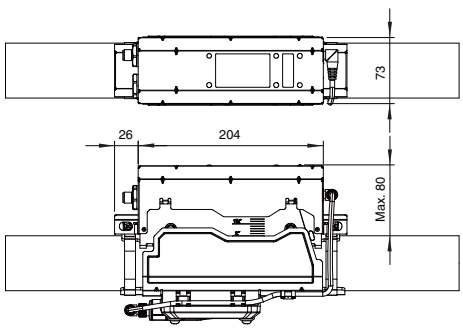
● **When the cable glands are attached**



● **When the thread conversion couplings are attached**



● **When the protection cover is attached**



12-3 Default Settings/Values List

Item			FD-R50	FD-R80	FD-R125	FD-R200	Notes
A. Setting the time			--	--	--	--	
B. Selecting the ch.1 function		(✓)	OUT	OUT	OUT	OUT	
C. Selecting the ch.2 function		(✓)	OFF	OFF	OFF	OFF	
D. Selecting NPN/PNP		(✓)	NPN	NPN	NPN	NPN	
E. Selecting the flow direction		(✓)	→R	→R	→R	→R	
F. Selecting the flow unit		(✓)	L/MIN	L/MIN	L/MIN	L/MIN	
G. Selecting the temperature unit		(✓)	°C	°C	°C	°C	
H. Selecting the pipe size		(✓)	1 1/2	2 1/2	4	6	
I. Setting the measurement unit expansion		(✓)	OFF	OFF	OFF	OFF	
1. Output 1 detection mode		(✓)	STD	STD	STD	STD	
2. Output 1 output logic		(✓)	NO	NO	NO	NO	
3. Output 2 detection mode		(✓)	STD	STD	STD	STD	
4. Output 2 output logic		(✓)	NO	NO	NO	NO	
5. Selecting the input function		(✓)	RESET	RESET	RESET	RESET	
6. Analog output current		(✓)	4-20	4-20	4-20	4-20	
7. Selecting the analog output		(✓)	FLOW	FLOW	FLOW	FLOW	
8. Setting the flow analog output	Lower limit		0	0	0	0	
	Upper limit		600	1500	3700	9500	
9. Setting the temperature analog output	Lower limit		-200°C	-200°C	-200°C	-200°C	
	Upper limit		1200°C	1200°C	1200°C	1200°C	
10. Response time		(✓)	50	50	50	50	
11. Integrated flow unit		(✓)	1	1	1	1	
12. Extended functions menu			END	END	END	END	
13. Display resolution		(✓)	1	1	1	1	
14. Display averaging		(✓)	1	1	1	1	
15. Hysteresis			6	15	37	95	
16. Zero cut flow rate		(✓)	36	90	220	570	
17. Detection hold time		(✓)	10	10	10	10	
18. Integrated pulse weight			100	100	100	100	
19. Display indicator illumination mode		(✓)	GREEN	GREEN	GREEN	GREEN	
20. Display brightness		(✓)	STD	STD	STD	STD	
21. Power-saving mode		(✓)	OFF	OFF	OFF	OFF	
22. Simulation mode			OFF	OFF	OFF	OFF	
23. Simulation flow rate			—	—	—	—	
24. Simulation temperature			—	—	—	—	
25. Key lock method		(✓)	STD	STD	STD	STD	
26. Correcting the flow rate value		(✓)	OFF	OFF	OFF	OFF	
27. Adjusting the flow rate span			1000	1000	1000	1000	
28. Correcting the pipe outer diameter		(✓)	STD	STD	STD	STD	
29. Pipe outer diameter input			60.5	89.1	139.8	216.3	
30. Selecting the pipe thickness		(✓)	SCH	SCH	SCH	SCH	
31. Pipe thickness input			3.8	4.2	4.5	5.8	
32. Selecting the fluid type		(✓)	WATER	WATER	WATER	WATER	
33. Ultrasonic speed input			1497	1497	1497	1497	
34. Kinematic viscosity input			1.0	1.0	1.0	1.0	
Set value P1/P1-L of the instantaneous flow rate			60	150	370	950	
Set value P1-H of the instantaneous flow rate			360	900	2200	5700	
Set value P2/P2-L of the instantaneous flow rate			120	300	740	1900	
Set value P2-H of the instantaneous flow rate			300	750	1800	4700	
Set value of the integrated flow			600	1500	3700	9500	
Set value T-LO of the temperature			00°C	00°C	00°C	00°C	
Set value T-HI of the temperature			1000°C	1000°C	1000°C	1000°C	
I. Selecting the recorded data display			FLOW	FLOW	FLOW	FLOW	
II. Display time interval			DAY	DAY	DAY	DAY	
III. Full-time recording extended functions menu			END	END	END	END	
IV. Recorded data transmission			NO	NO	NO	NO	
V. Communication baud rate			115.2K	115.2K	115.2K	115.2K	
VI. Selecting the data to transmit			FLOW	FLOW	FLOW	FLOW	
VII. Amount of data to transmit			2000	2000	2000	2000	
VIII. Clock battery alarm		(✓)	ON	ON	ON	ON	
IX. Stop recording		(✓)	OFF	OFF	OFF	OFF	

(*) Items with ✓ can be restored using the quick setting code function.

Quick setting code

Serial number	Quick setting code

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