Instruction Manual

SPOOL PIECE ULTRASONIC FLOWMETER

TYPE: FST

INF-TN1FSTd-E Fuji Electric Co., Ltd.

PREFACE

We thank you very much for purchasing Fuji Electric's ultrasonic flow meter.
The instruction manual describes how to install, operate, checkup and maintain the Spool Piece Ultrasonic Flowmeter (FST). Read it carefully before operation.

- Read this instruction manual thoroughly before performing installation, operation and maintenance of the flow meter. Improper handling may result in an accident or a failure.
- The specifications of this flow meter are subject to change without prior notice for improvement of the product.
- Do not attempt to modify the flow meter without permission. Fuji will not bear any responsibility for a trouble caused by such a modification. If it becomes necessary to modify the flow meter, contact our office in advance.
- This instruction manual should always be kept on hand by the operator.
- After reading the manual, be sure to store it at a place easy to access.
- This instruction manual should be delivered to the end user.
- If the instruction manual has been lost, request another one (with charge) to our local business office.

Manufacturer:	Fuji Electric Co., Ltd.
Type:	Described in the nameplate put on the main body
Date of manufacture:	Described in the nameplate put on the main body
Product nationality:	Japan

Note

Issued in August 2016
Rev. 1st edition November 2016
Rev. 2nd edition May 2017
Rev. 3rd edition August 2017
Rev. 4th edition May 2018

WARRANTY AND MAINTENANCE

1. Scope of application

To use this equipment, the following conditions must be met:

- the use of the equipment incurs no risk of a serious accident even if a failure or malfunction occurs on the equipment, and
- in case of product failure or malfunction, safety measures such as redundant design, prevention of malfunction, fail safe system, and foolproof mechanism are provided outside of the equipment.

Be sure to use this instrument under the conditions or environment mentioned in this instruction manual.
Please consult us for the use for the following applications:

Radiation-related facilities, systems related to charging or settlement, or other usages which may have large impact on lives, bodies, property, or other rights or interests.

2. Operating conditions and environment

Refer to "CAUTION ON INSTALLATION LOCATION" on Page vi and Chapter 3, “INSTALLATION” on Pages 5-13.

3. Precautions and prohibitions

Refer to "SAFETY PRECAUTIONS" on Pages iv–v.

4. Warranty

4-1. Period of warranty

(1) Warranty period for this product including accessories is one year after delivery.
(2) Warranty period for the parts repaired by our service providers is six months after the completion of repair.

4-2. Scope of warranty

(1) If any failure or malfunction attributable to Fuji Electric occurs in the period of warranty, we shall provide the product after repairing or replacing the faulty part for free of charge at the place of purchase or delivery. The warranty does not apply to failure or malfunctions resulting from:
  1) inappropriate conditions, environment, handling or usage that is not instructed in a catalog, instruction book or user's manual, or overuse of the product,
  2) other devices not manufactured by Fuji Electric,
  3) improper use, or an alteration or repair that is not performed by Fuji Electric,
  4) inappropriate maintenance or replacement of expendable parts listed in the instruction book or the catalog,
  5) damages incurred during transportation or fall after purchase,
  6) any reason that Fuji Electric is not responsible for, including a disaster or natural disaster such as earthquake, thunder, storm and flood damage, or inevitable accidents such as abnormal voltage.
(2) Regardless of the time period of the occurrence, Fuji Electric is not liable for the damage caused by the factors Fuji Electric is not responsible for, opportunity loss of the purchaser caused by malfunction of Fuji Electric product, passive damages, damage caused due to special situations regardless of whether it was foreseeable or not, and secondary damage, accident compensation, damage to products that were not manufactured by Fuji Electric, and compensation towards other operations.

5. Failure diagnosis

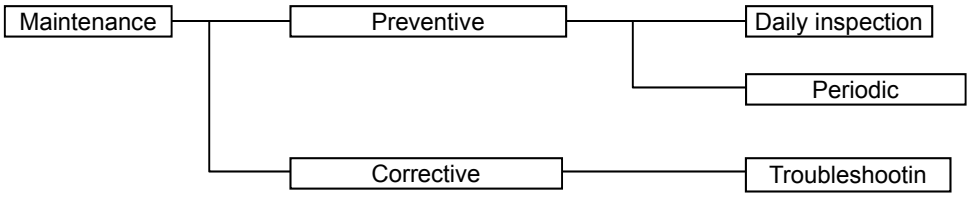
Regardless of the time period of the occurrence, if any failure occurs, the purchaser shall perform a primary failure diagnosis. However, at the purchaser's request, Fuji Electric or our service providers shall provide the diagnosis service for a fee. In such a case, the purchaser shall be charged for the service.

6. Service life

This product, excluding limited-life parts and consumable parts, is designed for a service life of 10 years under general operating conditions (with an average ambient temperature of 30°C).
The service life may be shortened depending on operating conditions and environment. To ensure the service life, it is important to perform planned maintenance of the product including limited-life parts and consumable parts.

7. Maintenance plan

Maintenance can be divided into "preventive maintenance" and "corrective maintenance". Preventive maintenance can further classified into "daily inspection" and "periodic inspection". Preventive maintenance is achieved through systematic implementation of "daily inspection" and "periodic inspection".



(1) Daily inspection

Be sure to perform daily inspection prior to operation to check for any problem in daily operation. For the specific items of daily inspection, refer to Chapter 5, “CHECK AND MAINTENANCE”.

(2) Periodic inspection

Periodic inspection is to replace limited-life parts before their service lives are over, thus preventing failure. Recommended inspection interval is 6 months to 12 months. If you are using the instrument under harsh environment, we recommend you to shorten the inspection interval. For the specific items of periodic inspection, refer to Chapter 5, "CHECK AND MAINTENANCE".

(3) Corrective maintenance

Corrective maintenance is a measure to be taken after a trouble has occurred. Refer to 5.3 “Troubleshooting”. If the measures mentioned in this instruction manual do not solve the problem, please contact one of our sales offices or service offices.

8. Limited-life parts and consumable parts

This product contains the following limited-life parts and consumable parts which may affect the service life of the product itself.

(1) Aluminum electrolytic capacitor

Design life: 10 years under general working conditions (annual average of ambient temperature: 30°C)
Symptoms when a capacitor loses its capacity: deterioration of power quality, malfunction
Factors which affect battery life: temperature. The life is shortened by half when the temperature rises by 10°C. (Arrhenius' law)
Replacement: Estimate the lifetime of capacitor according to your operating environment, and have the capacitor replaced or overhauled at appropriate time, at least once in 10 years.
Do not use capacitors beyond its lifetime. Otherwise, electrolyte leakage or depletion may cause odor, smoke, or fire. Please contact Fuji Electric or its service providers when an overhaul is required.

(2) LCD

Design life: approx. five years for continuous use
Symptoms when LCD is depleted: unclear indication, back light not working
Factors which affect battery life: temperature. The life is shortened by half when the temperature rises by 10°C. (Arrhenius' law)
Replacement: Estimate the lifetime of built-in battery according to your operating environment, and replace it at appropriate time.

9. Spare parts and accessories

Refer to 1-1. “Checking delivered items" for spare parts and accessories.

10. Period for repair and provision of spare parts after product discontinuation (maintenance period)

The discontinued models (products) can be repaired for five years from the date of discontinuation. Also, most spare parts used for repair are provided for five years from the date of discontinuation. However, some electric parts may not be obtained due to their short life cycle. In this case, repair or provision of spare parts may be difficult even in the above period.
Please contact one of our sales offices or service offices for further information.

11. RoHS compliance of the product when repaired or calibrated

We cannot assure the RoHS compliance of the product if it is returned for repair or calibration and delivered again. This is because that we cannot check whether or not the product returned has been contaminated by hazardous substances restricted by the RoHS directive.
If you want the product to be repaired in the RoHS compliant area in our factory, provide us with a certificate of non-inclusion of restricted substances. If you return the product from an EU member state to us for repair, provide us with a document that indicates the purpose of export is repair.

SAFETY PRECAUTIONS

Before using this product, read the following safety precautions and use the product correctly.

The following items are important for safe operation and must be fully observed. Safety precautions are ranked in 2 levels; "DANGER" and "CAUTION".

Warning/Symbol	Meaning
⚠ **DANGER**	Incorrect handling of the device may result in death or serious injury.
⚠ **CAUTION**	Incorrect handling may lead to a risk of medium or light injury, or to a risk of physical damage.
⏚	Protective ground terminal. Be sure to connect the product with the ground before starting operation.

The items noted under " ⚠ CAUTION " may also result in serious trouble depending on circumstances.
All the items must be fully observed.

Caution on mounting and piping	
⚠ **DANGER**	● This unit is not explosion-proof type. Do not use it in a place with explosive gases. Otherwise, it may result in serious accidents such as explosion, fire, etc.
⚠ **CAUTION**	● The unit should be installed in a place conforming to the installation requirements noted in this instruction manual. Otherwise, it may cause electric shocks, fire or malfunction of the unit. ● This equipment is designed as Class A equipment (intended for use in industrial environments) in conformity with EMC standards. Do not use this product in a residential area, or it may cause radio interference. If you unavoidably use it in such an area, take adequate measures outside the equipment to reduce radio interference. ● Install the flow meter according to the instructions in this manual to prevent it from damage, and to avoid error or malfunction. ● During installation, make sure that the inside of the unit is free from cable chips and other foreign objects. Otherwise, it may cause fire, failure or malfunction. ● To meet the safety standards, be sure to use SELV for analog output, contact output, and serial communication (RS485).

Caution on wiring

⚠ CAUTION

- To prevent output error caused by moisture, dew condensation or water leak, follow the instructions in 3.6. *Wiring* in this manual.
- Before performing the wiring work, be sure to turn OFF the main power. Otherwise, it may cause electric shock.
- To secure the insulation and prevent fault due to dew condensation, do not perform wiring work outdoors in rainy days.
- Be sure to connect a power source of correct rating. Use of power source out of rating may cause fire.
- The unit must be grounded as specified. Otherwise, it may cause electric shocks, malfunction, etc.
- The signal cables should be wired as far away as possible from high-voltage lines to prevent interference from noise.
- To prevent malfunction of the unit, the analog output signal cable and power cable should be wired using separate conduits.
- Be careful not to touch electronic components other than the terminal block. Electronic components can get hot during operation and cause skin burns.

Caution on operation and long-term stoppage

⚠ CAUTION

- During operation, be sure to observe the following instructions to prevent failure or malfunction.
  - Do not energize the flowmeter when the pipe is empty.
  - Do not leave the pipe with negative pressure.
  - Do not suddenly add a fluid of which temperature extremely differ from the existing fluid.
- When you stop the operation and leave the product unused for long time, be sure to:
  - Uninstall the flowmeter from the pipe, clean inside of the spool with clean water, and dry it. Fail to clean the spool may cause accretion and result in measurement error.
  - Disconnect the flowmeter from power supply. However, energize it at least once a year and for 24 hours or more, to prevent degradation of electrolytic capacitor.

Caution on maintenance and inspection

⚠ CAUTION

- The unit should be inspected every day to always obtain good results of measurements.
- Do not let the contaminants get into the fluid.
- If the fluid being measured is adhesive, periodically clean inside the spool with reference to 5.2.2 *Removing Accretion Inside Spool*
- When measuring the insulation resistance between the power/output terminal and the case, follow the instructions in 5.2.3. *Measuring the Insulation Resistance* in this manual.
- If a fuse has blown out, contact us to get it replaced.

CAUTION ON INSTALLATION LOCATION

⚠ CAUTION

(1) A place where ambient temperature is between -40°C and +60°C, and humidity is 90% RH or less.
(2) An indoor or outdoor place not exposed to direct sunshine, wind, or rain.
(3) A place that provides enough space for periodic inspection and wiring work.
(4) A place not subjected to radiated heat from a heating furnace, etc.
(5) A place not subjected to corrosive atmosphere.
(6) A place not to be submerged.
(7) A place free from excessive vibration, dust, dirt and moisture.
(8) A place remote from electrical devices (motor, transformer, etc.) which generate electromagnetic induction noise, electrostatic noise, etc.
(9) A place not subjected to excessive fluid pulsation such as pump discharge side.
(10) A place large enough to secure the required length of the straight portion of a pipe.
(11) Altitude: up to 2000m
(12) Overvoltage category: II
(13) Pollution degree: 2

} According to IEC61010-1

Table of Contents

1. PRODUCT OUTLINE

1.1. Checking Delivered Items

After opening the package, check if all the following parts are present.
Note that the delivered parts vary according to the model.

Flowmeter main unit ····· 1
Waterproof gland (Built into the main unit) ····· 1
CD-ROM (Instruction manual and loader software)····· 1
Safety precautions····· 1

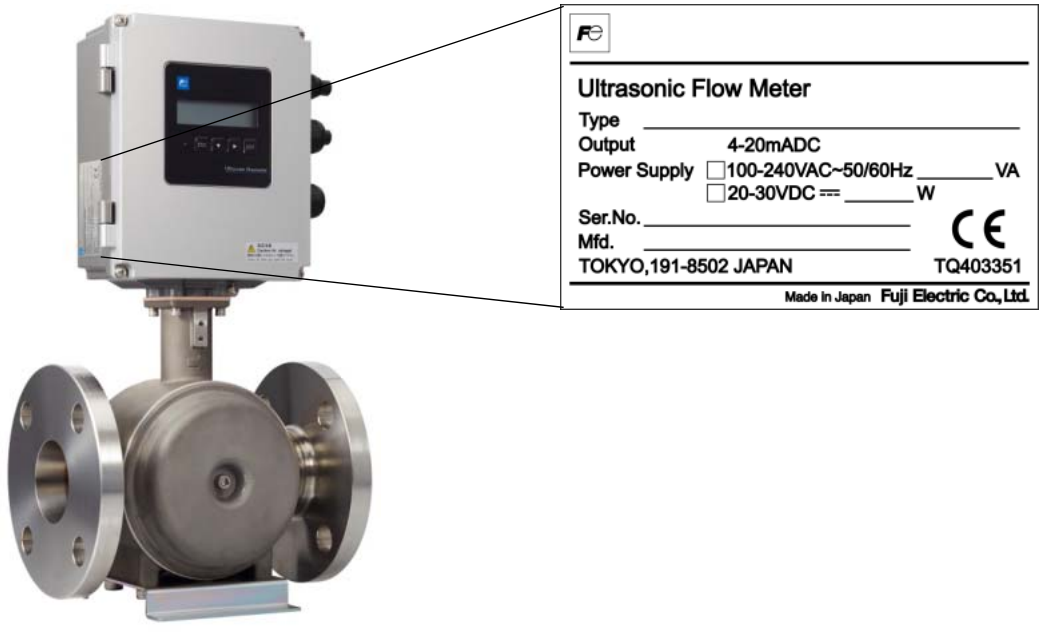
Out of the scope of delivery:
Power cable
Output signal cable
RS-485 communication cable

Flowmeter FST

1.2. Checking Type and Specifications

The type and specifications of product are indicated on the specification plate mounted on the flow transmitter frame. Check that they represent the type you ordered, referring to the following code symbols.

		4	5	6	7	8		9	10	11	12 ← Digit
	FST	1				1	-				Y
Digit	Description										
4	<Enclosure> Non-explosion-proof	1									
5	<Diameter> 25A 50A 80A 100A		A D F G								
6	<Flange rating and material> JIS 10K / SS 316L JIS 20K / SS 316L ANSI 150LB / SS 316L ANSI 300LB / SS 316L DIN PN16 / SS 316L DIN PN40 / SS 316L			1 2 3 4 5 6							
7	<Power Supply> 100–240 V AC, 50/60 Hz 20–30 V DC				1 4						
8	Revision code					1					
9	<Parameter setting/tag plate> None With setting With setting + tag With tag							Y A B C			
10	<Communication> None RS-485								Y D		
11	<Mounting/wiring port position> Horizontal/on downstream side Horizontal/on upstream side Horizontal/on the right side seen from upstream Horizontal/on the left side seen from upstream Vertical/on bottom side									A B C D E	
12	<Wiring port> G1/2/Plastic water-proof gland + rubber plug										Y



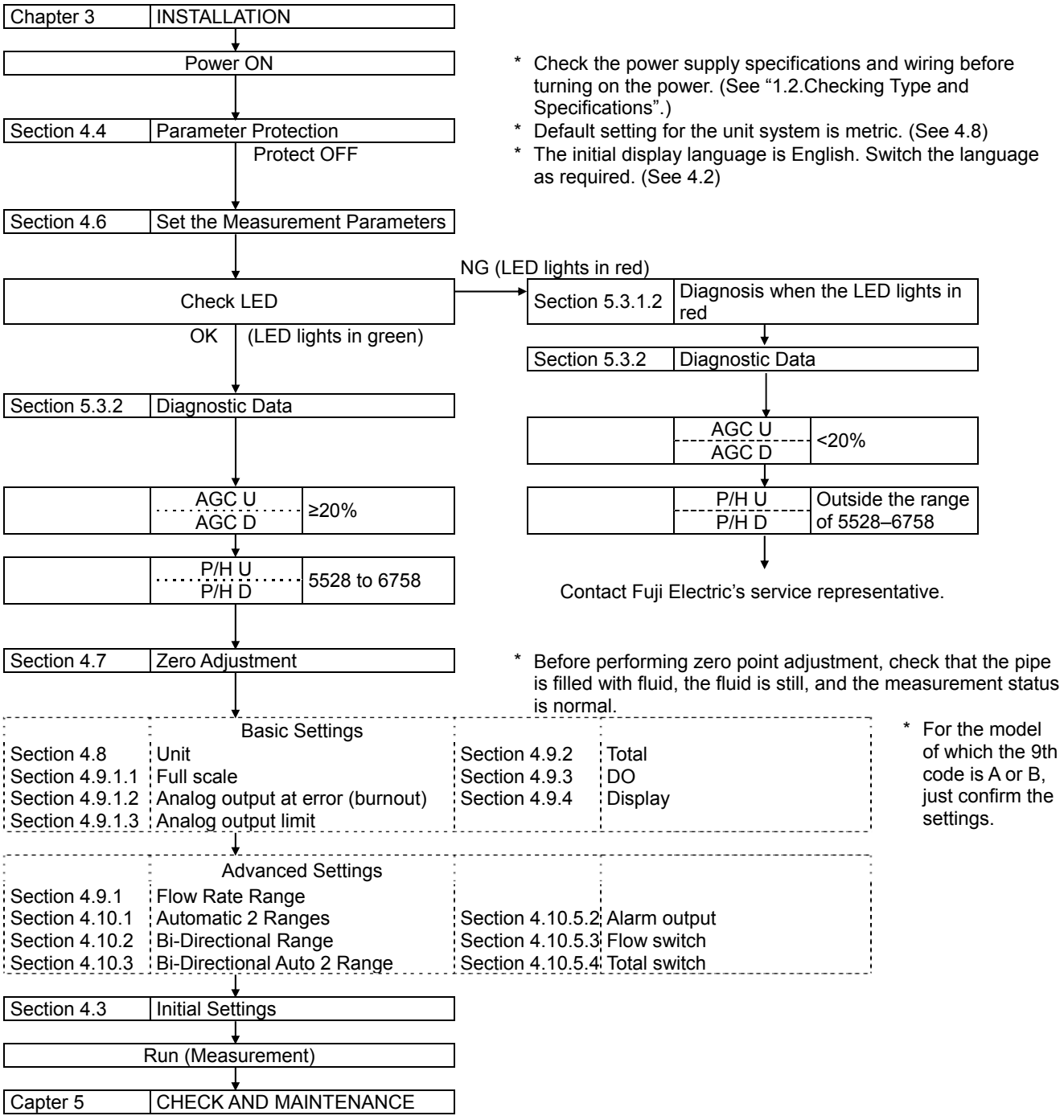
1.3. Name and Function of Each Part

No.	Name	Key	Description
①	Wiring port		For power cable and output cable
②	Wiring port		For communication cable only
③	Control panel		Displays measured results or used to setup the parameters.
④	Received wave diagnostic indicator (LED)		Indicates whether received wave is normal (green) or abnormal (red).
⑤	Escape key	ESC	Cancels an entry or returns to the higher-level menu.
⑥	Next key	▽	Selects a numeric value or symbol, or moves forward to the next menu item.
⑦	Shift key	▷	Moves forward the cursor or selects decimal place.
⑧	Enter key	ENT	Finishes editing an entry to register it, or enter into a menu.
⑨	LCD display		Indicates the flow rate or setpoints.
⑩	Insulation cover		Insulates the power supply and other circuits.
⑪	Power terminal		For power cable
⑫	Output terminal		For analog output cable or digital output cable.
⑬	Communication terminal		For communication cable (A communication board is optional)
⑭	Fuse holder		
⑮	Communication board		Mounted if communication is optionally ordered.
⑯	Detector		Obtains flow velocity by transit time method.

2. INSTALLATION AND SETUP

2.1. Outline

Install the flowmeter according to the following procedure.



* Check the power supply specifications and wiring before turning on the power. (See "1.2.Checking Type and Specifications".)

* Default setting for the unit system is metric. (See 4.8)

* The initial display language is English. Switch the language as required. (See 4.2)

* Before performing zero point adjustment, check that the pipe is filled with fluid, the fluid is still, and the measurement status is normal.

* For the model of which the 9th code is A or B, just confirm the settings.

Note) Set the parameter protection to OFF before you change settings or perform zero adjustment.

3. INSTALLATION

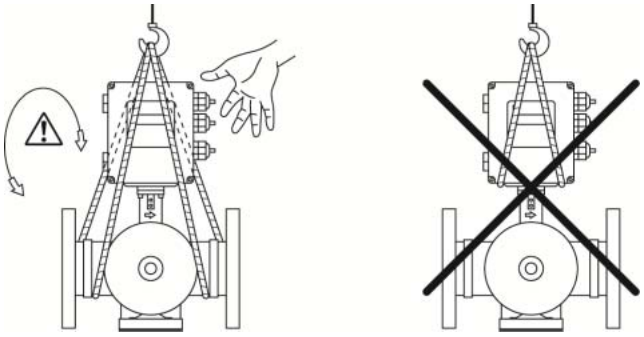
Select an installation location that satisfies the following conditions for ease of maintenance and for assurance of product service life and reliability all considered.

⚠ CAUTION

(1) A place where ambient temperature is between -40°C and +60°C, and humidity is 90% RH or less.
(2) An indoor or outdoor place not exposed to direct sunshine, wind, or rain.
(3) A place that provides enough space for periodic inspection and wiring work.
(4) A place not subjected to radiated heat from a heating furnace, etc.
(5) A place not subjected to corrosive atmosphere.
(6) A place not to be submerged.
(7) A place free from excessive vibration, dust, dirt and moisture.
(8) A place remote from electrical devices (motor, transformer, etc.) which generate electromagnetic induction noise, electrostatic noise, etc.
(9) A place not subjected to excessive fluid pulsation such as pump discharge side.
(10) A place large enough to secure the required length of the straight portion of a pipe.

3.1. Transportation

- Keep the product unpacked until it arrives at the place of installation. Be careful not to drop it or give shock to it.
- Do not lift up the transmitter unit to carry the flowmeter. If you suspend the flowmeter to carry it, use a wire rope, not a metal chain, and wind the wire rope around the pipe of the spool. Put protective materials at the portion where the wire rope touches the transmitter, to prevent the coating from being damaged and the rope from being displaced.
- Be careful not to damage the transmitter case, as it is coated with corrosion-resistant material.



