Fuji Electric

Instruction Manual

ULTRASONIC FLOWMETER FOR STEAM

TYPE: FSJ (Flow transmitter)
FSX (Detector)
FLY (Signal cable)

INF-TN1FSJc-E Fuji Electric Co., Ltd.

PREFACE

Thank you for purchasing Fuji Electric's ultrasonic flowmeter.
This instruction manual describes ultrasonic flow transmitter (FSJ) and detector (FSX) installation, operation, inspection, and maintenance, and should be read carefully before use.

- First read this instruction manual carefully until an adequate understanding is acquired, and then proceed to 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 easier 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

Issued in Nov., 2019
Rev. 1st edition Mar. 2020
Rev. 2nd edition Aug. 2020
Rev. 3rd edition Jun. 2021

Date:

To: Fuji Electric Co., Ltd.

Company name

Department

Name Seal

Certificate of Conformance with RoHS Directive

This certificate certifies that flowmeters returned to your company for the purpose of repair or calibration shall not be contaminated with substances of environmental concern applicable to RoHS regulations (EU Directive 2011/65/EU) listed in (1) below which exceed standard values, and pledges that these flowmeters shall not adversely affect your company' s repair equipment or instrumental error calibration equipment.

(1) Applicable substances of environmental concern

Substance name	Max. tolerance
Cadmium	100 ppm
Lead	1000 ppm
Mercury	1000 ppm
Hexavalent chromium	1000 ppm
Polybrominated biphenyl (PBB)	1000 ppm
Polybrominated diphenyl ethers (PBDE)	1000 ppm
Bis (2-ethylhexyl) phthalate (DEHP)	1000 ppm
Butyl benzyl phthalate (BBP)	1000 ppm
Dibutyl phthalate (DBP)	1000 ppm
Diisobutyl phthalate (DIBP)	1000 ppm

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.
These 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.
	This symbol indicates direct current (DC).
	This symbol indicates alternating current (AC).
	This symbol urges caution.
	This symbol indicates that care should be taken to prevent electric shock due to high voltage.

- Failure to heed the information indicated by " ⚠ CAUTION " may also result in serious consequences.
  All items indicate important content and must therefore be 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.
- EMC standards
  This product is intended for use in industrial areas and environments. This equipment has been designed as a Class A product (for industrial environment applications). Use in home environments may cause jamming, and therefore use in such environments should be avoided. If absolutely necessary to use the product in a home environment, take appropriate external countermeasures.
- Install the flow meter according to the following steps 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.
- The items under "Caution on Installation" noted in the manual must be fully observed. Careless installation may result in trouble or malfunction of the unit.Please observe the following in order to comply with safety standards. It will not be possible to meet safety standards if unable to do so.
- Connect an SELV for analog input and output, DO output, and serial communication (RS-485).
- When installing on hot pipes, pay attention to the following items when carrying out installation work. Failure to observe this may result in burns.
- Keep bare skin away from hot parts. If there is a risk of bare skin coming into contact with hot parts, cover the skin by wearing gloves, long-sleeves, long pants, and socks, etc.
- Take heat insulation measures if required for work (wearing heat-resistant gloves, etc.).
- Perform a safety check of the area below the installation location to ensure that there are no problems even if hot objects are dropped by accident.

Caution in wiring

⚠ CAUTION

- When performing wiring termination to prevent output trouble caused by moisture, dew condensation, or water leak, follow “3.4.Flow transmitter wiring” described in this manual.
- Before performing the wiring work, be sure to turn OFF the main power. Otherwise, it may cause electric shock.
- Do not perform wiring work outdoors in rainy days to prevent insulation deterioration and dew condensation. Otherwise, it may result in trouble, malfunction, etc.
- 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.
- This will result in malfunction, and therefore every effort should be made to keep the dedicated signal cable, input/output signal cable, resistance temperature detector extension cable, and communication cable away from other heavy-current lines in order to protect them from the effects of noise.
- This will result in malfunction, and therefore the dedicated communication cable, input/output signal cable, power cable, resistance temperature detector extension cable, and communication cable must be wired separately in conduits.

Caution on maintenance and inspection

⚠ CAUTION

- The unit should be inspected every day to always obtain good results of measurements.
- When measuring the insulation resistance between the power/output terminal and the case, follow “Section 6.2.2.How to measure the insulation resistance” described in this manual.
- Blown fuses must be replaced.
- Be sure to contact Fuji Electric when replacement is required. Do not attempt to replace fuses by yourself.

CAUTION ON INSTALLATION LOCATION

⚠ CAUTION

(1) A place where ambient temperature and humidity are -20 to +60°C and 95% RH or less for flow transmitter (FSJ).
(2) Indoor or outdoor locations where there is no exposure to direct sunlight or wind and 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 that provides enough place for the length of the straight pipe.
(11) Altitude: up to 2000 m
(12) Installation category: II
(13) Pollution degree: 2

} Stipulated by IEC61010-1.