3.2. Installation Location

Installation location and piping conditions largely affect the accuracy. Select the location where:

- The required length of straight portion, shown in 3.3 *Pipe Requirements* is secured.
- There is no pump, valve, or other obstructions within 30D on upstream side.
- The pipe shall be fully filled with fluid which contains neither air bubbles nor contaminants.
- There is enough space for maintenance work in front of the flowmeter, as shown in Figure 3-1.

  Note) A space should be provided so that maintenance work can be made with workers standing on both sides of the piping.

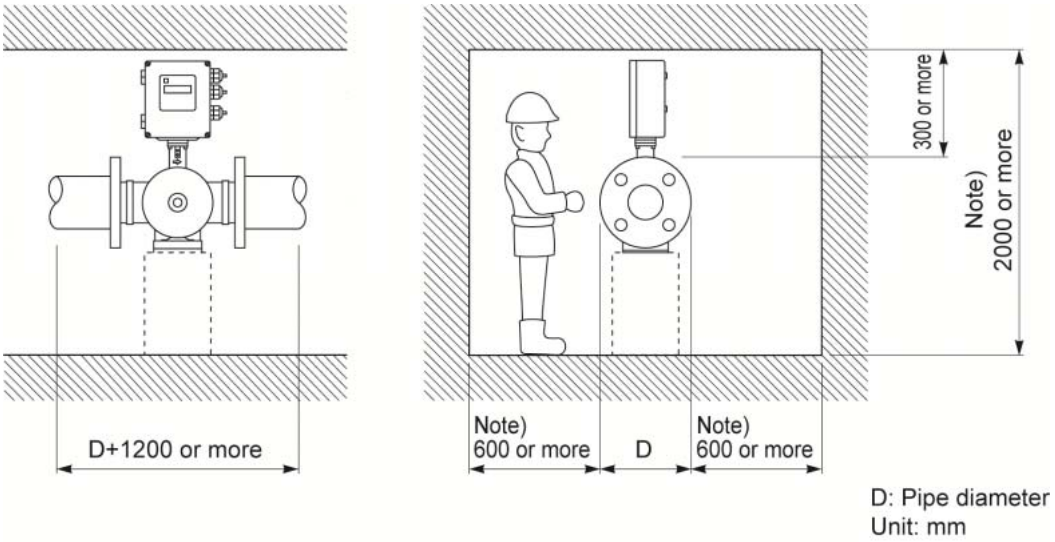
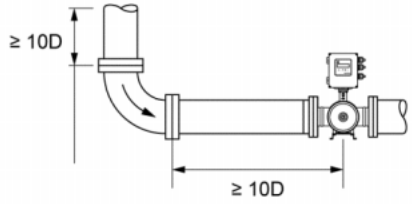
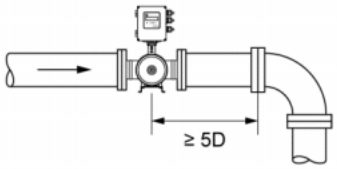
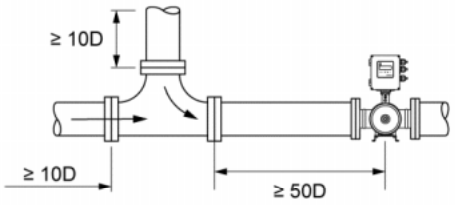
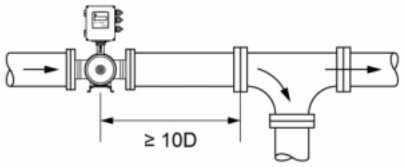
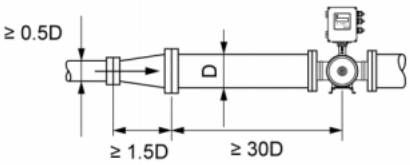
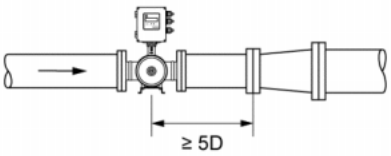
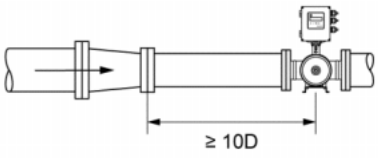
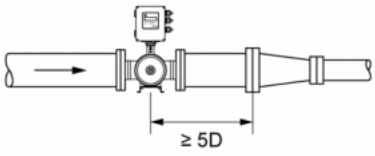
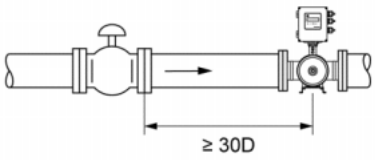
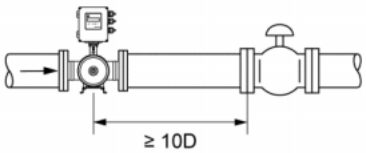
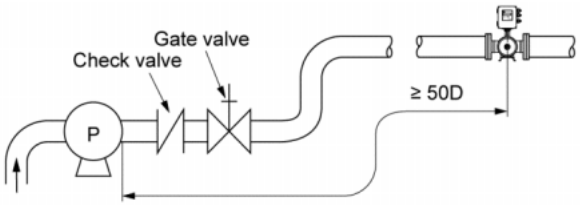


Figure 3-1 Required clearance

3.3. Pipe Requirements

(D: inside diameter of pipe)

	Upstream	Downstream
90° bend		
T-shaped pipe		
Expanding pipe		
Tapered pipe		
Valves	 In the case where a flow control valve exists on upstream side	 In the case where a flow control valve exists on downstream side
Pump		

3.4. Mounting Position

On horizontal pipe: position the flowmeter in such a way that the transmitter comes to upper side.
On vertical pipe: position the transmitter in such a way that the wiring ports come on the bottom side.

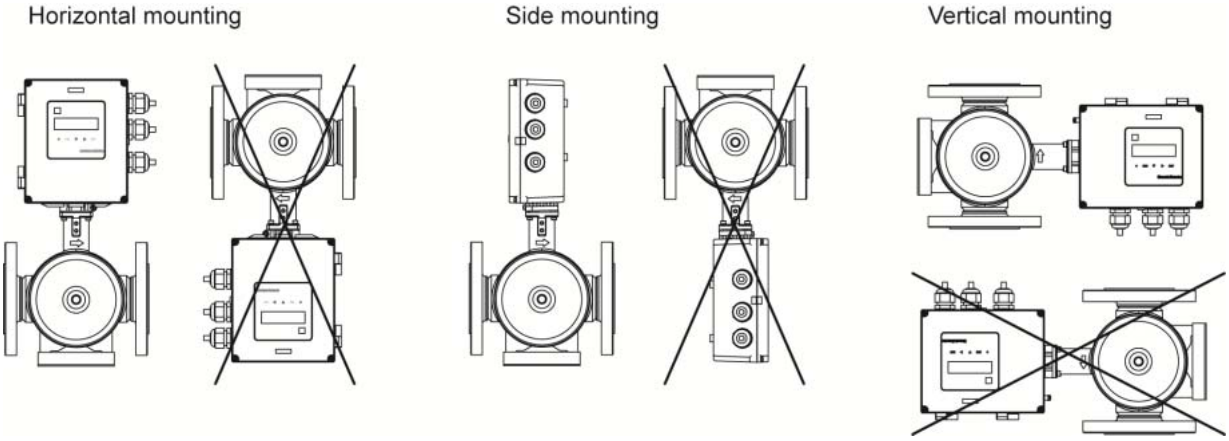


Figure 3-2 Mounting posture

Mount the flowmeter on the portion of the pipe where the pipe is fully filled with fluid.

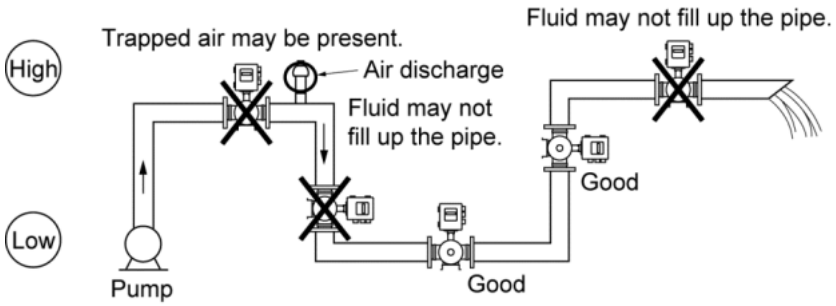


Figure 3-3 Example of mounting posture

For ease of maintenance and zero point adjustment, it is recommended to add a bypass line. In the configuration shown in Figure 3-5 where a bypass line and a closing flange is used, you can clean inside the spool without removing the flowmeter. Figure 3-4 and Figure 3-5 show how to install a bypass line.

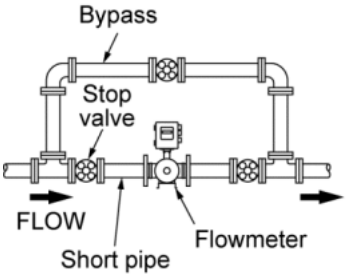


Figure 3-4 Horizontal bypass line

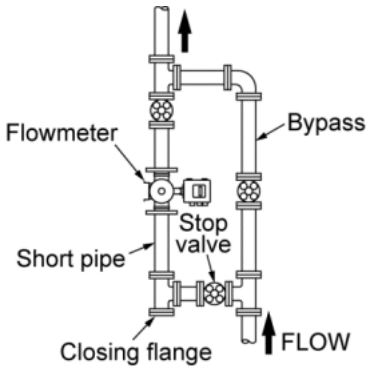


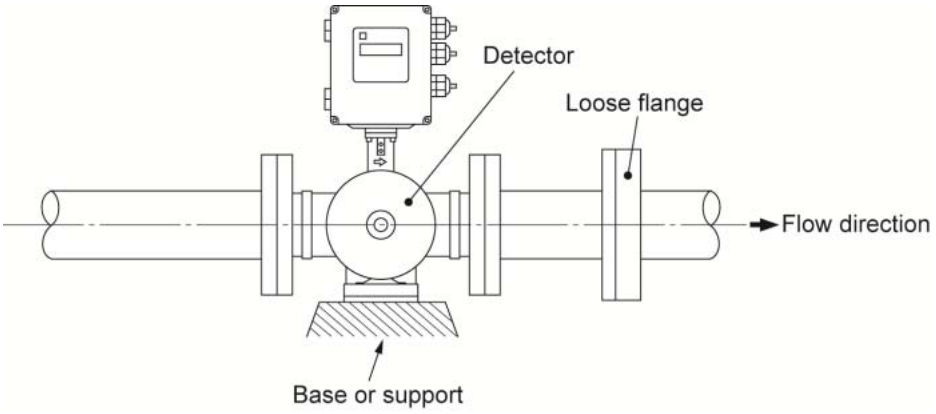
Figure 3-5 Vertical bypass line

3.5. Installation

⚠ CAUTION

(1) Be sure that the gasket or packing is not to extend inside the pipe.
(2) The torque table is just for your reference. The adequate torque differs with gasket material and/or pipe conditions.

1. Check the bolt hole size of the flange to be paired, and the space where the detector is to be installed.
2. Position the detector in a way that the arrow mark on the flowmeter neck matches to the flow direction. Do not use the detector to correct a twist or bend of pipe. Do not install the detector forcibly in a deficient space.
3. On horizontal pipe: position the flowmeter in such a way that the transmitter comes to upper side.
4. There are two methods of installation; with fixed flange or with loose flange (reducer). Using the loose flange makes installation and uninstallation easy, but a support or a base as shown below is required, because the flowmeter is too heavy for pipe. A support is required even in the case of installation using fixed flange, if there is no support for the lines on which the flowmeter is to be installed.
5. Align the center of the pipe and that of the detector.

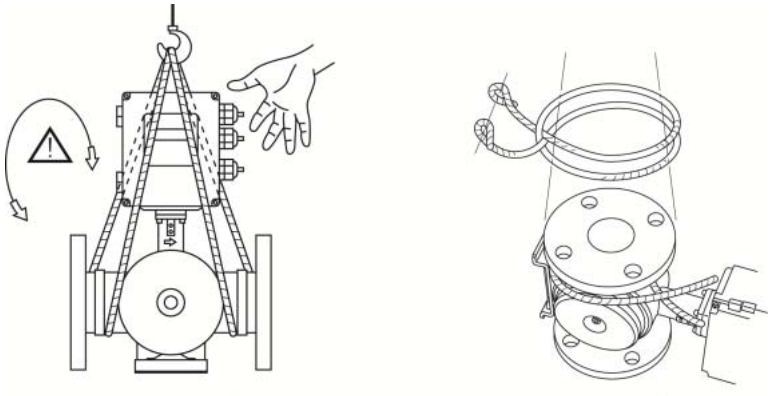


Use a torque wrench to fasten the flange bolts. The torque values in the below table is for your reference.

Torque [N・m]

Diameter	flange					
	JIS 10K	JIS 20K	ANSI 150LB	ANSI 300LB	DIN PN16	DIN PN40
25A	118±14	118±14	50±6	118±14	48±5.8	48±5.8
50A	118±14	118±14	118±14	118±14	118±14	118±14
80A	118±14	240±29	118±14	240±29	118±14	118±14
100A	118±14	240±29	118±14	240±29	118±14	240±29

6. If you install the flowmeter on vertical pipe, fix the upper pipe on the wall to prevent the detector from bearing excessive weight of pipe. When you lift the flowmeter with wire rope, put protective materials on the portion where the rope touches the flowmeter to prevent the coating from being damaged, and the rope from being displaced.



Hoisting methods

3.6. Wiring

⚠ CAUTION

(1) For output signal, use a shielded cable, where possible.
(2) To avoid noise interference, do not put the cables together with heavy duty line or the like into the same duct.
(3) For safety, carry out the class D grounding with ground resistance up to 100 ohm, by using M4 screw of the transmitter.
(4) This equipment has no power switch. To meet the safety requirements, add a power switch or a circuit breaker in the system. A power switch or a circuit breaker must be properly installed within easy reach of an operator, and must be identified as a disconnecting switch of the equipment.
(5) Put the provided caps on unused wiring ports.

3.6.1. Applicable Wires

Use the following cables.

- Power cable : 3-wire or 2-wire cabtire cable
  Allowable temperature: 70°C or more
  Nominal sectional area: 0.75 mm^2 or more
  Outside diameter: 7 to 11 mm
- Output signal cable : 2-wire or multi-wire cabtire cable as required
  Allowable temperature: 70°C or more
  Outside diameter: 7 to 11 mm
- Communication cable : Shielded twisted pair cable
  Allowable temperature: 70°C or more
  Outside diameter: 7 to 11 mm

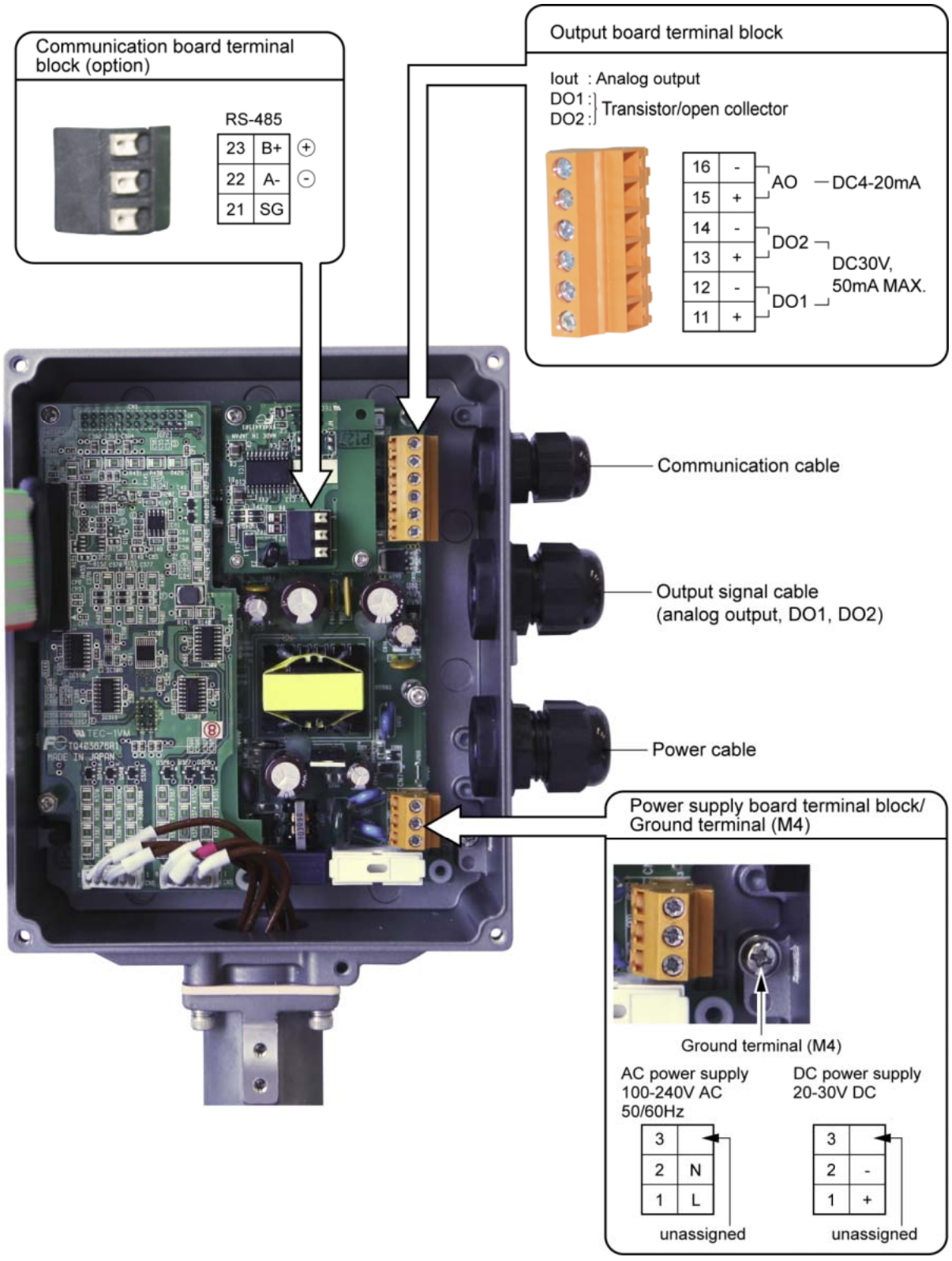
3.6.2. Treatment of Wiring Port

If the flowmeter is installed in a humid place, be sure to put the provided waterproof glands on the wiring ports to protect the ports from moisture or condensation. Put the supplied cover on each gland until you use it.

⚠ CAUTION

Do not install the instrument where there is a risk of submergence.

3.6.3. Wiring Diagram



Note 1) Terminal blocks are pluggable type (European style). Use rod-shaped crimp terminals.
Note 2) For output signal, use multiple core cable as required.
Note 3) Differential signal line of RS-485 consists of two pins.
⊕ means B+, and ⊖ means A-.

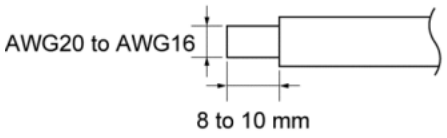
3.6.4. Connecting Cables to Terminal Blocks

3.6.4.1. Cable termination

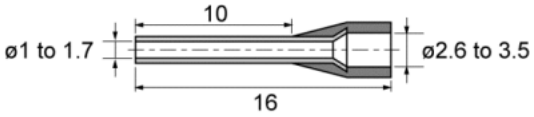
For safety, we recommend to use end ferrules to crimp wires and connect them to the terminals, although cables can be connected with bare wire.

Allowable wires

• Wire
Size: AWG20 (0.5 mm²) to AWG16 (1.5 mm²)
Strip length: 8–10 mm



• Recommended rod terminal
Weidmueller
http://www.weidmuller.com
Wire end ferrule with insulating collar



Wire size (mm²)	AWG	øD1 (mm)	øD2 (mm)	Type
0.5	20	1	2.6	H0.5/16
0.75	18	1.2	2.8	H0.75/16
1	17	1.4	3	H1/16
1.5	16	1.7	3.5	H1.5/16

Notes
1. Make sure to use PZ6/5 (for sleeves H0.25 to H6) as a crimp tool.
2. Use an appropriate sleeve for the wire used.
3. Insert the electric wire to the end of sleeve when crimping.
4. Cable strip length is 12 mm.

3.6.4.2. Power supply terminal and output terminal

Prepare the flathead screwdriver (head size: 0.6 x 3.5 mm).

1. Remove the insulation cover.
2. Hold the right side of the socket and pull it off the plug on the substrate.
3. If cable connector is closed, turn the screw to the left to open.
4. Insert the cable and turn the screw to the right.
5. Connect the socket to the plug.
6. Attach the insulation cover.

Note) Be careful not to damage the circuit board when you remove or install the socket.

3.6.4.3. Communication terminal

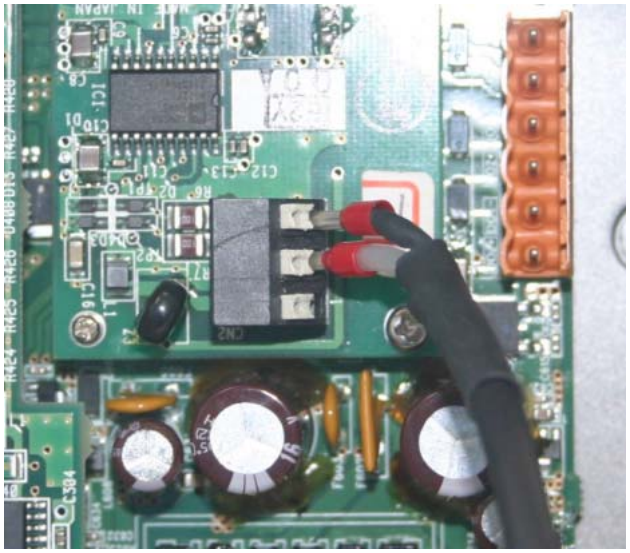
Rod terminal:

Insert the terminal into the connector hole. Make sure that it won't come out.

Bare cable:

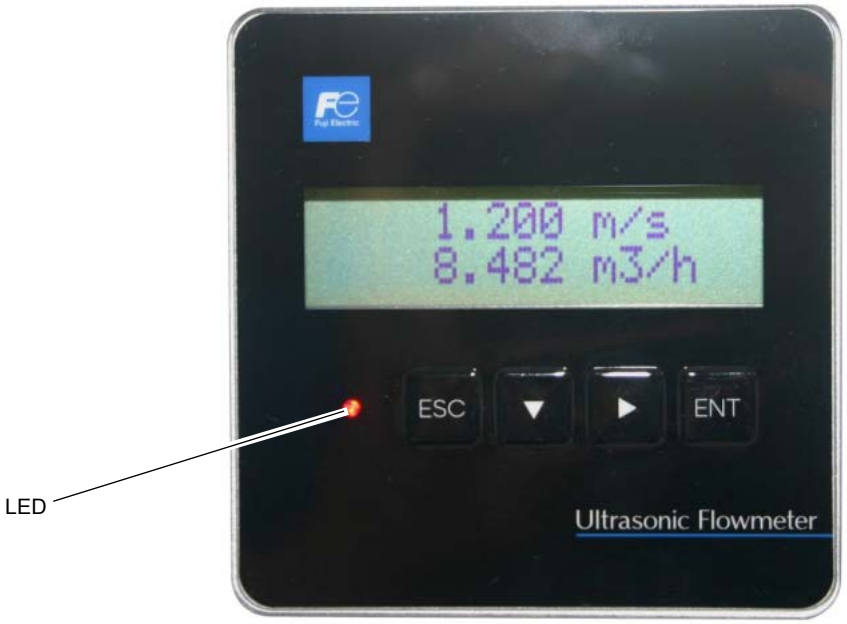
Prepare the flathead screwdriver (head size: 0.6 x 3.5 mm).

1. Remove the insulation cover.
2. Push the clamp to open the connector.
3. Insert the bare cable into the connector and release the clamp to fix the cable.
4. Attach the insulation cover.



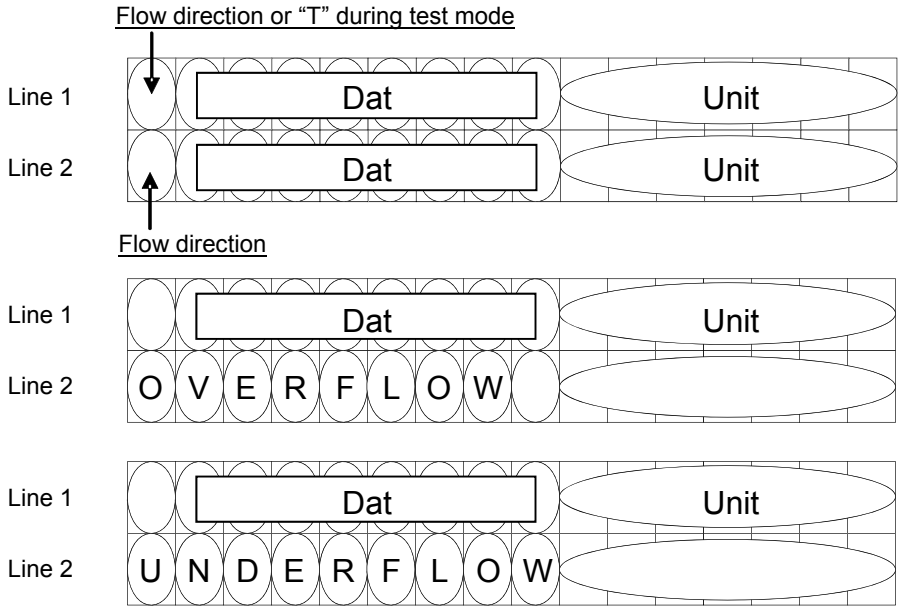
4. PARAMETERS

4.1. Control Panel



○ LCD (2-line, 16-digit): Displays the measurement results or setpoints.

In measurement display, up to 8 digits including the decimal point are displayed in the data field (left pane). When numerals exceed 8 digits, "<" appears on the first digit. When numerals exceed the range, "OVERFLOW" or "UNDERFLOW" is displayed blinking on the second line.



○ LED indicator: Indicates whether the received wave is normal or not.
(Green) : Received wave is normal.
(Red) : Received wave is abnormal.

○ Keys

ESC ESCAPE key : Cancels an entry or returns to the higher-level menu.

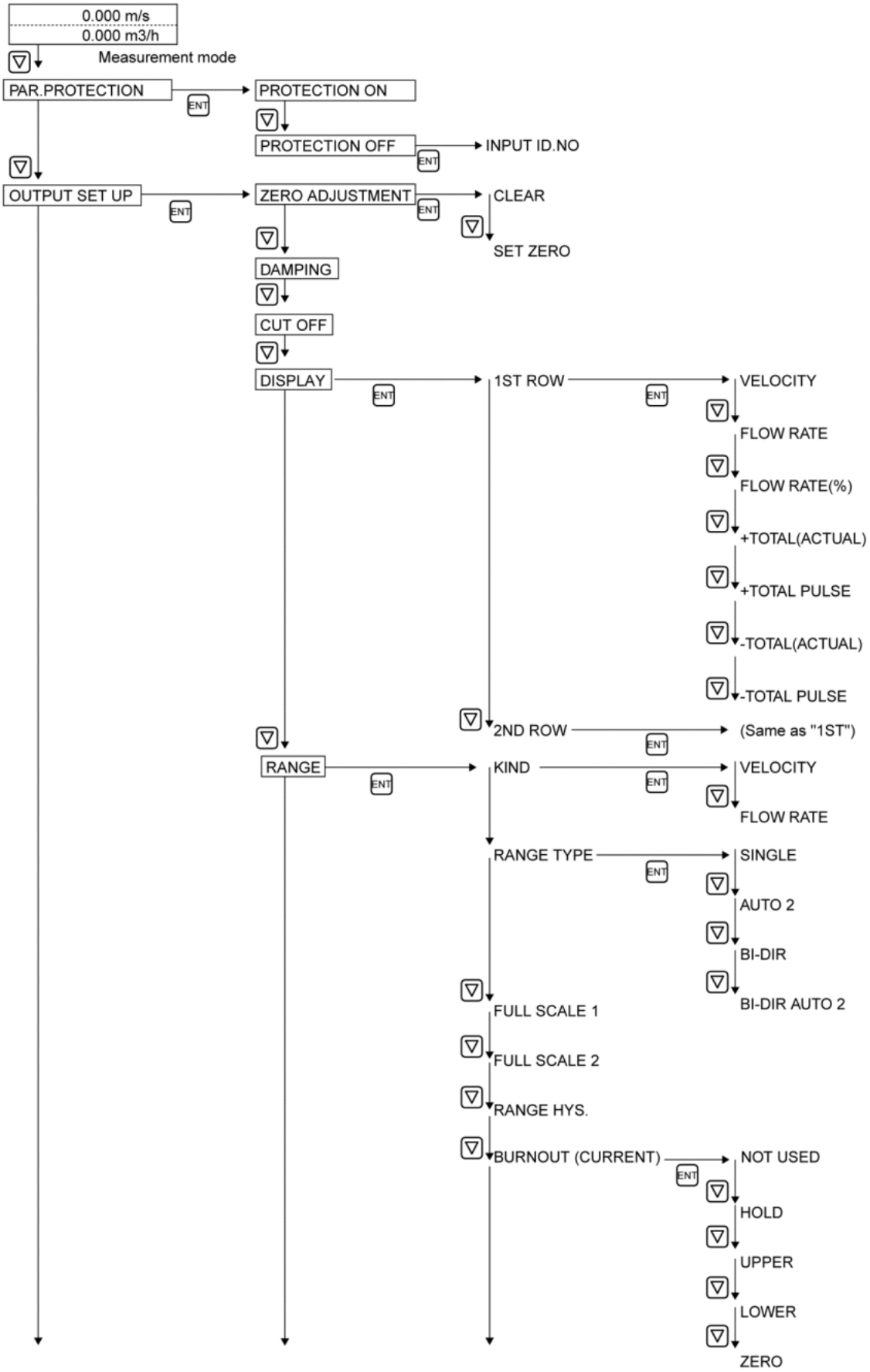
NEXT key : Selects a numeric value or symbol, or moves forward to the next menu item.

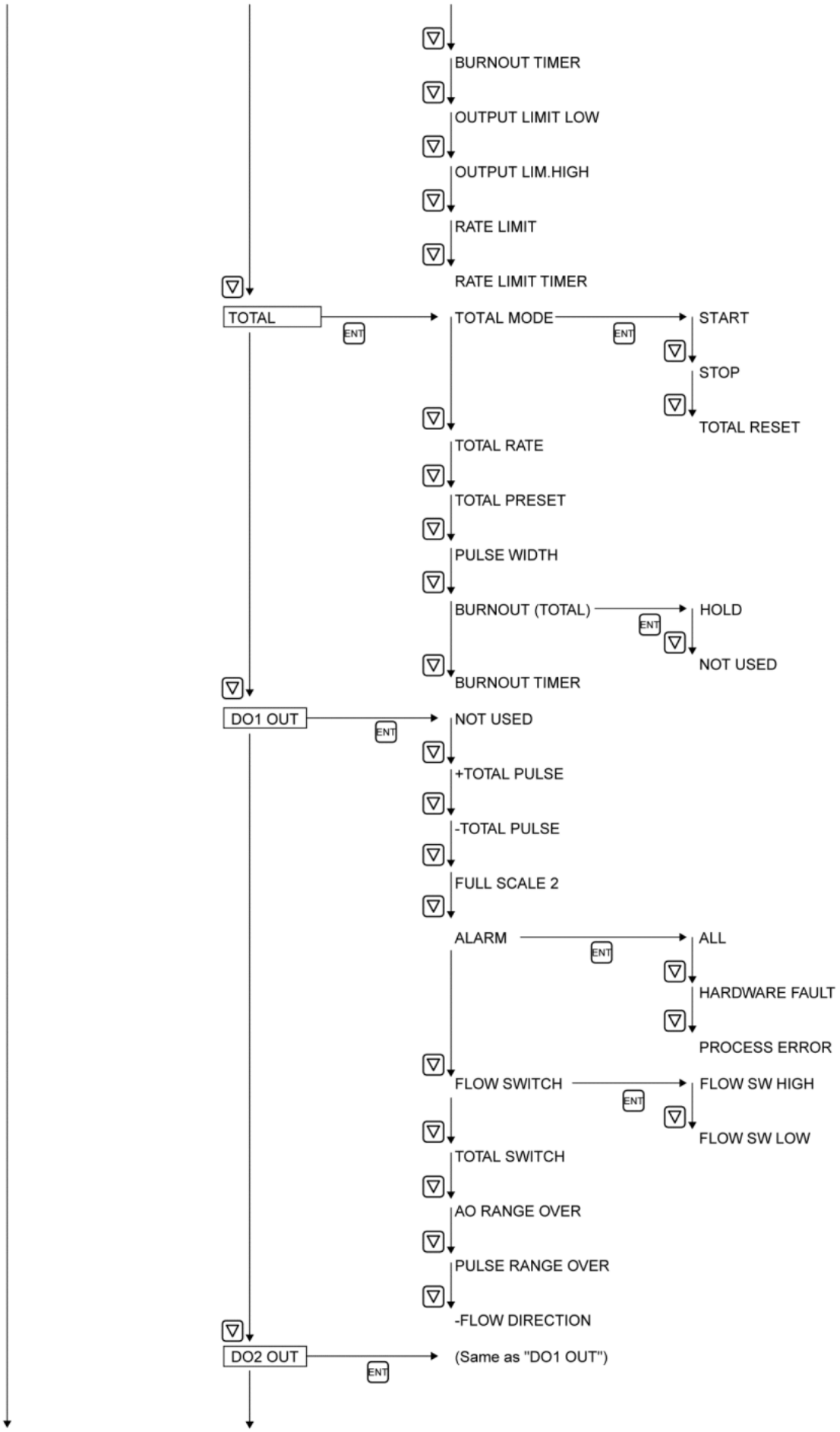
SHIFT key : Moves forward the cursor or selects decimal place.

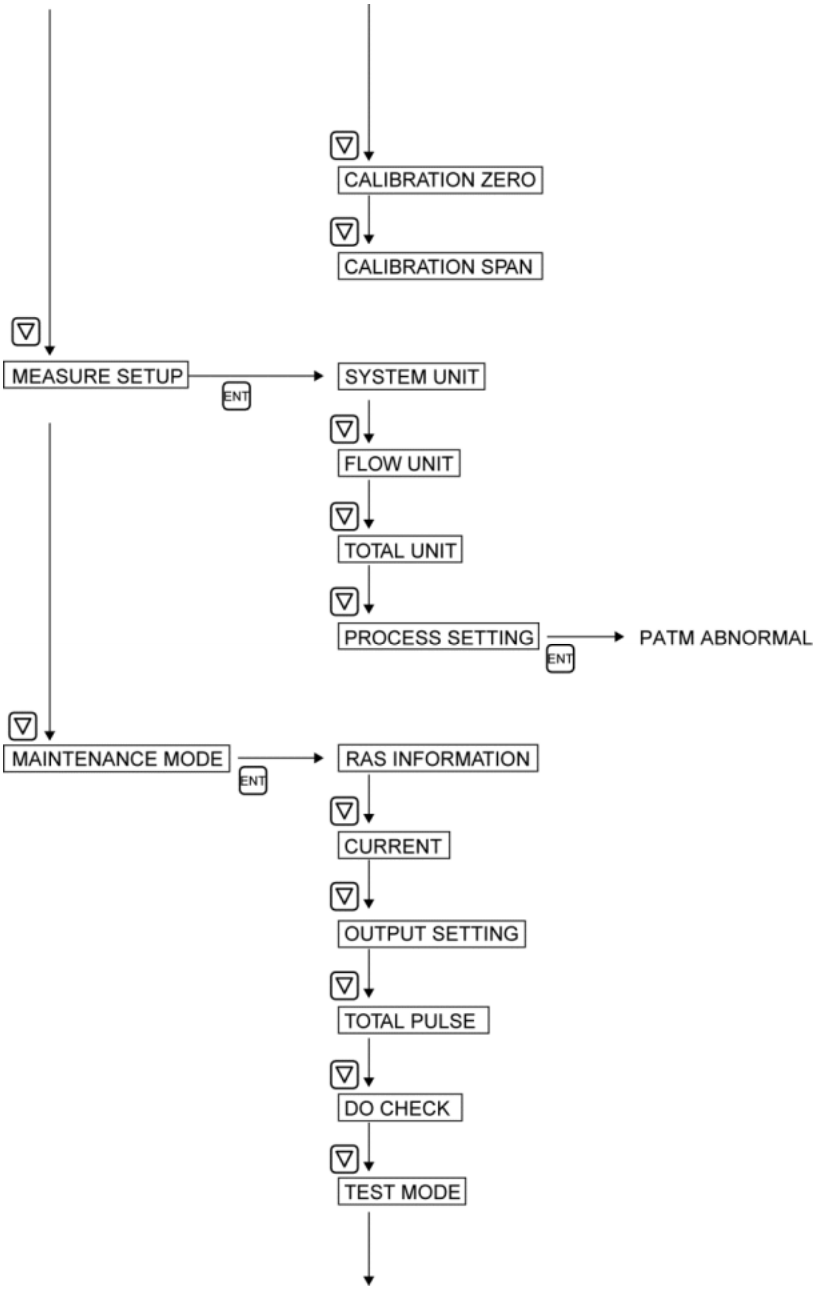
ENT ENTER key : Finishes editing an entry to register it, or enter into a menu.
*Do not forget to press this key after you change a parameter value.

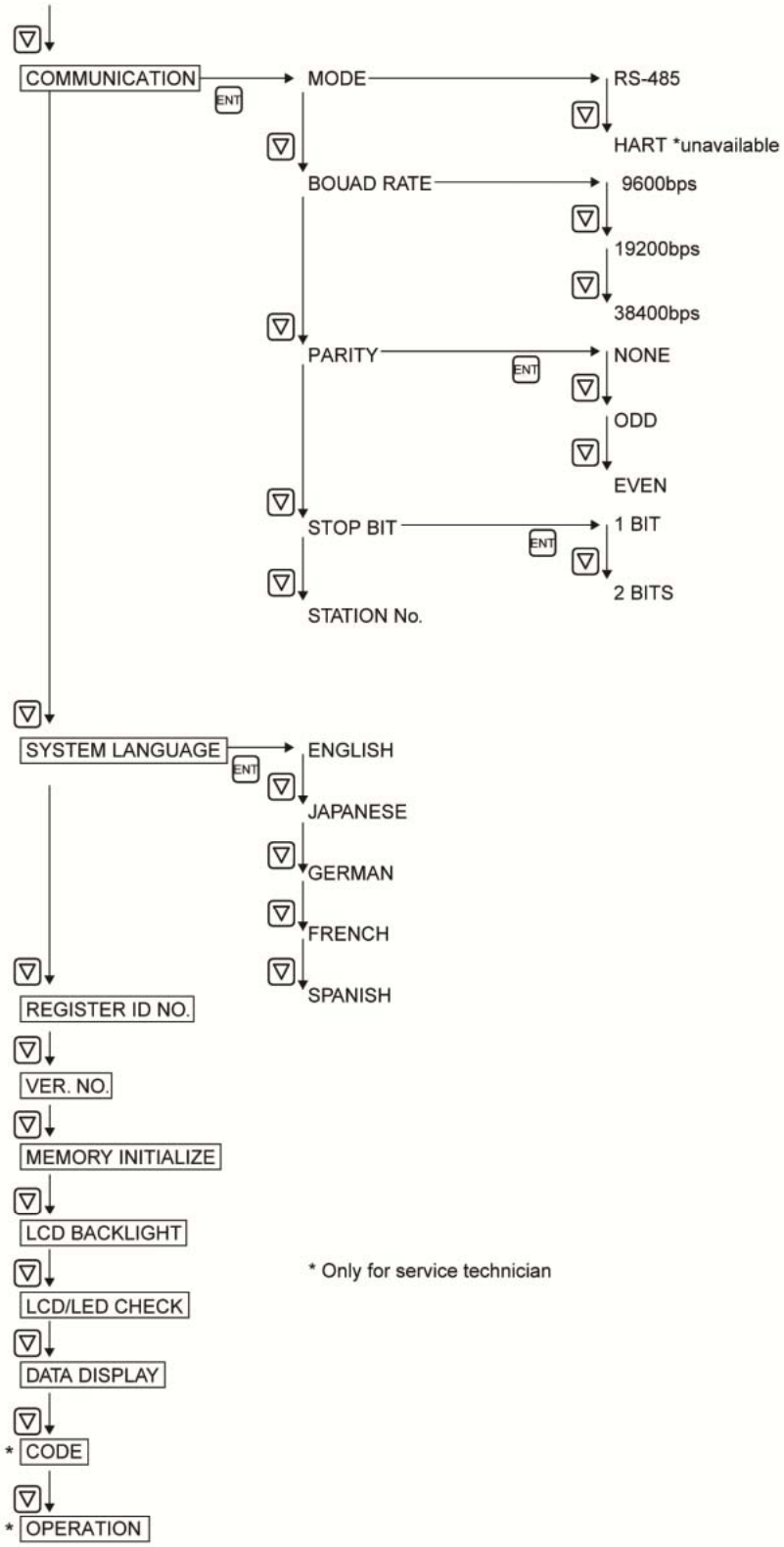
SHIFT + NEXT : Moves back to the previous menu item (within the same menu level).

4.2. Menu Map


0.000 m/s
0.000 m3/h
Measurement mode
PAR.PROTECTION
ENT
PROTECTION ON
PROTECTION OFF
ENT
INPUT ID.NO
OUTPUT SET UP
ENT
ZERO ADJUSTMENT
ENT
CLEAR
SET ZERO
DAMPING
CUT OFF
DISPLAY
ENT
1ST ROW
ENT
VELOCITY
FLOW RATE
FLOW RATE(%)
+TOTAL(ACTUAL)
+TOTAL PULSE
-TOTAL(ACTUAL)
-TOTAL PULSE
2ND ROW
ENT
(Same as "1ST")
RANGE
ENT
KIND
ENT
VELOCITY
FLOW RATE
RANGE TYPE
ENT
SINGLE
AUTO 2
BI-DIR
BI-DIR AUTO 2
FULL SCALE 1
FULL SCALE 2
RANGE HYS.
BURNOUT (CURRENT)
ENT
NOT USED
HOLD
UPPER
LOWER
ZERO


BURNOUT TIMER
OUTPUT LIMIT LOW
OUTPUT LIM.HIGH
RATE LIMIT
RATE LIMIT TIMER
TOTAL
ENT
TOTAL MODE
ENT
START
STOP
TOTAL RESET
TOTAL RATE
TOTAL PRESET
PULSE WIDTH
BURNOUT (TOTAL)
ENT
HOLD
NOT USED
BURNOUT TIMER
DO1 OUT
ENT
NOT USED
+TOTAL PULSE
-TOTAL PULSE
FULL SCALE 2
ALARM
ENT
ALL
HARDWARE FAULT
PROCESS ERROR
FLOW SWITCH
ENT
FLOW SW HIGH
FLOW SW LOW
TOTAL SWITCH
AO RANGE OVER
PULSE RANGE OVER
-FLOW DIRECTION
DO2 OUT
ENT
(Same as "DO1 OUT")


CALIBRATION ZERO
CALIBRATION SPAN
MEASURE SETUP
ENT
SYSTEM UNIT
FLOW UNIT
TOTAL UNIT
PROCESS SETTING
ENT
PATM ABNORMAL
MAINTENANCE MODE
ENT
RAS INFORMATION
CURRENT
OUTPUT SETTING
TOTAL PULSE
DO CHECK
TEST MODE


COMMUNICATION
ENT
MODE
RS-485
HART *unavailable
BOUAD RATE
9600bps
19200bps
38400bps
PARITY
NONE
ODD
EVEN
STOP BIT
1 BIT
2 BITS
STATION No.
SYSTEM LANGUAGE
ENGLISH
JAPANESE
GERMAN
FRENCH
SPANISH
REGISTER ID NO.
VER. NO.
MEMORY INITIALIZE
LCD BACKLIGHT
LCD/LED CHECK
DATA DISPLAY
* CODE
* OPERATION
* Only for service technician

4.3. Initial Settings

Factory-set values are shown below. (The settings when you did not order the parameter setting service.)