Contents

1. PRODUCT OUTLINE

1.1. Overview

This ultrasonic flowmeter for steam is used to measure the flow rate of saturated steam inside pipes by mounting ultrasonic sensors on the outside of existing pipes.

1.2. Checking delivered items

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

Flow transmitter (FSJ)
- Flow transmitter main unit ····· 1 set
- Waterproof gland (Built into the main unit) ····· 1 set
- Wall mount frame (Built into the main unit) ····· 1 set
- Pipe mounting bracket (option)
  (bracket × 1, U-bolt × 1, nut × 2, spring washer × 2, plain washer × 2) × 2 sets

Flow transmitter (FSJ)

Pipe mounting bracket (option)

Detector (FSX) and dedicated signal cable (FLYE)
- Pre-amplifier unit × 1 set
- Pre-amplifier mounting bracket × 1 set
- Sensor unit (with cable) × 1 set (2 pieces)
- Sensor mounting bracket × 1 set
- Noise elimination frame × 3 sets
- Dedicated signal cable × 1 piece
- Acoustic coupler (option) × 1 piece

CD-ROM (Instruction manual and loader software) ··· 1 piece
Safety precautiona ····· 1

Items not delivered with product
- Power cable, input/output signal cable, RS-485 communication cable, resistance temperature detector (Pt100 3-wire connections)

1.3. Check on type and specifications

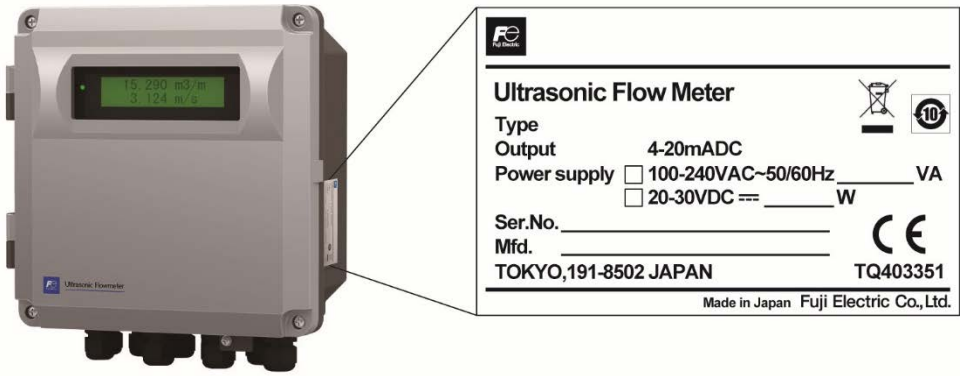
The type and specifications of product are indicated on the specifications plate mounted on the flow transmitter and detector frame.
Check that they represent the type you ordered, referring to the following code symbols.

<Flow transmitter (FSJ)>

FSJ □ 1 Y □ 1 - □
(4 5 6 7 8 9)

Digit	Specification	Note:	
4	<Wiring port, mounting method>	Note	
	With water-proof gland, wall mount		L
	With union (for plica tube) gland, wall mount		M
	With water-proof gland, pipe mount		N
	With union (for plica tube) gland, pipe mount		P
5	<Power Supply>		
	100 to 240 V AC, 50/60 Hz		1
6	<Explosion-proof specification>		
	None		Y
7	<Parameter setting/tag plate (flow transmitter)>		
	None		Y
	With setting		A
	With setting + tag plate (flow transmitter)		B
	Tag plate (flow transmitter)		C
8	Revision code		1
9	<Option functions>		
	Communication (RS-485)		F

Note) Specifications for the wiring port are as follows.
With water-proof gland: G1/2 and G3/8 (female screw)
With union (for plica tube) gland: G1/2 (female screw)