	Item			Setting range	Initial value	Options
1	Parameter protection			No. of option: 2	PROTECTION ON	PROTECTION ON, PROTECTION OFF
2	ID No			0000 to 9999	0000	ID No. is invalid when 0000 is selected.
3	Language			No. of options: 5	English *1	English, Japanese, German, French and Spanish
4	Measuring condition	System unit		No. of options: 2	Metric	Metric or inch
5	Measuring condition	Flow unit		No. of options: 18	m^3/h	L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h, m^3/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d
6	Measuring condition	Total unit		No. of options: 8	m^3	mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
7	Measuring condition	Path abnormal		No. of options: 2	Calculation OFF	Calculation ON, calculation OFF
8	Output condition	Zero adjustment		No. of options: 2	Clear (unadjusted)	Clear, adjustment
9	Output condition	Damping		0.0 to 100.0sec	5.0 sec	sec
10	Output condition	Low flow cut		0 to 5m/s in terms of flow velocity	0.150 m^3/h	[(5) unit]
11	Output condition	Display	Content of display 1st line	No. of options: 7	Flow velocity (m/s)	Flow velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual) and -Total pulse
12	Output condition	Display	Decimal point position of display 1st line		****.***	□□□□□□□□ (Selected digit will be reversed to black.)
13	Output condition	Display	Content of display 2nd line	No. of options: 7	Flow rate (m^3/h)	Flow velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual) and -Total pulse
14	Output condition	Display	Decimal point position of display 2nd line		****.***	□□□□□□□□ (Selected digit will be reversed to black.)
15	Output condition	Analog output	Kind	No. of options: 2	Flow rate	Flow velocity, Flow rate
16	Output condition	Analog output	Range type	No. of options: 4	Single range	Single range, Auto 2 range, Bi-dir range and Bi-dir Auto 2 range
17	Output condition	Analog output	Full scale 1	0, ±0.3 to ±10m/s in terms of flow velocity	15.000 m^3/h	[(5) unit]
18	Output condition	Analog output	Full scale 2	0, ±0.3 to ±10m/s in terms of flow velocity	0.000 m^3/h	[(5) unit]
19	Output condition	Analog output	Hysteresis	0.00 to 20.00	10.00%	%
20	Output condition	Analog output	Burnout (current)	No. of options: 5	Hold	Not used, Hold, Lower, Upper, and Zero
21	Output condition	Analog output	Burnout timer	10 to 900sec	10 sec	sec
22	Output condition	Analog output	Output limit low	-20 to 0%	-20%	%
23	Output condition	Analog output	Output limit high	100 to 120%	120%	%
24	Output condition	Analog output	Rate limit	0 to 5m/s in terms of flow velocity	0.000 m^3/h	[(5) unit]
25	Output condition	Analog output	Rate limit timer	0 to 900sec	0sec	sec
26	Output condition	Total output	Total mode	No. of options: 3	Stop	Start, Stop and Reset
27	Output condition	Total output	Total rate	0.000000 to 99999999	0 m^3	[(6) unit]
28	Output condition	Total output	Total preset	0.000000 to 99999999	0 m^3	[(6) unit]
29	Output condition	Total output	Pulse width	No. of options: 7	50.0 msec	5.0 msec, 10.0 msec, 50.0 msec, 100.0 msec, 200.0 msec, 500.0 msec,1000 msec.
30	Output condition	Total output	Burnout (total)	No. of options: 2	Hold	Not used, hold
31	Output condition	Total output	Burnout timer	10 to 900sec	10 sec	sec

	Item		Setting range	Initial value	Options
32	Output condition	DO1 output type	No. of output content options: 10 No. of alarm options: 3 Flow switch range 0 to 10 m/s in terms of flow velocity Total switch range 0.000000 to 99999999	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch ☐Flow SW high [[(5) unit]] ☐Flow SW low [[(5) unit]] ☐Total switch [[(6) unit]] ☐Range over ☐Pulse range over ☐–Flow direction
33		DO1 Output operation	No. of options: 2	Active ON	Active ON, Active OFF
34		DO2 Output type	No. of output content options: 10 No. of alarm options: 3 Flow switch range 0 to 10 m/s in terms of flow velocity Total switch range 0.000000 to 99999999	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch ☐Flow SW high [[(5) unit]] ☐Flow SW low [[(5) unit]] ☐Total switch [[(6) unit]] ☐Range over ☐Pulse range over ☐–Flow direction
35		DO2 Output operation	No. of options: 2	Active ON	Active ON, Active OFF
36		Zero calibration	-5 to 5 m/s in terms of flow velocity	0.000m^3/h	[(5) unit]
37		Span calibration	-200.00 to 200.00%	100.00%	%
38	Communication	Communication mode	No. of options: 2	RS-485	RS-485, HART (HART communication is unavailable)
39		Baud rate	No. of options: 3	9600bps	9600 bps, 19200 bps, 38400 bps
40		Parity	No. of options: 3	Odd	None, Odd, Even
41		Stop bit	No. of options: 2	1 bit	1 bit, 2 bits
42		Station No.	1 to 31	1	
43	LCD	LIGHTS OUT TIME	0 to 99 min	0 min	min

4.4. Parameter Protection

PAR. PROTECTION

Parameters can be protected by a four-digit ID number so that the flow meter settings will not be changed carelessly. Factory default ID No. is "0000". You can change it in “register ID No.” from the maintenance mode menu (See 4.11.7).

Setting range: PROTECTION ON : Parameter cannot be changed.
PROTECTION OFF: Parameter can be changed.
* When one hour has passed after “PROTECTION OFF” is set, the setting automatically changes to “PROTECTION ON”.
* The flowmeter always starts with protection ON.

An example of operation is shown below.

Cancelling the parameter protection (assuming the ID No. is "2234")

Key operation	Description	Display
▽ ▼	Press the ▽ key in the measurement mode once to indicate “PAR. PROTECTION”.	PAR.PROTECTION PROTECTION ON
ENT ▼	Press the ENT key once to blink the 2nd line.	PAR.PROTECTION PROTECTION ON
▽ ▼	Press the ▽ key once to display "PROTECTION OFF".	PAR.PROTECTION PROTECTION OFF
ENT ▼ ▼ ▼ ▼	Press the ENT key once to display “PAR.PROTECTION”.	PAR.PROTECTION ** COMPLETE ** ↓ INPUT ID NO. ****
ENT ▼ ▼	Press the ENT key once to indicate "0000" and blink the cursor. Note) If ID No. is "0000" (factory setting), press the ENT key to cancel the protection.	INPUT ID NO. 0000
▽ ▷ ▼	Use the ▽ key and the ▷ key to enter “2234”.	INPUT ID NO. 2234
ENT	Press the ENT key once. * If you enter a wrong ID No., "INPUT ERROR!" appears, and the screen go back to “INPUT ID NO” screen. . ——— Protection canceled. ———	INPUT ID NO. ** COMPLETE ** ↓ PAR.PROTECTION PROTECTION OFF

⚠ CAUTION

- If you are using analog output and/or alarm output, changing their parameters during operation may cause sudden output change after **COMPLETE** appears, resulting in an output error or alarm. To prevent this to occur, perform the signal lock on the system side prior to changing parameters, especially if you are using output signals for process control.
- Parameter change is stored in a non-volatile memory at the timing when the screen goes back to the measurement screen, and maintained even after the flowmeter is turned off. However, if you turn off the power before the screen goes back to the measurement screen, the change you made won’t be saved.

4.5. Language

SYSTEM LANGUAGE

You can select the language among: English, Japanese, German, French, and Spanish.

The default setting is English.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4.)

Changing the language to Japanese

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMAITION 0000000000000000
▽ ▼	Press the ▽ key for 8 times to display “SYSTEM LANGUAGE”.	SYSTEM LANGUAGE ENGLISH
ENT ▼	Press the ENT key once to blink on the 2nd line.	SYSTEM LANGUAGE ENGLISH
▽ ▼	Press the ▽ key for 4 times to display “JAPANESE”.	SYSTEM LANGUAGE JAPANESE
ENT ▼	Press the ENT key once to register.	SYSTEM LANGUAGE ** COMPLETE **
▼ ▼ ▼	——— Language has been changed to Japanese. ———	↓ ｹﾞﾝｺﾞ (LANGUAGE) ﾆﾎﾝｺﾞ (JAPANESE)
ESC ▽	Press the ESC key or the ▽ key to display the measurement mode.	0.000 m/s 0.000 m3/h

4.6. Measurement Parameters

4.6.1. Checking the Measurement Parameters

Key operation	Description	Display
		0.000 m/s 0.000 m3/h
▽ ▼	Press the ▽ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
▽ ▼	Press the ▽ key for 3 times to display “PROCESS SETTING”.	PROCESS SETTING
ENT ▼	Press the ENT key once to display “PATH ABNORMAL”.	PATH ABNORMAL CALC. OFF
ESC ▽	Press the ESC key twice, and press the ▽ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.6.2. Calculation upon Measuring Path Error

PATH ABNORMAL

You can select whether or not to perform calculation if any of three measuring paths falls into error.

- Calculation ON: if any of three paths works normally, the flowmeter runs normally and calculates the flow rate. (Note that the calculation will be rough estimation.)
- Calculation OFF: if any of three paths is faulty, the flowmeter does not calculate the flow rate.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4.)

Setting the flowmeter to carry out the calculation even if a measuring path error occurs

Key operation	Description	Display
		0.000 m/s 0.000 m3/h
▽	Press the ▽ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
▼ ENT	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
▼ ▽	Press the ▽ key for 3 times to display “PROCESS SETTING”.	PROCESS SETTING
▼ ENT	Press the ENT key twice to display “PATH ABNORMAL” and blink the cursor.	PATH ABNORMAL CALC. OFF
▼ ▽	Press the ▽ key once to select “CALC. ON”.	PATH ABNORMAL CALC. ON
▼ ENT	Press the ENT key once.	PATH ABNORMAL ** COMPLETE **
▼ ▼ ▼ ▼	——— The setting has been changed. ———	↓ PATH ABNORMAL CALC. ON
ESC ▽	Press the ESC key twice and the ▽ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.7. Zero Adjustment

ZERO ADJUSTMENT

Setting range:
CLEAR : Resets the zero point to the factory setting. Use this option when you cannot stop the flow to calibrate the zero point.
SET ZERO : A point where "SET ZERO" is carried out is regarded as zero. Use this option when you can stop the flow to calibrate the zero point.
*The flow must be completely stopped. Otherwise it will cause a measurement error.

It takes about 40 seconds to complete adjustment. When the adjustment is completed successfully, the indication ** COMPLETE ** appears on the second row.
If you carry out the zero adjustment during signal error, the adjustment will be cancelled after about 90 seconds, and the zero point will be reset to the factory setting. In this case, the indication ** FAILURE ** appears on the second row.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Carry out the zero point calibration for fully filled pipe with the upstream valve and downstream valve closed

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key twice to display “ZERO ADJUSTMENT” and blink the cursor.	ZERO ADJUSTMENT CLEAR
▽ ▼	Press the ▽ key once, and select “SET ZERO”.	ZERO ADJUSTMENT SET ZERO
ENT ▼ ▼ ▼ ▼	Press the ENT key once to carry out “SET ZERO”. * Be sure to completely stop the flow beforehand.	ZERO ADJUSTMENT ** ADJUSTMENT ** ↓ ZERO ADJUSTMENT ** COMPLETE **
	——— Zero adjustment has been completed. ———	ZERO ADJUSTMENT SET ZERO
ESC ▽	Press the ESC key once, and the ▽ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8. Unit

4.8.1. System of Units

SYSTEM UNIT

You can select the system of units, either metric system or inch system. Be sure to set the total mode to “stop” in advance (See 4.9.2.3).

- Metric system (factory setting)
  - Length ····· mm
  - Flow velocity ····· m/s
  - Flow rate ····· L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h, m^3/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d
  - Total unit ····· mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
  - Kinematic viscosity coefficient ····· $E^{-6}m^2/s$
- Inch system
  - Length ····· inch
  - Flow velocity ····· ft/s
  - Flow rate ····· gal/s, gal/min, gal/h, gal/d, kgal/d, Mgal/d, ft^3/s, ft^3/min, ft^3/h, ft^3/d, kft^3/d, Mft^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d
  - Total unit ····· gal, kgal, ft^3, kft^3, Mft^3, mBBL, BBL, kBBL, ACRf
  - Kinematic viscosity coefficient ····· $E^{-6}ft^2/s$

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Changing the system of units from inch system to metric system

Key operation	Description	Display
▽	Press the ▽ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
▼ ENT	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT INCH
▼ ENT	Press the ENT key once to blink the cursor.	SYSTEM UNIT INCH
▼ ▽	Press the ▽ key once to display “METRIC”.	SYSTEM UNIT METRIC
▼ ENT	Press the ENT key once to register.	SYSTEM UNIT ** COMPLETE **
▼ ▼ ▼ ▼	——— METRIC has been registered. ———	↓ SYSTEM UNIT METRIC
ESC ▽	Press the ESC key once and ▽ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.8.2. Flow Unit

FLOW UNIT

You can select the unit of flow rate. Your choice is narrowed either among the flow rate units of metric system or those of inch system, according to the system of units you selected (See 4.8.1.).

- Flow rate of metric system: L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h (factory setting), m^3/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d
- Flow rate of inch system: gal/s, gal/min, gal/h, gal/d, kgal/d, Mgal/d, ft^3/s, ft^3/min, ft^3/h, ft^3/d, kft^3/d, Mft^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the flow rate unit to “L/min”

Key operation	Description	Display
▽ ▼	Press the ▽ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
▽ ▼	Press the ▽ key once to display “FLOW UNIT”.	FLOW UNIT m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FLOW UNIT m3/h
▽ ▼	Press the ▽ key several times to display “L/min”.	FLOW UNIT L/min
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “L/min” has been registered. ———	FLOW UNIT ** COMPLETE ** ↓ FLOW UNIT L/min
ESC ▽	Press the ESC key once and the ▽ key twice to return to the measurement mode.	0.000 m/s 0.000 L/min

4.8.3. Total Unit

Select the unit of total volume. You need to set the system of units (see 4.8.1), and to set the total mode to “stop” (see 4.9.2.3) in advance.

- Total unit of metric system: mL, L, m^3 (factory setting), km^3, Mm^3, mBBL, BBL, kBBL
- Total unit of inch system: gal, kgal, ft^3, kft^3, Mft^3, mBBL, BBL, kBBL, ACRf

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the total unit to “L”

Key operation	Description	Display
▽ ▼	Press the ▽ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
▽ ▼	Press the ▽ key once to display “TOTAL UNIT”.	TOTAL UNIT m3
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL UNIT m3
▽ ▼	Press the ▽ key twice to display “L”.	TOTAL UNIT L
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “L” has been registered. ———	TOTAL UNIT ** COMPLETE ** ↓ TOTAL UNIT L
ESC ▽	Press the ESC key once and the ▽ key twice to return to the measurement mode.	0.000 L 0.000 L/min

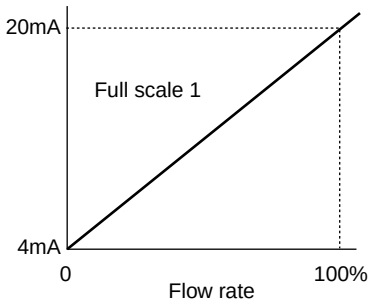
4.9. Output Setting

4.9.1. Flow Rate Range

4.9.1.1. Full scale

FULL SCALE

Define the range of flow rate for analog output.



- The analog output (4–20 mA) corresponds to the range setting.
- The flow rate unit (FLOW UNIT) must be set beforehand.
- If you enter a value beyond the range, "INPUT ERROR" appears and the last set value is applied.
- If you change the flow rate unit (FLOW UNIT) after setting the range, be sure to setup the flow rate range (FULL SCALE) again.
- The unit of flow rate is as specified in "FLOW UNIT" in the "MEASURE SETUP" menu. (See 4.8.2.)

- Setting range: 0.3 to 10 [m/s] in terms of flow velocity in a pipe

  - Flow rates in Table 1 are the calculation results obtained based on the internal diameters of pipes in the left columns. To obtain accurate results, calculate the flow rate based on the actual internal diameters.

  - **Formulas for flow velocity**

$$\text{Flow verocity [m/s]} \fallingdotseq 353.7 \times \frac{Flow\ rate\ [m^3/h]}{(Pipe\ inner\ diameter\ [mm])^2}$$

$$\text{Flow verocity [m/s]} \fallingdotseq 21.22 \times \frac{Flow\ rate\ [L/min]}{(Pipe\ inner\ diameter\ [mm])^2}$$

Flow velocity range: 0.3 ~ 10 [m/s] <Table1>

Diameter	Int. dia. of sensor [mm]	Flow rate unit	
		[m³/h]	[L/min]
25A	25	0.54 to 17.6	8.84 to 294.5
50A	50	2.13 to 70.6	35.4 to 1178
80A	74	4.65 to 154.8	77.5 to 2580
100A	94	7.99 to 266.0	133.1 to 4433

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the range type to single range and “FULL SCALE1” to a flow rate of 60 m^3/h

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key to enter the “ZERO ADJUSTMENT” mode.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND FLOW RATE
▽ ▼	Because flow rate (factory setting) is already registered, go to the next step Press the ▽ key to display “RANGE TYPE”	RANGE TYPE SINGLE
	Because single range (factory setting) is already registered, go to the next step.	
▽ ▼	Press the ▽ key once to display “FULL SCALE1”.	FULL SCALE1 15.000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE1 00015.000 m3/h
▽ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the ▽ key.	00015.000 m3/h 00065.000 m3/h 00065.000 m3/h
▼ ▼ ▼ ▼ ▼ ▼ ▼	Change the full scale1 to “60”. Note) To change the decimal point position, align the cursor with a place to change to and press the ▽ key likewise.	FULL SCALE1 000006[0].0 m3/h

ENT ▼ ▼ ▼ ▼ ESC ▽	Press the ENT key once to register. ——— FULL SCALE1 has been registered. ——— Press the ESC key for 2 times and then press the ▽ key for 3 times to enter the measurement mode.	FULL SCALE1 ** COMPLETE ** ↓ FULL SCALE1 60.000 m3/h 0.000 m/s 0.000 m3/h

4.9.1.2. Analog output at error (burnout)

BURNOUT (CURRENT)
BURNOUT TIMER

Determine how the analog output should function upon ultrasonic signal error due to device error, accidental drain from pipe, or existence of air bubbles.

Setting ranges

- BURNOUT (CURRENT): analog output (4-20mA) at error
  HOLD (factory setting) : Emits the current preceding the error.
  UPPER : Sets analog output to upper limit of the output (over scale).
  LOWER : Sets analog output to lower limit of the output (under scale).
  ZERO : Emits a current of 4 mA.
- BURNOUT TIMER: time from error detection to BURNOUT display. You can set from 10 seconds up to 900 seconds (factory setting is 10 s).

* BURNOUT display: LCD displays the value corresponds to the analog output as a measured value.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

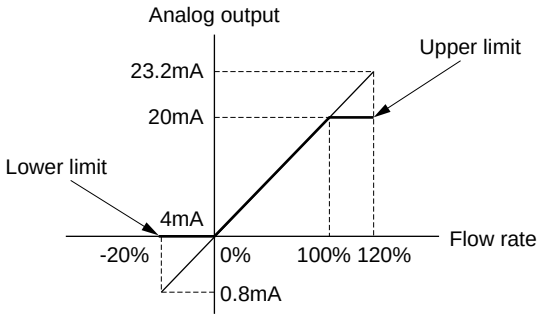
Setting the BURNOUT CURRENT to UPPER and BURNOUT TIMER to 20 seconds

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETTUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND FLOW RATE
▽ ▼	Press the ▽ key for 5 times to display “BURNOUT” (CURRENT).	BURNOUT (CURRENT) HOLD
ENT ▼	Press the ENT key once to blink on the 2nd line.	BURNOUT (CURRENT) HOLD
▽ ▼	Press the ▽ key once to display “UPPER”.	BURNOUT (CURRENT) UPPER
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— UPPER has been registered. ———	BURNOUT (CURRENT) ** COMPLETE ** ↓ BURNOUT (CURRENT) UPPER
▽ ▼	Press the ▽ key once to display “BURNOUT TIMER”.	BURNOUT TIMER 10 sec
ENT ▼	Press the ENT key once to blink the cursor.	BURNOUT TIMER 010 sec
▷ ▼	Press the ▷ key once to align the cursor to “1”.	BURNOUT TIMER 010 sec
▽ ▼	Press the ▽ key once to set “2”.	BURNOUT TIMER 020 sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— BURNOUT TIMER has been registered. ———	BURNOUT TIMER ** COMPLETE ** ↓ BURNOUT TIMER 20 sec
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.9.1.3. Analog output limit

Set the upper and the lower limits within the range from 0.8 mA to 23.2 mA (-20% to 120%). Be sure to setup the flow rate unit (FLOW UNIT) beforehand.

Setting range
- OUTPUT LIMIT LOW: -20% to 0% (0.8 mA to 4 mA)
- OUTPUT LIMIT HIGH: 100% to 120% (20 mA to 23.2 mA)



An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the lower limit to -10% (2.4 mA) and the upper limit to 110% (21.6 mA)

Key operation	Description	Display
▽	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT	Press the ENT key once to display “KIND”.	KIND FLOW RATE
▽	Press the ▽ key for 7 times to display “OUTPUT LIMIT LOW”.	OUTPUT LIMIT LOW -20 %
ENT	Press the ENT key once to blink the cursor.	OUTPUT LIMIT LOW -20 %
▷	Press the ▷ key once to align the cursor to “2”.	OUTPUT LIMIT LOW -20 %
▽	Press the ▽ key several times to set “1”.	OUTPUT LIMIT LOW -10 %
ENT	Press the ENT key once to register.	OUTPUT LIMIT LOW ** COMPLETE ** ↓
	——— OUTPUT LIMIT LOW has been registered. ———	OUTPUT LIMIT LOW -10 %
▽	Press the ▽ key once to display “OUTPUT LIM. HIGH”.	OUTPUT LIM. HIGH 120 %
ENT	Press the ENT key once to blink the cursor.	OUTPUT LIM. HIGH 120 %
▷	Press the ▷ key once to align the cursor to “2”.	OUTPUT LIM. HIGH 120 %
▽	Press the ▽ key several times to set “1”.	OUTPUT LIM. HIGH 110 %
ENT	Press the ENT key once to register.	OUTPUT LIM. HIGH ** COMPLETE ** ↓
	——— OUTPUT LIM. HIGH has been registered. ———	OUTPUT LIM. HIGH 110 %
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.9.2. Total

4.9.2.1. Total rate and pulse width

Configure these parameters if you want the flowmeter to transmit pulses to an external totalizer.

- Set TOTAL UNIT (see 4.8.3.) in advance.
- Set TOTAL MODE to “stop” in advance (see 4.9.2.3).
- When the total setting value is “0”, no pulse is transmitted.

- TOTAL RATE: A volumetric flow rate to be expressed by one pulse.
  The flowmeter transmits a pulse to an external totalizer when the total volume has reached the amount you set. You can check the total pulse count on LCD (see 4.9.2).
  Setting range: 0.000001 to 99999999

- PULSE WIDTH: width of total pulse output.
  Select an appropriate width for the totalizer used.
  Setting range: 5ms, 10ms, 50ms, 100ms, 200ms, 500ms, 1000ms.

- Restrictions

DO output port	Frequency range of pulse output (at full scale flow rate)	Pulse width
DO1, DO2: Transistor, open collector	100 pulse/sec	5ms, 10ms, 50ms, 100ms, 200ms, 500ms, 1000ms

The maximum output frequency is also restricted by the setup of the pulse width. Therefore, set the PULSE WIDTH and TOTAL RATE so that both of the condition 1 and the condition 2 indicated below are satisfied.

Condition 1:

$$\frac{\text{FULL SCALE}^{(\text{Note1})}\ [\text{m}^3/\text{s}]}{\text{TOTAL RATE}\ [\text{m}^3]} \leq 100[\text{Hz}]$$

Condition 2:

$$\frac{\text{FULL SCALE}^{(\text{Note1})}\ [\text{m}^3/\text{s}]}{\text{TOTAL RATE}\ [\text{m}^3]} \leq \frac{1000}{2 \times \text{PULSE WIDTH [ms]}}$$

Notes:

1. The FULL SCALE1 or FULL SCALE2, whichever is larger, is the object in the case of automatic 2-range setup, forward and reverse range setup or forward and reverse automatic 2-range setup.
2. The above restriction on frequency is also applied when the flow rate exceeds the set range. If you make such a setup where the maximum frequency occurs at 100% flow rate, the flowmeter may fail to transmit the correct pulse when the flow rate exceeds 100% of range. Therefore, if there may be the cases where the flow rate exceeds 100%, modify the range and the total rate so that the maximum frequency will not exceed the restricted level.

Example of calculation

Calculate the allowable range of the total rate when the full scale is -1: 36[m^3/h] (=0.01[m^3/s]), and pulse width is 50 ms.

According to the condition 1,

$$\text{TOTAL RATE} \geq \frac{\text{FULL SCALE}\ [\text{m}^3/\text{s}]}{100[\text{Hz}]} = \frac{0.01\ [\text{m}^3/\text{s}]}{100\ [\text{Hz}]} = 0.0001\ [\text{m}^3] = 0.1\ [\text{L}] \cdots\cdots \text{A}$$

According to the condition 2,

$$\text{TOTAL RATE} \geq \text{FULL SCALE}\ [\text{m}^3/\text{s}] \times \frac{2 \times \text{PULSE WIDTH [ms]}}{1000} = 0.01\ [\text{m}^3/\text{s}] \times \frac{2 \times 50\ [\text{ms}]}{1000}$$

$$= 0.001\ [\text{m}^3]$$

$$= 1\ [\text{L}] \cdots\cdots \text{B}$$

The allowable range of the total rate that satisfies both the condition 1 and the condition 2 is:

$$1\ [\text{L}] \leq \text{TOTAL RATE}$$

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the total rate to 0.1 m^3 and the pulse width to 100 ms

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
▽ ▼	Press the ▽ key once to display “ TOTAL RATE”	TOTAL RATE 0 m3
ENT ▼	Press the ENT key once to display the cursor.	TOTAL RATE 00000000 m3
▷ ▼	Press the ▷ key for 7 times to move the cursor.	TOTAL RATE 0000000 0 m3
▽ ▼	Press the ▽ key several times to display decimal point.	TOTAL RATE 0000000.0 m3
▷ ▼	Press the ▷ key once to move the cursor.	TOTAL RATE 0000000.0 m3
▽ ▼	Press the ▽ key once to display “1”.	TOTAL RATE 0000000.1 m3
ENT ▼	Press the ENT key once to register.	TOTAL RATE ** COMPLETE ** ↓
▼ ▼ ▼	——— “ TOTAL RATE” has been registered. ———	TOTAL RATE 0.1 m3
▽ ▼	Press the ▽ key twice to display “PULSE WIDTH”.	PULSE WIDTH 50.0 msec
ENT ▼	Press the ENT key once to blink the cursor.	PULSE WIDTH 50.0 msec
▽ ▼	Press the ▽ key twice, and select “100.0msec”.	PULSE WIDTH 100.0 msec
ENT ▼	Press the ENT key once to register.	PULSE WIDTH ** COMPLETE ** ↓
▼ ▼ ▼	——— PULSE WIDTH has been registered. ———	PULSE WIDTH 100.0 msec
▽ ▼	Press the ▽ key for 3 times to display “TOTAL MODE”.	TOTAL MODE STOP
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL MODE STOP
▽ ▼	Press the ▽ key once, and select “TOTAL PRESET”.	TOTAL MODE TOTAL PRESET
ENT ▼	Press the ENT key once to register.	TOTAL MODE ** COMPLETE ** ↓
▼ ▼ ▼	——— TOTAL MODE has been registered. ———	TOTAL MODE TOTAL PRESET
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

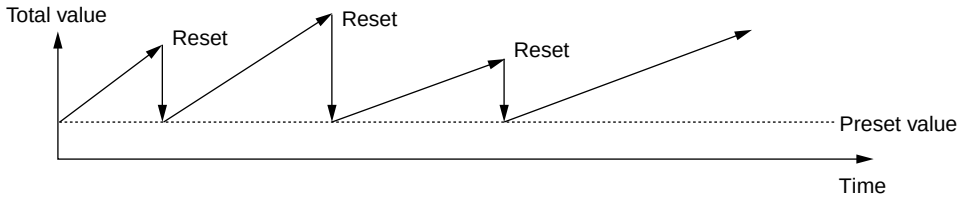
4.9.2.2. Preset value

TOTAL PRESET

Set thev alue which appears on the total counter when the total value is reset.
Select TOTAL UNIT (see 4.8.3.), and set TOTAL MODE to “stop” (see 4.9.2.3) in advance.

Setting range:0 to 99999999

Resetting action simultaneously resets both the forward total memory and the reverse total memory.



An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the preset value to 100 m^3

Key operation	Description	Display
▽	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽	Press the ▽ key for 5 times to display “TOTAL”.	TOTAL
ENT	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
▽	Press the ▽ key twice to display “TOTAL PRESET”	TOTAL PRESET 0 m3
ENT	Press the ENT key once to display the cursor.	TOTAL PRESET 0000000
▷	Press the ▷ key for 6 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	TOTAL PRESET 0000000 m3
▽	Press the ▽ key once to display “1”.	TOTAL PRESET 00000100 m3
ENT	Press the ENT key once to register.	TOTAL PRESET ** COMPLETE ** ↓
	——— “ TOTAL PRESET” has been registered. ———	TOTAL PRESET 100 m3
▽	Press the ▽ key for 4 times to display “TOTAL MODE”.	TOTAL MODE STOP
ENT	Press the ENT key once to blink the cursor.	TOTAL MODE STOP
▽	Press the ▽ key once, and select “TOTAL RESET”.	TOTAL MODE TOTAL RESET
ENT	Press the ENT key once to register.	TOTAL MODE ** COMPLETE ** ↓
	——— “TOTAL MODE” has been registered. ———	TOTAL MODE TOTAL RESET
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.9.2.3. Total mode

TOTAL MODE

This parameter allows you to start, stop, or reset the totalization.
*Set the LCD parameter to “total indication” (see 4.9.4) beforehand.

- START : Starts totalization. This is used to resume totalization after STOP.
- STOP : Stops totalization. Be sure to set TOTAL MODE to STOP before changing other parameters.
- TOTAL RESET : Resets the total memory to the preset value, and starts totalization again.
  *Resetting action simultaneously resets both the forward total memory and the reverse total memory.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Resetting the total value to the preset value of 0 m^3, and restarting totalization

Key operation	Description	Display
		0.00 m3/h + 127.26 m3
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE START
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL MODE START
▽ ▼	Press the ▽ key twice to display “TOTAL RESET”.	TOTAL MODE TOTAL RESET
ENT ▼ ▼ ▼ ▼	Press the ENT key twice to execute “TOTAL RESET”. ——— The total operation is started. ———	TOTAL MODE ** COMPLETE ** ↓ TOTAL MODE TOTAL RESET
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.00 m3/h 0.00 m3

4.9.2.4. Totalization at burnout

BURNOUT (TOTAL)
- Define whether to stop or to continue the totalization when the measurement status is in error due to empty pipe or air bubbles in fluid. Your setting will be reflected to the total indication and the total pulse output as well.
- Setting range:
  HOLD (factory setting) : stops totalization.
  NOT USED: continues totalization with the flow rate marked immediately before the error.

BURNOUT TIMER
- Define the time from error occurrence until the flowmeter starts the action defined in BURNOUT (TOTAL).
- Setting range: 10 to 900 seconds (factory setting is 10 seconds)
  *The totalization continues until the time you set has elapsed.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See Section 4.4)

Setting the BURNOUT (TOTAL) to "HOLD", and the burnout timer to 15 seconds

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE START
▽ ▼ ▼ ▼ ▼	Press the ▽ key for 4 times to display “BURNOUT(TOTAL)”. Because HOLD (factory setting) is already registered, go to the next step. Note) For setting “NOT USED”, press the //ENT key, and the /// key to select “NOT USED”.	BURNOUT(TOTAL) HOLD
▽ ▼	Press the ▽ key once to display “BURNOUT TIMER”.	BURNOUT TIMER 10sec
ENT ▼	Press the ENT key once to blink the cursor.	BURNOUT TIMER 010sec
▷ ▼	Press the ▷ key twice to move the cursor.	BURNOUT TIMER 010sec
▽ ▼	Press the ▽ key for 5 times to set “5”.	BURNOUT TIMER 015sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— BURNOUT TIMER has been registered. ———	BURNOUT TIMER ** COMPLETE ** ↓ BURNOUT TIMER 15sec
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.00 m3/h + 0.00 m3

4.9.3. DO1 and DO2

Define the contents of DO 1 and DO2.

- Setting range (common to DO1, DO2)

NOT USED	: Does not use the contact output.
+TOTAL PULSE	: Transmits the total pulses for forward flow.
- TOTAL PULSE	: Transmits the total pulses for reverse flow.
FULL SCALE 2	: Contact output is actuated during FULL SCALE 2 measurement. (forward automatic 2 ranges, forward and reverse range, forward/reverse automatic 2 ranges)
ALARM	
ALL	: Contact output is actuated upon HARDWARE FAULT or PROCESS ERROR.
HARDWARE FAULT	: Contact output is actuated upon circuit error.
PROCESS ERROR	: Contact output is actuated when no waves are received, or waves are unstable.
FLOW SWITCH	
FLOW SW HIGH	: Contact output is actuated when the flow rate is above the setting.
FLOW SW LOW	: Contact output is actuated when the flow rate is below the setting.
TOTAL SWITCH	:Contact output is actuated when the total value exceeds the setting.
AO RANGE OVER	: Contact output is actuated when the lower and upper limits of range are above the setting.
PULSE RANGE OVER	: Contact output is actuated when the total pulse output exceeds the maximum output frequency.
-FLOW DIRECTION	: Contact output is actuated when the flow is in reverse direction.
CONTACT ACTION	
ACTIVE ON	: Normally off
ACTIVE OFF	: Normally on

⚠ CAUTION

- If DO is set to “ACTIVE OFF”, the output is provided when the power is turned on.
- Before you change the setting, make sure if the change cause no problem.

Notes

- DO1/DO2 specifications : open collector, contact capacity 30 V DC, 50 mA
- If you selected the TOTAL PULSE, set the total rate and pulse width (see 4.9.2.1) as well.
  100 pulses/s or less (at full scale flow rate)
  Pulse width: 5, 10, 50, 100, 200, 500, or 1000 ms

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting DO1 to “+ TOTAL PULSE” and the contact action to “ACTIVE ON”

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 6 times to display “DO1 OUT”.	DO1 OUT NOT USED
	* Press the ▽ key again to display “DO2 OUT”.	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽ ▼	Press the ▽ key once to display “+ TOTAL PULSE ” on the 2nd line.	DO1 OUT +TOTAL PULSE
	Press the ▽ key again to select “- TOTAL PULSE”.	
ENT ▼	Press the ENT key once to register “+TOTAL PULSE”.	DO1 OUT ** COMPLETE ** ↓
▼ ▼ ▼	——— “+TOTAL PULSE” has been registered. ———	STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼	Press the ENT key once to register “ACTIVE ON” (normally off).	CONTACT ACTION ** COMPLETE ** ↓
▼	* To select normally on, press the ▽ key.	

▼ ▼	——— “ACTIVE ON” has been registered. ———	STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.000 m3/h 0.000 m3

4.9.4. Display

DISPLAY

You can define the content to be displayed on the first line and the second line independently.

- VEROCITY : Flow velocity indication
  Flow velocity units: m/s (if SYSTEM UNIT is set to METRIC) (See 4.8.1)
  *The decimal point position is fixed. (3 decimal places)

- FLOW RATE : Actual flow rate
- FLOW RATE (%)
  *The unit is as selected in FLOW UNIT. (See 4.8.2.)

- +TOTAL (ACTUAL) : total value of actual flow (forward direction)
- +TOTAL PULSE : total pulse count (forward direction)
- -TOTAL (ACTUAL) : total value of actual flow (reverse direction)
- -TOTAL PULSE : total value of actual flow (reverse direction)
  *The unit is as selected in TOTAL UNIT. (See 4.8.3.)

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4.)

Setting the 1st line of LCD to indicate the % flow rate

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 3 times to display “DISPLAY”.	DISPLAY DISPLAY 1
ENT ▼	Press the ENT key once to blink the cursor.	DISPLAY DISPLAY 1
ENT ▼	Press the ENT key again, and select “1ST LOW”.	1ST LOW VELOCITY
▽ ▼	Press the ▽ key twice to display “FLOW RATE(%)”.	1ST LOW FLOW RATE(%)
ENT ▼	Press the ENT key once, and select and fix “FLOW RATE(%)” to display “1:DECIMAL POINT”.	1:DECIMAL POINT ****.***
▷ ▼	Press the ▷ key once to shift the decimal point position to next place.	1:DECIMAL POINT *****.**
ENT ▼	Press the ENT key once to register.	1:DECIMAL POINT ** COMPLETE ** ↓
▼ ▼ ▼	——— FLOW RATE(%) indication has been set. ———	1:DECIMAL POINT *****.**
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.00 % 0.000 m3

4.9.5. Damping

DAMPING

This parameter is used to suppress the fluctuation of measured value. Damping is available by setting a time constant which is the time necessary for about 63% response.

Setting range: 0.0 to 100.0 seconds, in 0.1 seconds steps

If you set the damping to 0 sec, response time will be determined by the followings:

- System cycle: 0.2sec
- Dead time: 0.2 sec or less
- Time constant: 0.1 sec

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4.)

Changing the damping from 5 sec to 20 sec

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key once to display “DAMPING”.	DAMPING 5.0 sec
ENT ▼	Press the ENT key once to blink the cursor.	DAMPING 005.0 sec
		005.0 sec
		025.0 sec
		025.0 sec
▽ ▷ ▼	Set “20” by the ▽ key and the ▷ key.	DAMPING 020.0 sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— DAMPING has been registered. ———	DAMPING ** COMPLETE ** ↓ DAMPING 20 sec
ESC ▽	Press the ESC key once and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.6. Low Flow Rate Cutoff

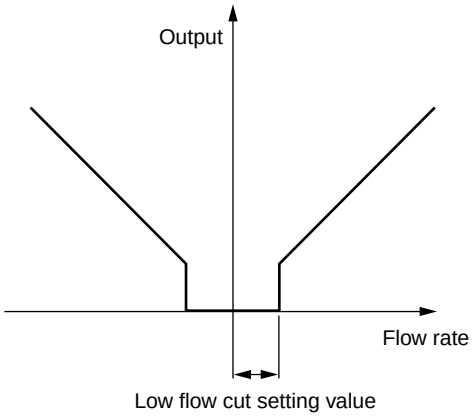
CUT OFF

This parameter is used to cutoff the output (indication, 4–20 mA analog output, and totalization) when flow rate is smaller than the specified value.

Setting range: 0 to 5 [m/s] in terms of flow velocity.
(Factory setting is 0.150 [m^3/h])

Notes:
1. Even if the valves are closed, there may be movement in the fluid due to convention or other factors, and the flowmeter may read the flow rate and transmit the outputs. In such a case, it is recommended to set this parameter.
2. The unit of flow rate is as selected in "FLOW UNIT" (see 4.8.2).

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)



Setting the low flow rate cut point to 0.5 m^3/h

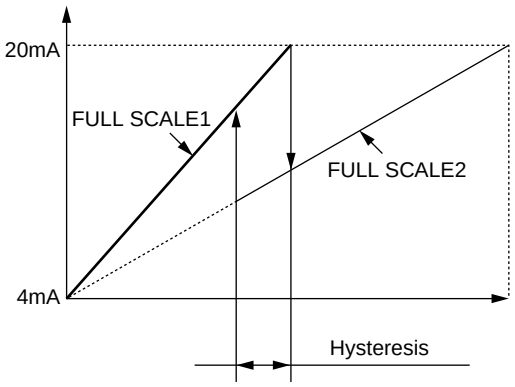
Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key twice to display “CUT OFF”.	CUT OFF 0.150 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	CUT OFF 0000.150 m3/h
		0000.150 m3/h
		0000.550 m3/h
		0000.550 m3/h
▽ ▷ ▼	Set “0.5” by the ▽ key and the ▷ key.	CUT OFF 0000.500 m3/h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— CUT OFF has been registered. ———	CUT OFF ** COMPLETE ** ↓ CUT OFF 0.500 m3/h
ESC ▽	Press the ESC key once and then press the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10. Advanced Setting

4.10.1. Automatic 2 Ranges

AUTO 2

- The function carries out a measurement while changing the range according to the flow rate.
- The current output changes with the working range as illustrated on the right figure.
- You can set the hysteresis (RANGE HYS) between 0 and 20% of the smaller range.
- If you set DO1 or DO2 to "FULL SCALE 2", the contact output will be actuated while "FULL SCALE 2" is working. Select “ACTIVE ON” or “ACTIVE OFF” separately. (See 4.10.5.1.)
- Setting range: 0.3 to 10 [m/s] in terms of flow velocity



* The unit of flow rate is as selected in "FLOW UNIT" (See 4.8.2). Be sure to set FLOW UNIT beforehand.
* If you change "FLOW UNIT" after setting the range, redo the range setting.
* If you enter a value beyond the range, "INPUT ERROR" appears on LCD and then last set value will be applied.
* When you do not use FULL SCALE2 (i.e. during single range), set FULL SCALE2 to “0”.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

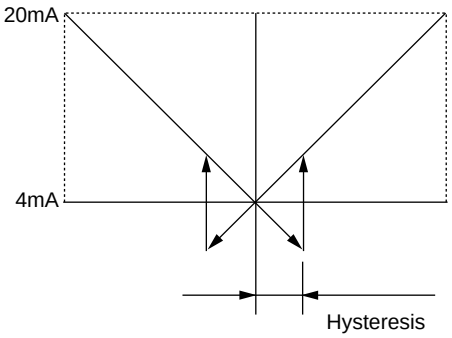
Setting up the AUTO 2 with FULL SCALE1 to 10 m^3/h, FULL SCALE2 to 60 m^3/h, and the hysteresis to 7%

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
▽ ▼	Press the ▽ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE TYPE SINGLE
▽ ▼	Press the ▽ key once, and select “AUTO 2”.	RANGE TYPE AUTO 2
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE AUTO 2
▽ ▼	Press the ▽ key once to display “FULL SCALE1”.	FULL SCALE1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	FULL SCALE1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	FULL SCALE1 0020.0000 m3/h
▽ ▼	Press the ▽ key several times to change to “1”.	FULL SCALE1 0010.0000 m3/h
	Note) To change the decimal point position, align the cursor with a place to change to, and press the ▽ key.	
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register.	FULL SCALE1 ** COMPLETE ** ↓
	——— FULL SCALE1 has been registered. ———	FULL SCALE1 10.0000 m3/h

▽ ▼	Press the ▽ key once to display “FULL SCALE2”.	FULL SCALE2 0.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE2 0000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	FULL SCALE2 0000.0000 m3/h
▽ ▼	Press the ▽ key for 6 times to set “6”.	FULL SCALE2 0060.0000 m3/h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— FULL SCALE2 has been registered. ———	FULL SCALE2 ** COMPLETE ** ↓ FULL SCALE2 60.0000 m3/h
▽ ▼	Press the ▽ key once to display “RANGE HYS.”.	RANGE HYS. 5.00 %
ENT ▼	Press the ENT key once to blink the cursor.	RANGE HYS. 05.00 %
▷ ▼	Press the ▷ key once to move the cursor.	RANGE HYS. 05.00 %
▽ ▼	Press the ▽ key twice to set “7”.	RANGE HYS. 07.00 %
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— RANGE HYS. has been registered. ———	RANGE HYS. ** COMPLETE ** ↓ RANGE HYS. 7.00 %
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10.2. Bi-Directional Range

BI-DIR



- The function measures the flow rate of either forward or reverse flow while changing over the range corresponding to the flow direction.
- The current output changes with the working range as illustrated on the right figure.
- You can set the hysteresis (RANGE HYS) between 0 and 20% of the working range.
- If you set DO1 or DO2 to "FULL SCALE 2", the contact output will be actuated while "FULL SCALE 2" is working. Select “ACTIVE ON” or “ACTIVE OFF” separately. (See 4.10.5.1.)

- Setting range: ±0.3 to 10 [m/s] in terms of flow velocity

* The unit of flow rate is as selected in "FLOW UNIT" (See 4.8.2). Be sure to set FLOW UNIT beforehand.
* If you change "FLOW UNIT" after setting the range, redo the range setting.
* If you enter a value beyond the range, "INPUT ERROR" appears on LCD and then last set value will be applied.
* When you do not use FULL SCALE2 (i.e. during single range), set FULL SCALE2 to “0”.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

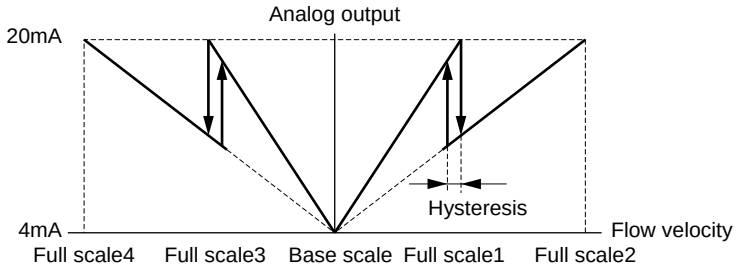
Setting up BI-DIR with FULL SCALE1 to 20 m^3/h, FULL SCALE2 to -10 m^3/h, and the hysteresis to 7%

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
▽ ▼	Press the ▽ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE SINGLE
▽ ▼	Press the ▽ key twice, and select “BI-DIR”.	RANGE TYPE BI-DIR
ENT ▼	Press the ENT key for 4 times to display “RANGE TYPE”.	RANGE TYPE BI-DIR
▽ ▼	Press the ▽ key once to display “FULL SCALE1”.	FULL SCALE1 50.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE1 0050.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “5”.	FULL SCALE1 0050.0000 m3/h
▽ ▼	Press the ▽ key several times to set “2”.	FULL SCALE1 0020.0000 m3/h
	Note) To change the decimal point position, align the cursor with a place to change to, and press the ▽ key.	
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— FULL SCALE1 has been registered. ———	FULL SCALE1 ** COMPLETE ** ↓ FULL SCALE1 20.0000 m3/h
▽ ▼	Press the ▽ key once to display “FULL SCALE2”.	FULL SCALE2 0.0000 m3/h
ENT ▼	Press the ENT key once to register.	FULL SCALE2 0000.0000 m3/h

▽ ▼	Press the ▽ key several times to display “-” on the 1st line.	FULL SCALE2 -000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	FULL SCALE2 -000.0000 m3/h
▽ ▼	Press the ▽ key once to set “1”.	FULL SCALE2 -010.0000 m3/h
ENT ▼	Press the ENT key once to register.	FULL SCALE2 ** COMPLETE ** ↓
▼ ▼ ▼	——— FULL SCALE2 has been registered. ———	FULL SCALE2 -10.0000 m3/h
▽ ▼	Press the ▽ key once to display “RANGE HYS.”.	RANGE HYS. 5.00 %
ENT ▼	Press the ENT key once to blink the cursor.	RANGE HYS. 05.00 %
▷ ▼	Press the ▷ key once to move the cursor.	RANGE HYS. 05.00 %
▽ ▼	Press the ▽ key twice to set “7”.	RANGE HYS. 07.00 %
ENT ▼	Press the ENT key once to register.	RANGE HYS. ** COMPLETE ** ↓
▼ ▼ ▼	——— RANGE HYS. has been registered. ———	RANGE HYS. 7.00 %
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10.3. Bi-Directional Auto 2 Range

BI-DIR AUTO 2



- The function measures the flow rate of either forward or reverse flow while changing the range corresponding to the flow direction and the flow rate.
- The current output changes with the working range as illustrated on the right figure.
- You can set the hysteresis (RANGE HYS) between 0 and 20% of either a) FULL SCALE1 and FULL SCALE2 or b) FULL SCALE3 and FULL SCALE4, whichever the span is smaller.
- If you set DO1 or DO2 to "FULL SCALE 2", the contact output will be actuated while "FULL SCALE 2" is working. Select “ACTIVE ON” or “ACTIVE OFF” separately. (See 4.10.5.1.)

- Setting range: ±0.3 to 10 [m/s] in terms of flow velocity

- When you set FULL SCALE1 and FULL SCALE2, FULL SCALE3 and FULL SCALE4 are automatically set.
  FULL SCALE1 and FULL SCALE3, FULL SCALE2 and FULL SCALE4 are related as follows.
  |FULL SCALE1| = |FULL SCALE3|
  |FULL SCALE2| = |FULL SCALE4|

* The unit of flow rate is as selected in "FLOW UNIT" (See 4.8.2). Be sure to set FLOW UNIT beforehand.
* If you change "FLOW UNIT" after setting the range, redo the range setting.
* If you enter a value beyond the range, "INPUT ERROR" appears on LCD and then last set value will be applied.
* When you do not use FULL SCALE2 (i.e. during single range), set FULL SCALE2 to “0”.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting up BI-DIR AUTO 2 with FULL SCALE1 of 10m^3/h, FULL SCALE2 of 60 m^3/h, and the hysteresis to 7%

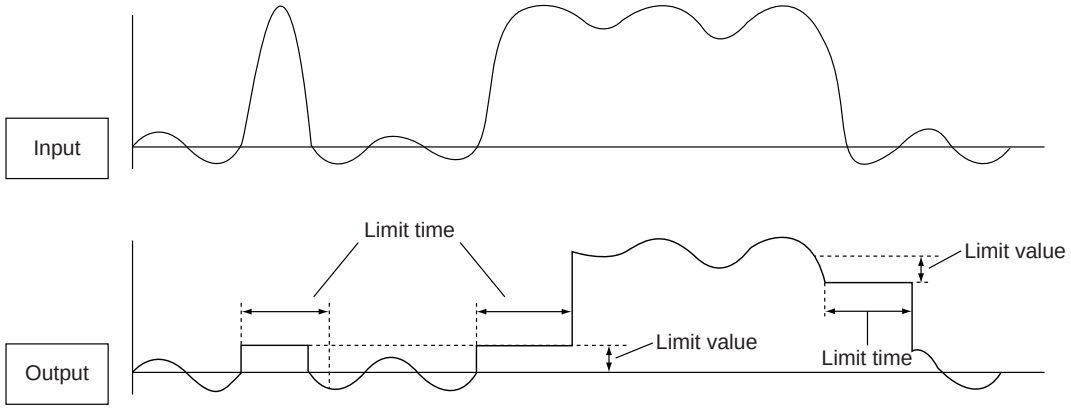
Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
▽ ▼	Press the ▽ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE TYPE SINGLE
▽ ▼	Press the ▽ key for 3 times, and select “BI-DIR AUTO 2”.	RANGE TYPE BI-DIR AUTO 2
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE BI-DIR AUTO 2
▽ ▼	Press the ▽ key once to display “FULL SCALE1”.	FULL SCALE1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	FULL SCALE1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	FULL SCALE1 0020.0000 m3/h
▽ ▼	Press the ▽ key several times to set “1”.	FULL SCALE1 0010.0000 m3/h
	Note) To change the decimal point position, align the cursor with a place to change to, and press the ▽ key.	
ENT ▼	Press the ENT key once to register.	FULL SCALE1 ** COMPLETE ** ↓

▼ ▼ ▼	——— FULL SCALE1 has been registered. ———	FULL SCALE1 10.0000 m3/h
▽ ▼	Press the ▽ key once to display “FULL SCALE2”.	FULL SCALE2 0.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE2 0000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	FULL SCALE2 0000.0000 m3/h
▽ ▼	Press the ▽ key for 6 times to set “6”.	FULL SCALE2 0060.0000 m3/h
ENT ▼	Press the ENT key once to register.	FULL SCALE2 ** COMPLETE ** ↓
▼ ▼ ▼	——— FLOW SPAN2 has been registered. ———	FULL SCALE2 60.0000 m3/h
▽ ▼	Press the ▽ key once to display “RANGE HYS.”.	RANGE HYS. 5.00 %
ENT ▼	Press the ENT key once to blink the cursor.	RANGE HYS. 05.00 %
▷ ▼	Press the ENT key once to move the cursor.	RANGE HYS. 05.00 %
▽ ▼	Press the ▽ key twice to set “7”.	RANGE HYS. 07.00 %
ENT ▼	Press the ENT key once to register.	RANGE HYS. ** COMPLETE ** ↓
▼ ▼ ▼	——— RANGE HYS. has been registered. ———	RANGE HYS. 7.00 %
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m^3

4.10.4. Rate Limit

This parameter allows the flowmeter to cut off the input spikes due to slurry or other causes.

- Setting range
  RATE LIMIT : 0 to 5 [m/s] in terms of flow velocity. Absolute value input. (Factory setting: 0 [m^3/h])
  RATE LIMIT TIMER : 0 to 900 sec. (Factory setting: 0 sec)



* When the input beyond RATE LIMIT continues for more than the time you set in RATE LIMIT TIMER, the flowmeter regards it as a true signal and transmits an output.
* RATE LIMIT does not work if the RATE LIMIT TIMER is set to 0 second.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting RATE LIMIT to 5 m^3/h, and RATE LIMIT TIMER to 10 seconds

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display ““KIND”	KIND FLOW RATE
▽ ▼	Press the ▽ key for 9 times to display “RATE LIMIT”.	RATE LIMIT 0.000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	RATE LIMIT 00000.000 m3/h
▷ ▼	Press the ▷ key for 4 times to align the cursor.	RATE LIMIT 00000.000 m3/h
▽ ▼	Press the ▽ key several times to set “5”.	RATE LIMIT 00005.000 m3/h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— RATE LIMIT has been registered. ———	RATE LIMIT ** COMPLETE ** ↓ RATE LIMIT 5.000 m3/h
▽ ▼	Press the ▽ key once to display “RATE LIMIT TIMER”.	RATE LIMIT TIMER 0 sec
ENT ▼	Press the ENT key once to blink the cursor.	RATE LIMIT TIMER 000 sec
▷ ▼	Press the ▷ key once to align the cursor.	RATE LIMIT TIMER 000 sec
▽ ▼	Press the ▽ key several times to set “1”.	RATE LIMIT TIMER 010 sec

ENT ▼ ▼ ▼ ▼ ESC ▽	Press the ENT key once to register. ——— RATE LIMIT TIMER has been registered. ——— Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	RATE LIMIT TIMER ** COMPLETE ** ↓ RATE LIMIT TIMER 10 sec 0.000 % 0.000 m3

4.10.5. Detailed DO Setting

4.10.5.1. Full scale 2

FULL SCALE2

This parameter allows the flowmeter to actuate DO1 and/or DO2 while FULL SCALE2 is working.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting DO1 to activate during FULL SCALE2

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 6 times to display “DO1 OUT”.	DO1 OUT NOT USED
	* Press the ▽ key again to display “DO2 OUT”.	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽ ▼	Press the ▽ key for 3 times to display “FULL SCALE2” on the 2nd line.	DO1 OUT FULL SCALE2
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “FULL SCALE2”.	DO1 OUT ** COMPLETE ** ↓
	——— “FULL SCALE2” has been registered. ———	STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON” (normally off). * To select normally on, press the ▽ key. ——— ACTIVE ON has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10.5.2. Alarm output

ALARM

This parameter is used to actuate DO1 or DO2 when received wave or EEPROM is abnormal.

- Setting range
  - ALL : Actuates a contact upon a hardware fault and/or a process error.
  - HARDWARE FAULT : Actuates a contact when any of the circuits is in error.
  - PROCESS ERROR : Actuates a contact when received wave is abnormal (i.e. no wave or unstable).

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting DO1 to activate during PROCESS ERROR

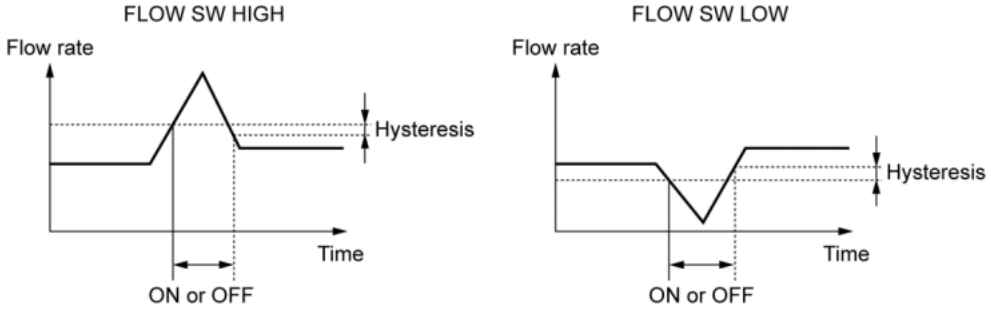
Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 6 times to display “DO1 OUT”. * Press the ▽ key again to display “DO2 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽ ▼	Press the ▽ key for 4 times to display “ALARM” on the 2nd line.	DO1 OUT ALARM
ENT ▼	Press the ENT key once to display the ALARM select panel.	ALARM ALL
▽ ▼	Press the ▽ key twice to display “PROCESS ERROR”.	ALARM PROCESS ERROR
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “PROCESS ERROR” has been registered. ———	ALARM ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON” (normally off). * To select normally on, press the ▽ key. ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

Burnout timer
You can edit the time from error occurrence until the contact actuation by setting the burnout timer. See 4.9.1.2 *Analog output at error (burnout)*.
Please note that the burnout timer is available only for PROCESS ERROR and ALL, but not available for DEVICE ERROR.

4.10.5.3. Flow switch

FLOW SW HIGH
FLOW SW LOW

This parameter allows DO1 and/or DO2 to be actuated when the instantaneous flow rate has exceeded a setpoint. The trigger can be either the high limit (FLOW SW HIGH) or the low limit (FLOW SW LOW).



- Setting range: 0 to 10 m/s in terms of flow velocity
  *For the formulas to convert the flow rate into the flow velocity, see 4.9.1.1 *Full scale*.
- Contact action : ACTIVE ON (Normally off)
  ACTIVE OFF (Normally on)

Note) The hysteresis value set in 4.9.1 "Flow Rate Range" is applied.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting DO1 to actuate at the upper limit of 12 m^3/h

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 6 times to display "DO1 OUT".	DO1 OUT NOT USED
	* Press the ▽ key again to display "DO2 OUT".	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽ ▼	Press the ▽ key for 5 times to display "FLOW SWITCH" on the 2nd line.	DO1 OUT FLOW SWITCH
ENT ▼	Press the ENT key once to display the flow rate setting screen of "FLOW SW HIGH".	FLOW SW HIGH 10.0000 m3/h
	* Press the ▽ key once to display the flow rate setting screen of "FLOW SW LOW".	
ENT ▼	Press the ENT key once to blink the cursor.	FLOW SW HIGH 0010.0000 m3/h
▷ ▼	Press the ▷ key for 3 times to move the cursor.	FLOW SW HIGH 0010.0000 m3/h
▽ ▼	Press the ▽ key twice to set "2".	FLOW SW HIGH 0012.0000 m3/h
ENT ▼ ▼ ▼	Press the ENT key once to register. ——— "FLOW SW HIGH" has been registered. ———	FLOW SW HIGH ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display "CONTACT ACTION".	CONTACT ACTION ACTIVE ON

ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON” (normally off). * To select normally on, press the ▽ key. ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

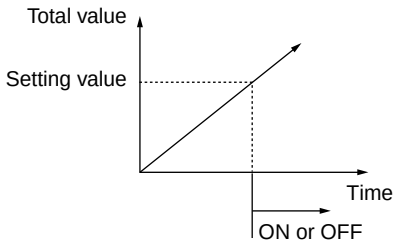
4.10.5.4. Total switch

TOTAL SWITCH

This parameter allows DO1 and/or DO2 to be actuated when the total flow rate exceeds a setpoint.

Setting range: 0.000001 to 99999999

Contact action:
ACTIVE ON : Normally off
ACTIVE OFF : Normally on
*You can configure the contact action of DO1 and DO2 independently.



An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting DO1 to be actuated by TOTAL SWITCH, and changing trigger point from 10000 m^3 to 100 m^3

Key operation	Description	Display
▽	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽	Press the ▽ key for 6 times to display “DO1 OUT”.	DO1 OUT NOT USED
	* Press the ▽ key again to display “DO2 OUT”.	
ENT	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽	Press the ▽ key for 6 times to display “TOTAL SWITCH” on the 2nd line.	DO1 OUT TOTAL SWITCH
ENT	Press the ENT key once to display the setting screen of “TOTAL SWITCH”.	TOTAL SWITCH 10000 m3
ENT	Press the ENT key once to blink the cursor.	TOTAL SWITCH 00010000 m3
▷	Press the ▷ key for 3 times to move the cursor.	TOTAL SWITCH 00010000 m3
▽	Press the ▽ key for 10 times to set “0”.	TOTAL SWITCH 00000000 m3
▷	Press the ▷ key twice to move the cursor.	TOTAL SWITCH 00000000 m3
▽	Press the ▽ key once to set “1”.	TOTAL SWITCH 00000100 m3
ENT	Press the ENT key once to register.	TOTAL SWITCH ** COMPLETE ** ↓
	——— “TOTAL SWITCH” has been registered. ———	STATUS OUT CONTACT ACTION
ENT	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT	Press the ENT key once to register “ACTIVE ON” (normally off).	CONTACT ACTION ** COMPLETE ** ↓
	* To select normally on, press the ▽ key.	
	——— “ACTIVE ON” has been registered. ———	STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m^3

4.10.5.5. AO rangeover and pulse rangeover

- AO RANGE OVER : Actuates DO1 and/or DO2 when the flow rate is beyond the flow rate range (see 4.9.1.1)
- PULSE RANGE OVER: Actuates DO1 and/or DO2 when the total pulse output exceeds the specified maximum output frequency.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting up DO1 to be actuated when the flow rate is beyond the range

Key operation	Description	Display
▽ ▼	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽ ▼	Press the ▽ key for 6 times to display “DO1 OUT”. * Press the ▽ key again to display “DO2 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▽ ▼	Press the ▽ key for 7 times to display “AO RANGE OVER” on the 2nd line. * Press the ▽ key again to display “PULSE RANGE OVER”.	DO1 OUT AO RANGE OVER
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “RANGE OVER”. ——— “RANGE OVER” has been registered. ———	DO1 OUT ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON” (normally off). * To select normally on, press the ▽ key. ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then press the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10.5.6. Output at reverse flow

-FLOW DIRECTION

This parameter is used to actuate DO1 and/or DO2 when the flow is in reverse direction.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting up DO1 to be actuated during reverse flow

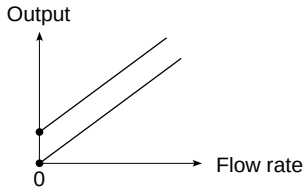
Key operation	Description	Display
▽	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
▼ ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▼ ▽	Press the ▽ key for 6 times to display “DO1 OUT”.	DO1 OUT NOT USED
▼	* Press the ▽ key again to display “DO2 OUT”.	
ENT	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
▼ ▽	Press the ▽ key for 9 times to display “-:FLOW DIRECTION” on the 2nd line.	DO1 OUT -:FLOW DIRECTION
▼ ENT	Press the ENT key once to register “-:FLOW DIRECTION”.	DO1 OUT ** COMPLETE ** ↓
▼ ▼ ▼ ▼	——— “-:FLOW DIRECTION” has been registered. ———	STATUS OUT CONTACT ACTION
ENT	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
▼ ENT	Press the ENT key once to register “ACTIVE ON” (normally off).	CONTACT ACTION ** COMPLETE ** ↓
▼ ▼ ▼ ▼	* To select normally on, press the ▽ key. ——— “ACTIVE ON” has been registered. ———	STATUS OUT CONTACT ACTION
ESC ▽	Press the ESC key twice and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10.6. Measured Value Compensation

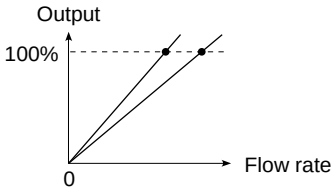
CALIBRATION ZERO
CALIBRATION SPAN

You can compensate the measured values by adjusting the zero point and the span point at need.

Setting range
Zero : -5 to +5 [m/s] in terms of flow velocity
*For the formulas to convert the flow rate into the flow velocity, see 4.9.1.1 Full scale.
Span : ±200%



Zero adjustment movement



Span movement

The output value (indication, analog output, and total output) is computed by the following equation.

$$\text{Output} = \frac{Reading \times [Span\ setpoint\ \%]}{100} + Zero\ point$$

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Compensate the zero point by 0.5 m^3/h, and the span by +1%.

Key operation	Description	Display
▽	Press the ▽ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▽	Press the ▽ key for 8 times to display “CALIBRATION ZERO”.	CALIBRATION ZERO 0.000 m3/h
ENT	Press the ENT key once to blink the cursor.	CALIBRATION ZERO 00000.000 m3/h
▷	Press the ▷ key for 6 times to move the cursor.	CALIBRATION ZERO 00000.000 m3/h
▽	Press the ▽ key for 5 times to set “5”.	CALIBRATION ZERO 00000.500 m3/h
ENT	Press the ENT key once to register.	CALIBRATION ZERO ** COMPLETE **
	——— “CALIBRATION ZERO” has been registered. ———	CALIBRATION ZERO 0.500 m3/h
▽	Press the ▽ key once to display “CALIBRATION SPAN”.	CALIBRATION SPAN 100.0 %
ENT	Press the ENT key once to blink the cursor.	CALIBRATION SPAN 100.0 %
▷	Press the ▷ key twice to move the cursor.	CALIBRATION SPAN 100.0 %
▽	Press the ▽ key once to set “1”.	CALIBRATION SPAN 101.0 %
ENT	Press the ENT key once to register.	CALIBRATION SPAN ** COMPLETE **
	——— “CALIBRATION SPAN” has been registered. ———	CALIBRATION SPAN 101.0 %
ESC ▽	Press the ESC key once and then the ▽ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

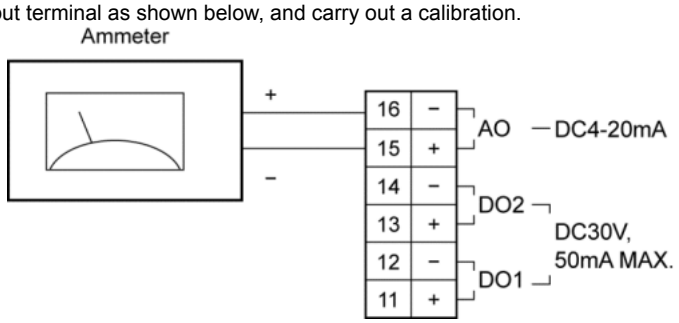
4.11. Maintenance Mode

4.11.1. Analog Output Calibration

CALIBRATION

This page explains how to calibrate the analog output, so that it be 4 mA when the flow rate is 0% of rate and 20 mA when the flow rate is 100% of rate.

Connect an ammeter to the output terminal as shown below, and carry out a calibration.



An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Adjusting the analog output

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key once to display “CURRENT”.	CURRENT CARIBRATION
ENT ▼	Press the ENT key twice to enter the calibration mode of 4mA output.	CARIBRATION 4 mA
	Adjust the output to 4mA by the ▽ and the ▷ key, while observing the output of calibration devices such as an ammeter.	
ENT ▼	Press the ENT key once to register the adjustment result.	CARIBRATION ** COMPLETE **
▼ ▼ ▼	——— 4mA adjustment result has been registered. ———	CARIBRATION 4 mA
▽ ▼	Press the ▽ key once, and select 20mA.	CARIBRATION 20mA
ENT ▼	Press the ENT key twice to enter the calibration mode of 20mA output.	CARIBRATION 20mA
	Adjust the output to 20mA by the ▽ and the ▷ key.	
ENT ▼	Press the ENT key once to register the adjustment result.	CARIBRATION ** COMPLETE **
▼ ▼ ▼	——— 20mA adjustment result has been completed. ———	CARIBRATION 20mA
ESC ▽	Press the ESC key twice and then the ▽ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.2. Constant Current Output

OUTPUT SETTING

This parameter allows you to set the analog output signal to a fixed value. This can be used when you want to check the operation of a device which receives the analog signals.

- Setting range: -20% (0.8 mA) to +120% (23.2 mA)

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the constant current output to 50% (12 mA)

Key operation	Description	Display
▽	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
△	Press the △ key twice to display “OUTPUT SETTING”.	CURRENT OUTPUT SETTING
ENT	Press the ENT key once to display the setting screen.	OUTPUT SETTING 0 %
ENT	Press the ENT key once to blink the cursor.	OUTPUT SETTING +000 %
	Note) Start constant current output.	
▷ ▽	Enter “5” by the ▷ and the ▽ key.	OUTPUT SETTING +050 %
ENT	Press the ENT key once to output 12mA.	OUTPUT SETTING ** COMPLETE ** ↓
	——— Outputting 12mA. ———	OUTPUT SETTING 50 %
ESC	Press the ESC key once to stop constant current output.	CURRENT OUTPUT SETTING
	Note) Current output is in the measurement status.	
ESC ▽	Press the ESC key once and then the ▽ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.3. Total Pulse Output Check

TOTAL PULSE

This parameter is used to check the operation of total pulse output. Specify the number of pulses to be generated per second, and check if the pulse frequency is as you set.

- Setting range: 1 to 100 pulses per second (when pulse width is 5 ms, 10 ms, 50 ms,100 ms, or 200 ms)

Notes

1. The pulse width is as selected in PULSE WIDTH (See 4.9.2.1.). Set the frequency which meets the following inequation:
   The number of pulses ≤ 1000/(Pulse width [ms] × 2)
   For example, if the pulse width is set to 50 ms, the frequency should be 10 pulses/s or less.
2. When the pulse width is 500 ms or 1000 ms, the frequency would be 1 pulse per 4 seconds regardless of setting.
3. Before performing the check, make sure if it cause no problem.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Checking the pulse output with a frequency of 5 pulses/s

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 3 times to display “TOTAL PULSE”.	TOTAL PULSE 1 PULSE/s
ENT ▼	Press the ENT key once to blink the cursor. Note) Simulated pulse output starts.	TOTAL PULSE 001 PULSE/s
▷ ▼	Press the ▷ key twice to move the cursor.	TOTAL PULSE 001 PULSE/s
▽ ▼	Press the ▽ key for 4 times to set “5”.	TOTAL PULSE 005 PULSE/s
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— 5 PULSE/s has been registered. ——— 5 PULSE/s will be generated.	TOTAL PULSE ** COMPLETE ** ↓ TOTAL PULSE 005 PULSE/s
ESC ▼	After checking the output, press the ESC key once to stop simulated pulse output.	TOTAL PULSE 005 PULSE/s
ESC ▽	Press the ESC key once and then the ▽ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.4. Contact Action Check

DO CHECK

Setting ON: Close the contact.
OFF: Open the contact.

⚠ CAUTION

- This operation makes DO1 and DO2 the same contact action.
- Before operation, check if testing DO output is permitted.

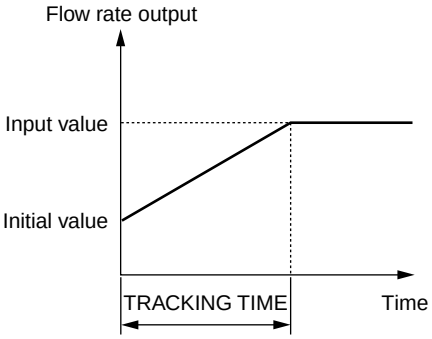
An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Checking the contact action

Key operation	Description	Display
▽	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼ ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼ ▽	Press the ▽ key for 4 times to display “DO CHECK”.	DO CHECK OFF
▼ ENT	Press the ENT key once to blink the cursor.	DO CHECK OFF
▼	Note) The contacts will act as indicated. In this example, the contacts will open.	
▽	Press the ▽ key once, and select “ON”.	DO CHECK ON
▼ ENT	Press the ENT key once to register “ON”.	DO CHECK ** COMPLETE ** ↓
▼ ▼ ▼	——— “ON” has been registered. ———	DO CHECK ON
▼	* Check the contact output “ON”.	
▽	Press the ▽ key once, and select “OFF”.	DO CHECK OFF
▼ ENT	Press the ENT key once to register “OFF”.	DO CHECK ** COMPLETE ** ↓
▼ ▼ ▼	——— “OFF” has been registered. ———	DO CHECK OFF
▼	* Check the contact output “OFF”.	
ESC	Press the ESC key once to stop the cursor from blinking.	DO CHECK OFF
▼	* It returns to contact output at the normal measurement status.	
ESC ▽	Press the ESC key once and then press the ▽ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.5. Test Mode (Simulated Flow Rate Output)

TEST MODE



This parameter is used to check each output (LCD indication, analog output, DO output) by simulating flow rate outputs. Starting with the output at the time you set the test mode as the initial value, the flowmeter will increase the output up to the target value (INPUT DATA) in the specified time (TRACKING TIME). Once the output reaches the target value, it will stay at the value.

Set DISPLAY to FROW RATE (%) beforehand.
During the test mode, "T" blinks on the left end of the 1st line of LCD.

Setting content
- TEST MODE : Enables or disables the test mode.
- INPUT DATA : Simulated flow rate target (in % of full scale).
- TRACKING TIME : Time required attaining the simulated flow rate target (INPUT DATA).

Setting range
- TEST MODE : SETTING (valid), NOT USED (invalid)
- INPUT DATA : ±120%
- TRACKING TIME : 0 to 999 seconds

* Before setting TRACKING TIME, set DAMPING (See 4.9.5) to 0 seconds.

⚠ CAUTION

- Because performing the test mode causes changes in the analog output, DO1, and DO2, check that it causes no problem to change these outputs beforehand.
- Be sure to change the TEST MODE back to "NOT USED" after the test. Otherwise, the flowmeter keeps transmitting the value you set in INPUT DATA until the power is turned off.
- If TOTAL MODE is set to START or RESET, the total value also changes during the test mode. To prevent the total value from changing, set TOTAL MODE to STOP.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the simulated flow rate target to 100%, and the tracking time to 100 s

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 5 times to display “TEST MODE”.	TEST MODE NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	TEST MODE NOT USED
▽ ▼	Press the ▽ key once, and select “SETTING”.	TEST MODE SETTING
ENT ▼	Press the ENT key once to register “SETTING”.	INPUT DATA 0 %
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	INPUT DATA +000 %
▷ ▽ ▼	Enter “100” by the ▷ and the ▽ key.	INPUT DATA +100 %
ENT ▼	Press the ENT key once to register.	INPUT DATA ** COMPLETE ** ↓
▼ ▼ ▼	——— “INPUT DATA” has been registered. ———	INPUT DATA 100 %
▽ ▼	Press the ▽ key once to display “TRACKING TIME”.	TRACKING TIME 0 sec
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	TRACKING TIME 000 sec

▽ ▼ ENT ▼ ▼ ▼ ▼ ESC ▽	Press the ▽ key once to set “100”. Press the ENT key once to register. ——— “TRACKING TIME” has been registered. ——— * Simulating flow rate output starts. Press the ESC key twice and the ▽ key once to return to the measurement mode. "T" blinks on the left end of 1st line of LCD, and the output changes. In 100 seconds (TRACKING TIME), the output becomes stable at 10 [m^3/h] (INPUT DATA). (Assuming the full scale is 10 [m^3/h]) Note) Be sure to set TEST MODE back to "NOT USED" after you finish the testing.	TRACKING TIME 100 sec TRACKING TIME ** COMPLETE ** ↓ TRACKING TIME 100 s T 0.00 % 0.000 m3/h ↓ T 100.00 % 10.000 m3/h

4.11.6. Serial Transmission (RS-485)

COMMUNICATION

Items and ranges

MODE	: RS-485
BAUD RATE	: 9600 bps (factory setting), 19200 bps, 38400 bps
PARITY	: NONE, EVEN (factory setting), ODD
STOP BIT	: 1 BIT (factory setting), 2 BITS
STATION NO	: 1 to 31 (factory setting: 1)

Note) For details, refer to the separate instruction manual “SPOOL PIECE Ultrasonic Flowmeter Communication functions” (INF-TN5A2746-E).

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the baud rate to 9600 bps, the parity to "NONE", the stop bits to "1 BIT", and the station No. to "5".

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 6 times to display “COMMUNICATION”.	COMMUNICATION
ENT ▼	Press the ENT key once to display ” RS-485 “	MODE RS-485
▽ ▼	Press the ▽ key once to display “BAUD RATE”. Because “9600 BPS” is set, go to the next step. To select other baud rate, press the ENT key, and select by the ▽ key, and register by the ENT key.	BAUD RATE 9600BPS
▽ ▼	Press the ▽ key once to display “PARITY”.	PARITY ODD
ENT ▼	Press the ENT key once to blink on the 2nd line.	PARITY ODD
▽ ▼	Press the ▽ key once to display “NONE”.	PARITY NONE
ENT ▼	Press the ENT key once to register.	PARITY ** COMPLETE ** ↓
▼ ▼ ▼	——— “NONE” has been registered. ———	PARITY NONE
▽ ▼	Press the ▽ key once to display “STOP BIT”. Because “1 BIT” is set, go to the next step. To select “2 BITS”, press the ENT key, and select by the ▽ key, and register by the ENT key.	STOP BIT 1 BIT
▽ ▼	Press the ▽ key once to display “STATION No.”.	STATION No. 01
ENT ▼	Press the ENT key once to blink the cursor.	STATION No. 01
▽ ▷ ▼	Set “5” by the ▽ and the ▷ key.	STATION No. 05
ENT ▼	Press the ENT key once to register.	STATION No. ** COMPLETE ** ↓
▼ ▼ ▼	——— STATION No. has been registered. ———	STATION No. 05

▽ ▼	Press the ▽ key once to display “PROTOCOL”. Because “MODBUS” is set, setting is completed. To select other protocol, press the ENT key, and select a protocol by the ▽ key, and register it by the ENT key.	PROTOCOL MODBUS
ESC ▽	Press the ESC key twice and the ▽ key once to return to the measurement mode.	0.000 % 0.000 m3/h

4.11.7. ID No.

REGISTER ID NO

You need to set the ID No. if you want to use parameter protection (See 4.4 PAR. PROTECT). To validate the parameter protection, set a 4-digit ID No. and then set PAR.PROTECT to ON. The ID No. is required when you cancel the protection.

Setting range: 0000 to 9999 (4-digit)

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)
If you forget the ID number you set, contact us.

Setting the ID No. to “1106”

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 8 times to display “REGISTER ID NO.”.	REGISTER ID NO.
ENT ▼	Press the ENT key twice to blink on the 2nd line.	REGISTER ID NO. 0000
▽ ▷ ▼	Set “1106” by the ▽ and the ▷ key.	REGISTER ID NO. 1106
ENT ▼	Press the ENT key once to register.	REGISTER ID NO. ** COMPLETE ** ↓
▼ ▼ ▼	——— ID NO. has been registered. ———	REGISTER ID NO. ****
ESC ▽	Press the ESC key twice and the ▽ key once to return to the measurement mode. Note) To validate the protection, set the protection to "ON". (See 4.4.)	0.000 % 0.000 m3/h

4.11.8. Software Version

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 9 times to display “VER. NO.”.	* VER. NO. FST****26T 11
ESC ▽	Press the ESC key twice and the ▽ key once to return to the measurement mode.	0.000 % 0.000 m3/h

*The above indicated version number is an example.

4.11.9. LCD Backlight

LCD BACKLIGHT

This parameter allows you to set the time until the backlight goes off after the last key operation.

- Setting range: 0 to 99 min

If you set the LCD BACKLIGHT to 0 min, the backlight keeps lighting all the time.

An example of operation is shown below. Set the parameter protection to OFF beforehand. (See 4.4)

Setting the backlight to go off 10 minuites after the last key operation

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 11 times to display “LCD BACKLIGHT”	LCD BACKLIGHT 00min
ENT ▼	Press the ENT key once to blink the cursor.	LCD BACKLIGHT 00min
▷ ▽ ▼	Use the ▷ key and the ▽ key to enter “10”.	LCD BACKLIGHT 10min
ENT ▼	Press the ENT key once to register.	LCD BACKLIGHT 10min
	——— LCD BACKLIGHT has been registered ———	LCD BACKLIGHT ** COMPLETE **
ESC ▽	Press the ESC key twice and the ▽ key once to return to the measurement mode.	0.000 m/s 0.000 m3/h

5. CHECK AND MAINTENANCE

5.1. Daily Check

Visually check the following items.

- Whether flow transmitter cover screws are loose. ⇒ Tighten the screws.
- Whether cable glands are loose. ⇒ Tighten the glands.
- Whether received wave is abnormal (LED lit red). ⇒ Check whether piping is filled or not. Remove bubbles or foreign matters, if mixed in measurement pipe. Also check if detector mounting and wiring are set up properly.
- Whether the main unit is dusty or dirty. ⇒ Moisten a soft cloth with water and wring it out, and then wipe them off.
  *Do not use volatile solvents such as benzene or thinner, as they may damage the paint or coating.
  *Be careful not to damage the display.

5.2. Periodic Inspection

5.2.1. Checking the Zero Point

Stop the fluid flow, fill the measurement pipe with fluid, and check the zero point.

5.2.2. Removing Accretion Inside Spool

⚠ CAUTION

If the fluid contains scales or the like, wipe inside the spool with a soft cloth to prevent the scales from causing measurement errors.

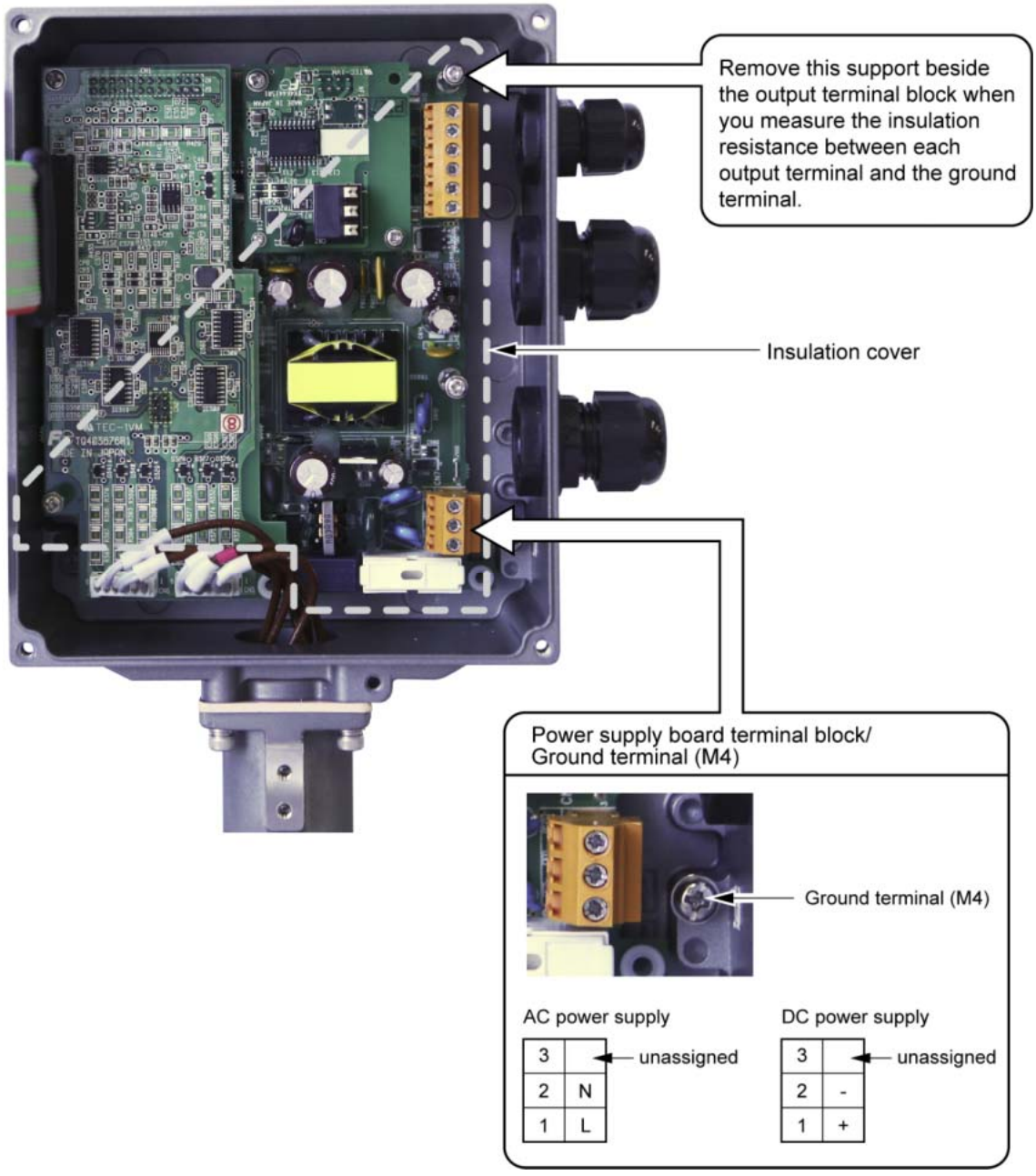
5.2.3. Measuring the Insulation Resistance

⚠ CAUTION

Turn off the power before opening the flow transmitter cover.
The power terminal is equipped with a variable resistor, and the output terminal is equipped with an arrester, as standard. When you measure the insulation resistance between each terminal and the ground terminal, remove the insulation cover and the support beside the output terminal block.

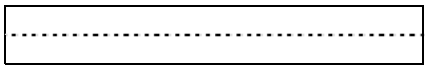
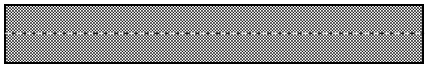
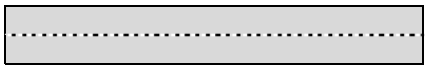
Measurement point: between the power terminal and ground terminal
between each output terminal and the ground terminal

Insulation resistance: 100 MΩ/500 V DC
After measuring the resistance, put the supports of terminal blocks and the insulation covers back on.



5.3. Troubleshooting

5.3.1. Display Errors

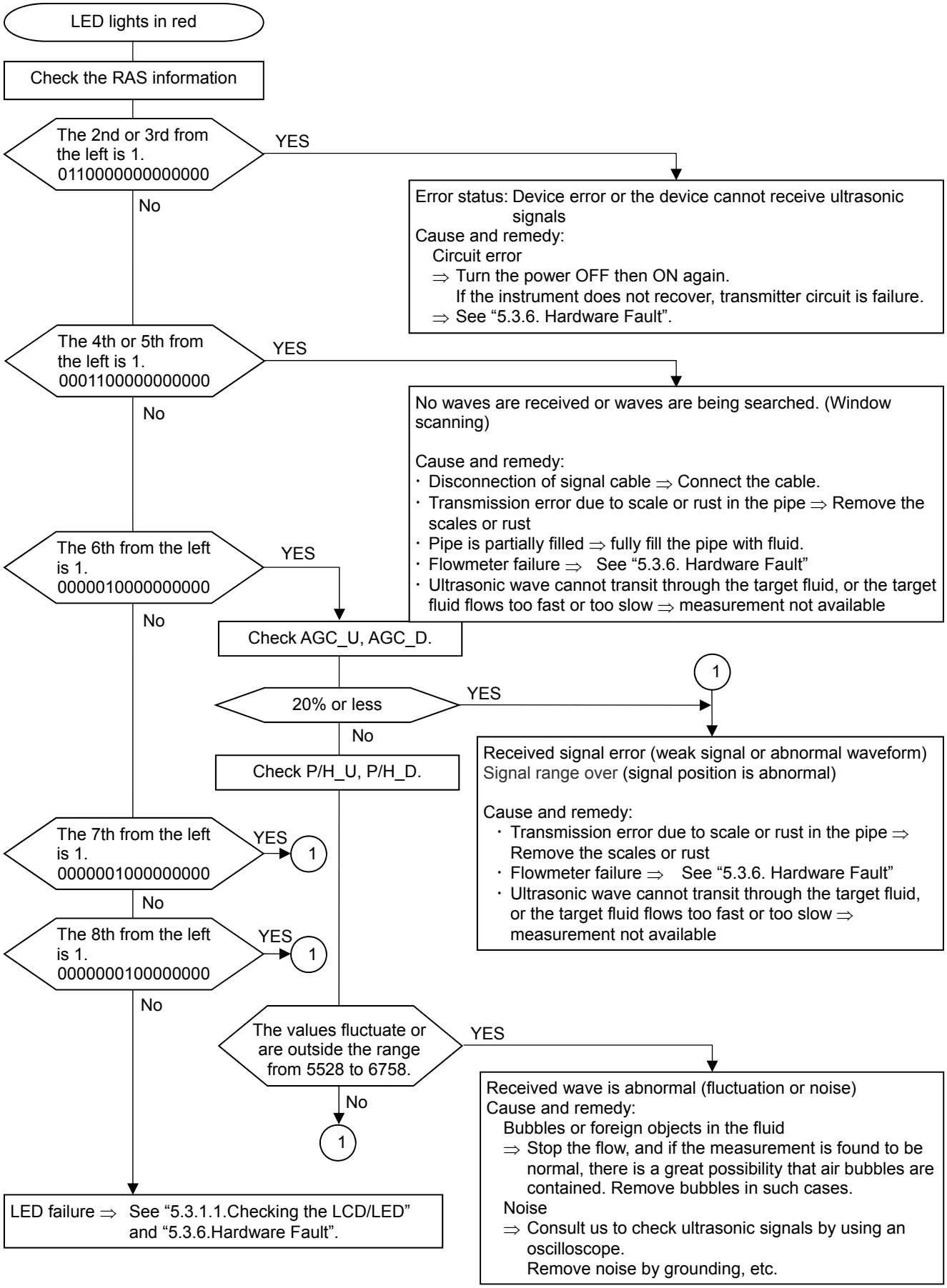
State	Probable cause
 Nothing is displayed.	● Power is not suppled. ● Low power voltage ● Fuse is blown out. ● LCD error ⇒ Refer to “5.3.6. Hardware Fault”. ● Reverse polarity of DC power supply
 Upper line appears black.	● Low power voltage ● Reverse polarity of DC power supply ● LCD error ⇒ Refer to “5.3.6. Hardware Fault”.
 Irrational display	● Hardware error ⇒ Refer to “5.3.6. Hardware Fault”.
 Pale display	● Ambient temperature is too low (-20°C or lower) ⇒ Increase temperature. ● LCD has reached the end of its service life. ⇒ Replace the LCD.
 Entire display is blackish.	● Ambient temperature is too high (50°C or higher) ⇒ Decrease temperature.
LCD characters are skipped. LED does not come on	● Refer to “5.3.1.1. Checking the LCD/LED”. ● The dots on the LCD are missing or the LED does not come on. ⇒ Refer to “5.3.6. Hardware Fault”.
LED lights in red.	● Received wave is abnormal. ⇒ Refer to “5.3.1.2. Diagnosis when the LED lights in red”.

5.3.1.1. Checking the LCD/LED

Follow the procedure below to check possible display errors.

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 12 times to display “LCD/LED CHECK”.	LCD/LED CHECK
ENT ▼	Press the ENT key once.	● ← red
▷ ▼	Pressing the ▷ key changes the display to the next check, in the order shown below. LCD: OFF completely LED: Lit in green LCD: blackish LED: Lit in red If any dots on the LCD are missing or the LED does not turn on, the LCD/LED may have failed.	● ← green
ESC ▽	Press the ESC key twice and the ▽ key once to return to the measurement mode.	0.000 m/s 0.000 m3/h

5.3.1.2. Diagnosis when the LED lights in red



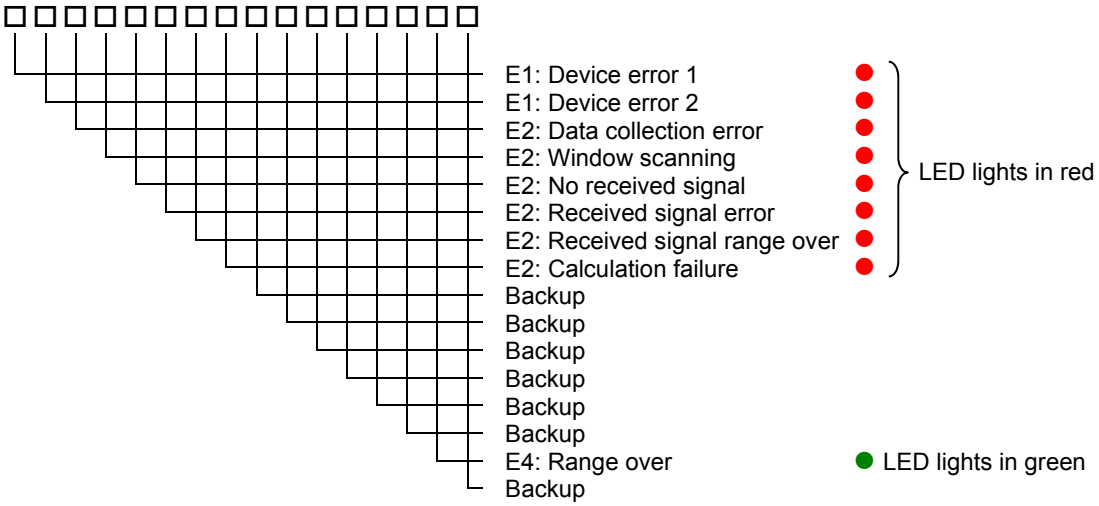
5.3.1.3. Checking the RAS information

If the LED lights in red, check the detail of error in RAS information.

Key operation	Description	Display
▽	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION #ALL 0000000000000000
▽	Press the ▽ key once to display RAS information of the 1st path.	RAS INFORMATION #1 0000000000000000
▽	Press the ▽ key once to display RAS information of the 2nd path.	RAS INFORMATION #2 0000000000000000
▽	Press the ▽ key once to display RAS information of the 3rd path.	RAS INFORMATION #3 0000000000000000

If there is any error, “1” appears somewhere in the numerals. To display the type of error, move the cursor to 1 by the ▷ key, and press the ENT key. Pressing the ENT key again displays the troubleshooting information.

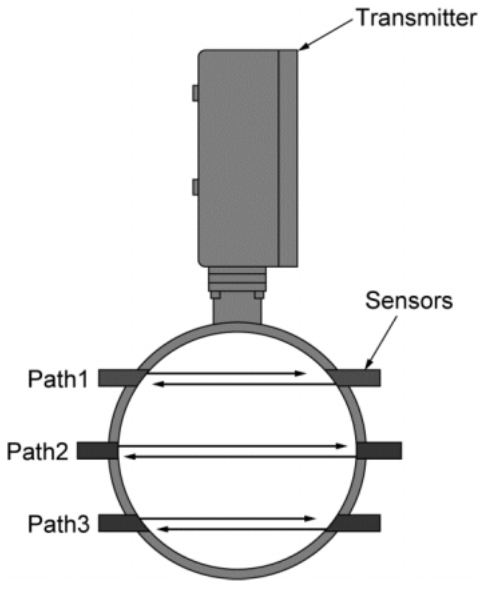
Configuration of the RAS information



RAS information	Status	Troubleshooting
E1: Device error 1	Backup memory failure	See “5.3.6. Hardware Fault”.
E1: Device error 2	Abnormality of measuring circuit	Turn the power off then on again. If the instrument does not recover, refer to “5.3.6. Hardware Fault”.
E2: Data collection error	Ultrasonic signals cannot be collected.	
E2: Window scanning	The ultrasonic signal is being detected.	Check that the pipe is fully filled and remove the contaminants in pipe If the problem is not solved, it means the flowmeter has failed (see 5.3.6. Hardware Fault) or the fluid is unavailable to be measured.
E2: No received signal	No ultrasonic signal	
E2: Received signal error	The status of received waveform is poor.	Check the air bubbles or foreign objects. Check the receiving sensitivity. If the problem is not solved, it means the flowmeter has failed (see 5.3.6. Hardware Fault) or the fluid is unavailable to be measured.
E2: Received signal range over	Receiving signal waveform is outside the appropriate range.	The flowmeter has failed (see 5.3.6. Hardware Fault) or the fluid is unavailable to be measured.
E2: Calculation failure	Measured value is abnormal.	Check the receiving sensitivity. If the problem is not solved, it means the flowmeter has failed (see 5.3.6. Hardware Fault) or the fluid is unavailable to be measured.
E4: Range over	Analog output and/or total output exceed the range.	Check the range and the totalization setting.

DO setting for alarm

“All” : Alarm is issued at occurrence of E1 or E2. [Burnout timer is enabled]
“Device error” : Alarm is issued at occurrence of E1. [Burnout timer is disabled]
“Process error” : Alarm is issued at occurrence of E2. [Burnout timer is enabled]
Burnout timer allows you to configure the time from the error occurrence until a contact output actuation.



Parallel three paths line vertically. The top (nearest to the flow transmitter) is the 1st path.

5.3.2. Diagnostic Data

If error occurs, follow the procedure shown below to check each items, especially “AGC” and “P/H”.

Key operation	Description	Display
▽ ▼	Press the ▽ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▽ ▼	Press the ▽ key for 13 times to display “DATA DISPLAY”.	DATA DISPLAY CH1
ENT ▼	Press the ENT key.	DATA DISPLAY CH1
	*The below is an example of the path 1 (CH1). To check the path 2 or the path 3, use the ▽ key to change the channel.	
▽ ▼	Press the ▽ key once. ● Transit time (TO C) and the window opening time (WinC) are displayed.	TO C: 89 usec WinC: 80 usec
▽ ▼	Press the ▽ key once. ● Transit time T1 (forward) and T2 (reverse) are displayed.	T1: 0.000 usec T2: 0.000 usec
▽ ▼	Press the ▽ key once. ● Average transit time TO, and transit time difference DT are displayed.	TO: 0.000 usec DT: 0.00 nsec
▽ ▼	Press the ▽ key once. ● Flow velocity V1 and V2 are displayed.	V1: 0.000 m/s V2: 0.000 m/s
▽ ▼	Press the ▽ key once. ● Flow velocity V3 and V4 are displayed.	V3: 0.000 m/s V4: 0.000 m/s
▽ ▼	Press the ▽ key once. ● The intensity of received signals is displayed. The larger the value, the larger the intensity of received signals. Normally, the value is 20% or more. If the display shows 0%, it means no signals are being received. This may be caused either by insufficient water volume or obstructions such as rust, accretion, or air bubbles.	AGC U: 0.00 % AGC D: 0.00 %
▽ ▼	Press the ▽ key once. ● The peak value of received signal waveform is displayed. Normal values stably fall within the range from 5528 to 6758. Large fluctuations or too small value indicates the possible existence of obstructions such as rust, accretion, or air bubbles. In such a case, stop the flow and check if the values get normal. If the values are normal, it is likely that air bubbles exist in the fluid.	P/H U: 6143 P/H D: 6143
▽ ▼	Press the ▽ key once. ● Displays the signal detection level.	TRG U: 25.00% TRG D: 25.00%
ESC ▽	Press the ESC key or the ▽ key to display the measurement mode.	

5.3.3. Key Errors

Status	Probable cause
No response to key operation.	● Hardware failure ⇒ Refer to “5.3.6. Hardware Fault”.
Certain key does not work or works incorrectly	

5.3.4. Measured Value Errors

Status	Probable cause	Troubleshooting
The reading appears with "-" (minus).	● Connection between main unit and sensor units (upstream, downstream) are inverted.	● Connect properly.
	● Reverse flow	
Measured value fluctuates though flow rate is constant.	● Straight pipe length is not enough.	● Move the sensor to the place where the length of 10D can be assured on upstream side and 5D on downstream side.
	● Pump, valve or others which disturb the flow are located nearby.	● Mount the instrument with a clearance of 30D or more.
	● Pulsation exists in flow.	● Set the damping to increase the response time.
Measured value remains the same though there is a flow. (LED lights in red)	Measured value is held because ultrasonic pulses cannot be propagated through a pipe. 1. Problem in pipe or fluid ○ Pipe not fully filled with fluid	Move the flowmeter to a position where the pipe is fully filled. ● Install the flowmeter onto the pipe portion which is lower than other portions of the line.
	○ Bubbles in the fluid If readings are normal during no flow, it means there are air bubbles.	Eliminate bubbles. ● Raise the level of the pump well. ● Check the shaft seal of the pump. ● Retighten the flange of negative pressure pipe. ● Arrange so that fluid doesn't fall into the pump well.
	If the flowmeter is mounted immediately downstream a valve, cavitation occurs, resulting in the same phenomenon as when air bubbles exists.	Move the sensor to the location where air bubbles does not present. ● Inlet side of the pump ● Upstream side of the valve
	◎ High turbidity	● The fluid is unavailable to be measured.
	◎ Turbidity is higher than those of sewage and return sludge.	
	2. Effect of external noise ● There is a radio broadcasting station nearby. ● Measurement is conducted near a passage of vehicles or trains.	● Ground the upstream pipe and the downstream pipe which are connected with the detector.
	3. Hardware failure	Refer to "5.3.6. Hardware Fault".

Status	Probable cause	Troubleshooting
Measured value is not zero although the fluid is still.	● Fluid forms convection inside the pipe.	Normal
	● Zero point adjustment	● Readjust the zero point after fluid has completely stopped flowing.
	● When the flow is stopped, the pipe is not fully filled with fluid or is empty. (LED lights in red).	Normal
Error in measured value	● Scales exist on pipe wall.	A difference of 1% in inner diameter causes an error of about 3%. ● Remove scales
	● Insufficient linear pipe length (10D or more for upstream and 50D or more for downstream)	Move the position of the flowmeter (upstream of disturbing objects). See 3.3 Pipe Requirements.
	● Pipe is not filled with fluid or sludge is deposited in the pipe.	This occurs particularly where sectional area is small. ● Move sensor to a vertical pipe.

5.3.5. Analog Output Errors

Status	Probable cause	Troubleshooting
Current output does not match with the setting of FULL SCALE.	Range setting is wrong.	● Set the range correctly.
Not 4mA when a reading is 0.	Analog output is misadjusted.	● Perform analog output calibration.
Output is 0mA.	Cable disconnection	
Output rises beyond 20mA. (“OVER FLOW” appears on the LCD.)	Over range	● Reconfigure the analog output range.
The output becomes lower than 4mA. (“UNDER FLOW” appears on the LCD.)	The flow is backward.	● Check that the direction of the arrow on the flowmeter neck matches with the flow direction.
Indication changes but analog output remains the same.	The output load is 600 Ω or more.	● It must be less than 600 Ω.
Indication does not agree with analog output.	Analog output is misadjusted.	● Perform analog output calibration.
Analog output doesn’t change even after it has been adjusted.	Hardware failure	● Contact us.

5.3.6. Hardware Fault

If the hardware is diagnosed as faulty in the result of diagnoses from 5.3.1 to 5.3.5, contact us.

6. RETURN AND DISPOSAL

6.1. Return

- Do not return the instrument if you are not sure if all the hazardous substance are removed. For example, the substance may have penetrated into the groove, or may have diffused through plastic.
- The holder or the operator of the instrument is to bear the cost for waste disposal or external injuries caused by insufficient cleaning of the flowmeter.
- If you return the flowmeter to us for repair or calibration:
    - Remove all the residues.
    - Thoroughly check grooves and gaps, and seals where residues can be left, especially when the residue is hazardous (i.e. combustible, toxic, corrosive, or carcinogenic) to health.

6.2. Disposal

Please follow your local laws and regulations.

7. APPENDIX

7.1. Specifications

SPECIFICATIONS

1. General specifications

- **Measuring principle:**
  Transit time difference method
  Parallel 3-path with the advanced ABM (anti-bubble measurement) system
- **Diameter (mm):**
  25, 50, 80, 100
- **Flow velocity range:**
  Minimum 0 to 0.3 m/s or -0.3 to 0 m/s
  Maximum 0 to 10 m/s or -10 to 0 m/s
- **Flow range:**

Diameter (mm)	25	50	80	100
Minimum (m^3/h)	0 to 0.54	0 to 2.13	0 to 4.65	0 to 7.99
Maximum (m^3/h)	0 to 17.6	0 to 70.6	0 to 154.8	0 to 266.0

- **Dimensions and weight:**
  Refer to outline diagram
- **Power supply:**
  100–240 V AC (+10% -15%), 50/60 Hz or 20-30V DC
- **Power consumption:**
  Approx. 20 VA (AC power)
  Approx. 6 W (DC power)
- **Grounding:**
  D-class grounding with ground resistance of 100Ω or less
- **Varistor:**
  Attached to the power supply port
- **Surge arrester:**
  Attached to the analog output port
- **Enclosure:**
  IP66
- **Ambient temperature:**
  -40°C to +60°C
- **Ambient humidity:**
  90% RH or less

2. Fluid conditions

- **Applicable fluid:**
  Liquid (uniform liquid through which ultrasonic wave can propagate; and liquid that won't corrode stainless steel 316)
- **Bubble content:**
  ≤ 12 vol%
- **Turbidity:**
  10,000 mg/L or less
- **Flow profile:**
  fully-developed turbulent or laminar flow in a fully-filled pipe
- **Temperature:**
  -40°C to +150°C
- **Pressure:**
  Up to flange rating
- **Kinematic viscosity:**
  ≤ 100 mm^2/s

3. Detector

- **Wetted parts material:**
  Flow cell: stainless steel 316L
  Flange: stainless steel 316L
  Sensor wetted parts: stainless steel 316L
- **Detecto r material:**
  Housing: SCS13
- **Process connections:**
  Flange (horizontal or vertical mounting)
- **Flange rating:**
  JIS10K/JIS20K
  ANSI class 150/300
  DIN PN16/40

4. Performance

- **Accuracy:**
  - Reading and pulse output:
    ±0.2% of rate (flow velocity 1 m/s to 10 m/s)
    ±0.002 m/s (flow velocity 0.5 m/s to 1 m/s)
  - Analog output:
    Above indicated accuracy ±0.01 mA (at the ambient temperature of 25°C)
- **Reference condition:**
  - Fluid: water
  - Straight run requirements: 10D on inlet side
    5D on outlet side
    (D: pipe diameter)
  - Measurement period: 600s
  - Pipe wall thickness: schedule 40
  - Fluid temperature: 0°C to 35°C
- **Response time:**
  1.2 s (standard)

5. Flow transmitter

- **Analog output signal:**
  4–20 mA DC (insulated), 1 point
  Allowable load resistance: ≤ 600Ω
- **Contact output:**
  Forward total, reverse total, alarm, acting range, flow switch, or total switch
  User configurable
  - Type: transistor output (isolated, open collector)
  - Contact capacity: 30 V DC, 50 mA
  - 2 points
  - Normal: ON or OFF, selectable
  - Frequency: 100 P/s max.
    (Pulse width: 5, 10, 50, 100, 200, 500, 1000 ms)
- **Communication (option):**
  RS-485 (MODBUS), isolated, arrestor incorporated
  No. of connectable modules: up to 31
  Baud rate: 9600, 19200, 38400 bps
  Parity: none/odd/even, selectable
  Stop bit: 1 or 2 bit, selectable
  Cable length: up to 1 km
  Data: Flow velocity, flow rate, forward total, reverse total, status, etc.

• **Display:**
16-digit 2-line backlit LCD
2-color LED (green: normal, red: at error)
• **Language:**
Japanese (katakana), English, French, German, Spanish (switchable)
• **Flow velocity/flow rate indication:**
8 digits numerals (decimal point is counted as 1 digit)
Instantaneous flow rate, instantaneous flow velocity (minus indication for reverse flow)
Unit:

Flow velocity	m/s
Flow rate	L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h, m^3/d, km^3/d, Mm^3/d

• **Total value indication:**
Integrated value of forward flow or reverse flow (reverse flow is indicated with minus symbol)
8 digits numerals (decimal point is counted as 1 digit)
Unit: mL, L, m^3, km^3, Mm^3
• **Housing material:**
Aluminum alloy
• **Coating:**
Urethane resin
• **Finish color:**
Silver
• **Wiring port:**
G1/2
Plastic water-proof gland + rubber plug
• **Terminal:**
Euro-style terminal

6. Functional specifications

• **Setting**
By using 4 keys (ESC, △, ▷, ENT)
• **Zero point adjustment:**
By setting zero or clearing zero
• **Damping:**
For analog output or velocity/flow rate indication, 0 to 100 seconds
(In 1-second steps)
• **Low flow cut-off:**
0 to 5 m/s in terms of flow velocity
• **Alarm:**
For hardware error or process error
Contact output available
• **Output burnout:**
Analog output: hold, overscale, underscale, or zero
Flow rate total: hold or count
Burnout timer: 0 to 100 seconds (in 1-second steps)
• **Output limit:**
High/low limit for analog output is available in the range from 0.8 mA to 23.2 mA
• **Bi-directional range:**
Forward and reverse ranges configurable independently.
Hysteresis: 0% to 20 % of working range
Working range applicable to digital output.
• **Auto 2 range:**
Two ranges configurable independently
Hysteresis: 0% to 20 % of working range
Working range applicable to digital output.
• **Flow switch:**
High limit and low limit are configurable independently
Contact output can be activated while the instantaneous flow rate is beyond the high/low limit.
• **Total switch:**
High limit for total flow
Contact output can be activated when the total flow has exceeded the high limit.
• **Total preset:**
Total flow returns to the user-defined preset value every time a user resets the total.
• **Data backup at power outage**
on nonvolatile memory

7. EU Directive Compliance CE

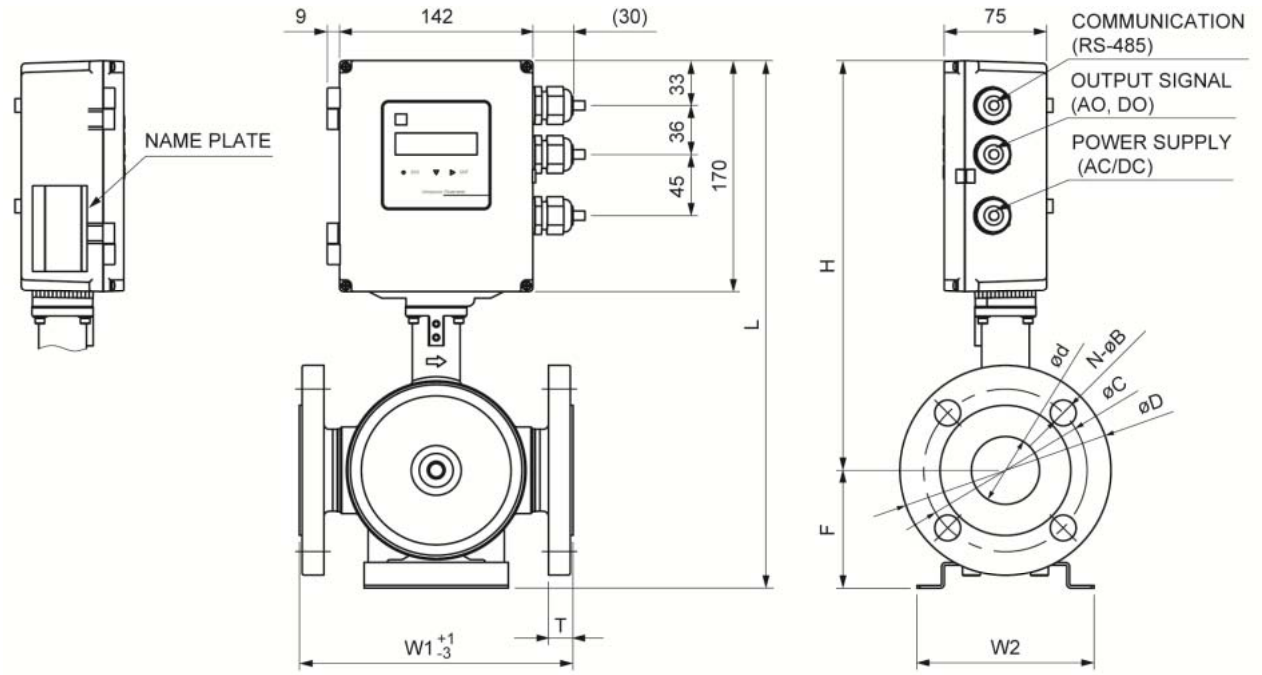
LVD (2014/35/EU)
EN 61010-1
EMC (2014/30/EU)
EN 61326-1 (Table 2)
EN 55011 (Group 1 Class A)
EN 61000-3-2 (Class A)
EN 61000-3-3
EN 61326-2-3
RoHS (2011/65/EU)
EN 50581

■ Parameter loader software

Provided as a standard accessory.
• For IBM PC compatible
• Allows a user to configure or to change parameter values.
• Supported OS:
Windows 7 (Home Premium, Professional), Windows 8 (Professional), Windows 10 (Enterprise)
• Memory:
≥ 128 MB
• Drive:
CO-ROM drive compatible with Windows 7 (Home Premium, Professional), Windows 8 (Professional), Windows 10 (Enterprise)
• Hard-disk space:
≥ 52 MB

Note 1) To use serial communication, select "D" in 10th code.
Note 2) Communication interface converter:
For a PC which supports the RS-232C serial interface, a RS232C to RS485 converter is required.
If your PC does not support the RS232C serial interface, an USB to RS232C converter is additionally required.
<Recommended products>
RS232C to RS485 converter:
OMRON K3SC-10 interface converter (insulated)
*A D-sub connector cable is required.
USB to RS232C converter:
SANWA SUPPLY USB–CVRS

7.2. Outline Diagram



BODY DIMENSIONS

PIPE SIZE	25A	50A	80A	100A
W1	200	200	300	300
W2	130	130	160	160
ød	25	50	74	97
H	292	303	315	326
F	84	87	120	129
L	376	390	435	455

FLANGE DIMENSIONS (6th DIGIT)

PIPE SIZE		25A	50A	80A	100A
JIS 10K FLANGE (CODE: 1)	øD	125	155	185	210
	øC	90	120	150	175
	N-øB	4-19	4-19	8-19	8-19
	T	14	16	18	18
	MASS. (kg)	10	13	18	23
ANSI 150LB FLANGE (CODE: 3)	øD	110	150	190	229
	øC	79.4	120.7	152.4	190.5
	N-øB	4-15.9	4-19	4-19	8-19
	T	14.3	19.1	23.9	23.9
	MASS. (kg)	10	13	21	27
DIN PN16 FLANGE (CODE: 5)	øD	115	165	200	220
	øC	85	125	160	180
	N-øB	4-14	4-18	8-18	8-18
	T	16	18	20	20
	MASS. (kg)	11	14	21	24

PIPE SIZE		25A	50A	80A	100A
JIS 20K FLANGE (CODE: 2)	øD	125	155	200	225
	øC	90	120	160	185
	N-øB	4-19	8-19	8-23	8-23
	T	16	18	22	24
	MASS. (kg)	10	13	21	26
ANSI 300LB FLANGE (CODE: 4)	øD	125	165	210	254
	øC	88.9	127	168.1	200
	N-øB	4-19.1	8-19	8-22	8-22
	T	17.5	22.3	28.6	31.8
	MASS. (kg)	12	15	25	35
DIN PN40 FLANGE (CODE: 6)	øD	115	165	200	235
	øC	85	125	160	190
	N-øB	4-14	4-18	8-18	8-22
	T	18	20	24	24
	MASS. (kg)	12	15	22	28

7.3. Parameter Setting Table

1. Type of flowmeter
2. Tag No. (When tag plate is specified)
3. Parameter setting table (When parameter setting is specified)

Company name: _____ Branch: _____

Name of the contact person: _____ TEL: _____

Fluid to be measured: _____

Parameter setting table

Setting items			Initial value	Setting value	Setting items			Initial value	Setting value
ID No			0000		Output condition	Total output	Total mode	Stop	
Language			English				Pulse value	$0m^3$	
Measurement	System unit		Metric				Total preset	$0m^3$	
	Flow unit		m^3/h				Pulse width	50.0msec	
	Total unit		m^3				Burnout (total)	Hold	
	Path abnormal		Calculation OFF				Burnout timer	10sec	
Output condition	Damping		5.0sec			DO1 Output type (Note1)		Not used	
	Cut off		$0.150m^3/h$			DO1 Output operation		Active ON	
	Display	Content of 1st line	Velocity (m/s)			DO2 Output type		Not used	
		Decimal point position of 1st line	****.***			DO2 Output operation		Active ON	
						Operation mode		Standard	
		Content of 2nd line	Flow Rate (m^3/h)		Communication	Communication mode		RS-485	
		Decimal point position of 2nd line	****.***			Baud rate		9600bps	
						Parity		Odd	
	Analog output	KIND	FLOW RATE			Stop bit		1 bit	
		Range type	SINGLE			Station No.		1	
		Full scale 1	$15.000m^3/h$						
		Full scale 2	$0.000m^3/h$						
		Hysteresis	10.00%						
		Burnout (current)	HOLD						
		Burnout timer	10sec						
		Output limit low	-20%						
		Output limit high	120%						
		Rate limit	$0.000m^3/h$						
		Rate limit timer	0sec						

Note 1) when total pulse output has been selected for DO1 and/or DO2 specify total pulse value and total pulse width so that conditions 1 and 2 shown below are satisfies.

Condition 1:

$$\frac{\text{Full scale*1 } [m^3/s]}{\text{Pulse value } [m^3]} \leq 100[Hz]$$

Condition 2:

$$\frac{\text{Full scale*1 } [m^3/s]}{\text{Pulse value } [m^3]} \leq \frac{1000}{2 \times \text{Pulse width [ms]}}$$

*1) The range of FULL SCALE 1 or FULL SCALE 2, whichever is larger, is the object in case of automatic 2-range, forward and reverse range, forward and reverse automatic 2-range.

Fuji Electric Co., Ltd.

Instrumentation & Sensors Planning Dept.
1, Fuji-machi, Hino-city, Tokyo 191-8502, Japan
http://www.fujielectric.com
Phone: +81-42-514-8930 Fax: +81-42-583-8275
http://www.fujielectric.com/products/instruments/