< Detector (FSX)>

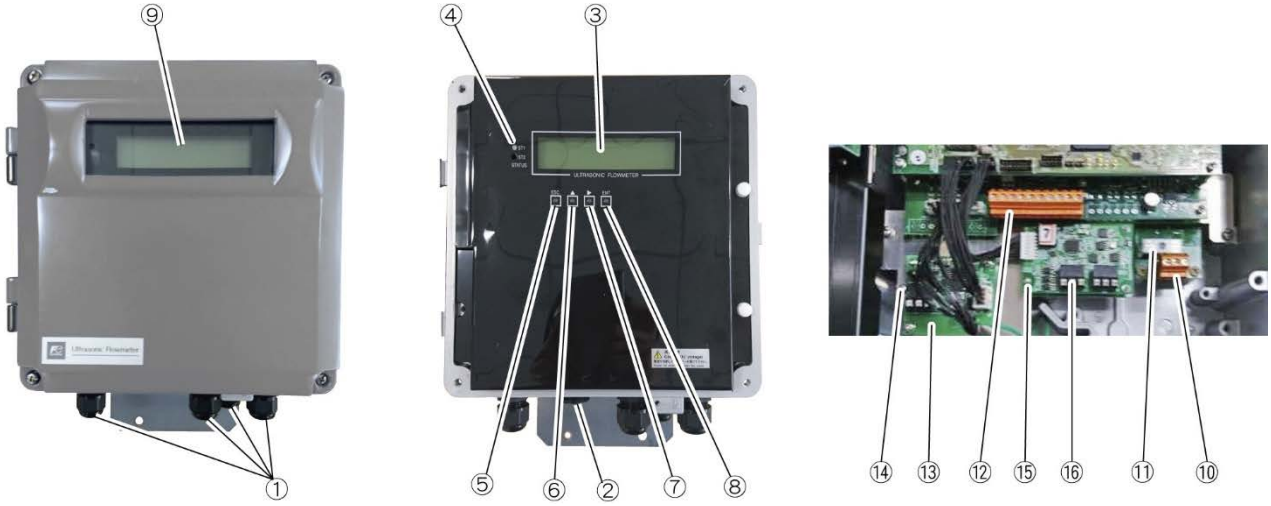
			4	5	6	7	8		9
			FSX	5	S	Y		1	-	S
Digit	Specification	Note:							
4	<Pipe diameter> 50A 65A 80A 100A			5 6 8 A					
5	<Sensor fixing bracket, noise elimination frame> Standard				S				
6	<Explosion-proof specification> None					Y			
7	<Acoustic coupler, tag plate (detector)> None High-temperature grease (for short-term installation) High-temperature grease (for long-term installation) Tag plate (detector) High-temperature grease (for short-term installation) + tag plate (detector) High-temperature grease (for long-term installation) + tag plate (detector) Note) Please contact us if you use E and H overseas.						Y D E F G H		
8	Revision code							1	
9	<Pre-amplifier> Standard								S

< Dedicated signal cable >

			4	5	6	7	8
			FLY	E			1
Digit	Specification	Note:					
4	<Applications> Flow transmitter for steam (FSJ), detector for steam (FSX)			E			
5 6 7	<Dedicated cable length> 5m 10m 15m 20m 25m 30m Other standard length (Max. 30 m)				0 0 0 0 0 0 Z	0 1 1 2 2 3 Z	5 0 5 0 5 0 Z
8	Revision code						1

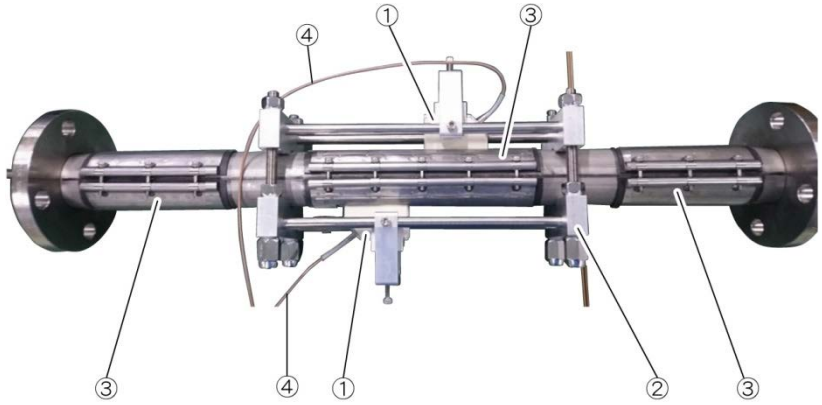
1.4. Name and function of each part

1.4.1. Flow transmitter (FSJ)



No.	Name	Key	Description
(1)	Wiring connection port		This is a wiring connection port for the power cable, input/output signal cable, communication cable, or resistance temperature detector cable.
(2)	Signal cable connector		This is a dedicated signal cable connector.
(3)	Indication and setting unit		Indicates and sets the flow rate, etc.
(4)	Diagnostic indicator lamp (LED)		Indicates whether flow rate and/or temperature is normal (green) or abnormal (red).
(5)	Escape key	ESC	Returns to the next-higher menu level or cancels the set status.
(6)	UP key	△	Selects items, numeric values, and symbols.
(7)	Shift key	▷	Moves the cursor and selects decimal place.
(8)	Entry key	ENT	Enters a selection or registers a setting.
(9)	LCD display		Indicates the flow rate or setting.
(10)	Power terminal		Connects the power cable.
(11)	Fuse holder		Fuse holder
(12)	Input/output terminal block		Connects analog input, analog output, or DO output cables.
(13)	Communication board		Mounted if communication is optionally designated.
(14)	Communication board terminal		Connects communication cable. (A communication board is optional)
(15)	Temperature measurement board		The product will be equipped with this board if temperature measurement is selected.
(16)	Temperature measurement board terminal block		Connects the cable from resistance bulb.

1.4.2. Detector (FSX)



No.	Name	Description
(1)	Sensor unit	Sends and receives ultrasonic waves.
(2)	Sensor mounting bracket	Secures the sensor unit to pipes.
(3)	Noise elimination frame	Eliminates acoustic noise which propagates to pipe walls.
(4)	Sensor cable	Transfers transmission and receipt signals. Connect to the pre-amplifier unit.

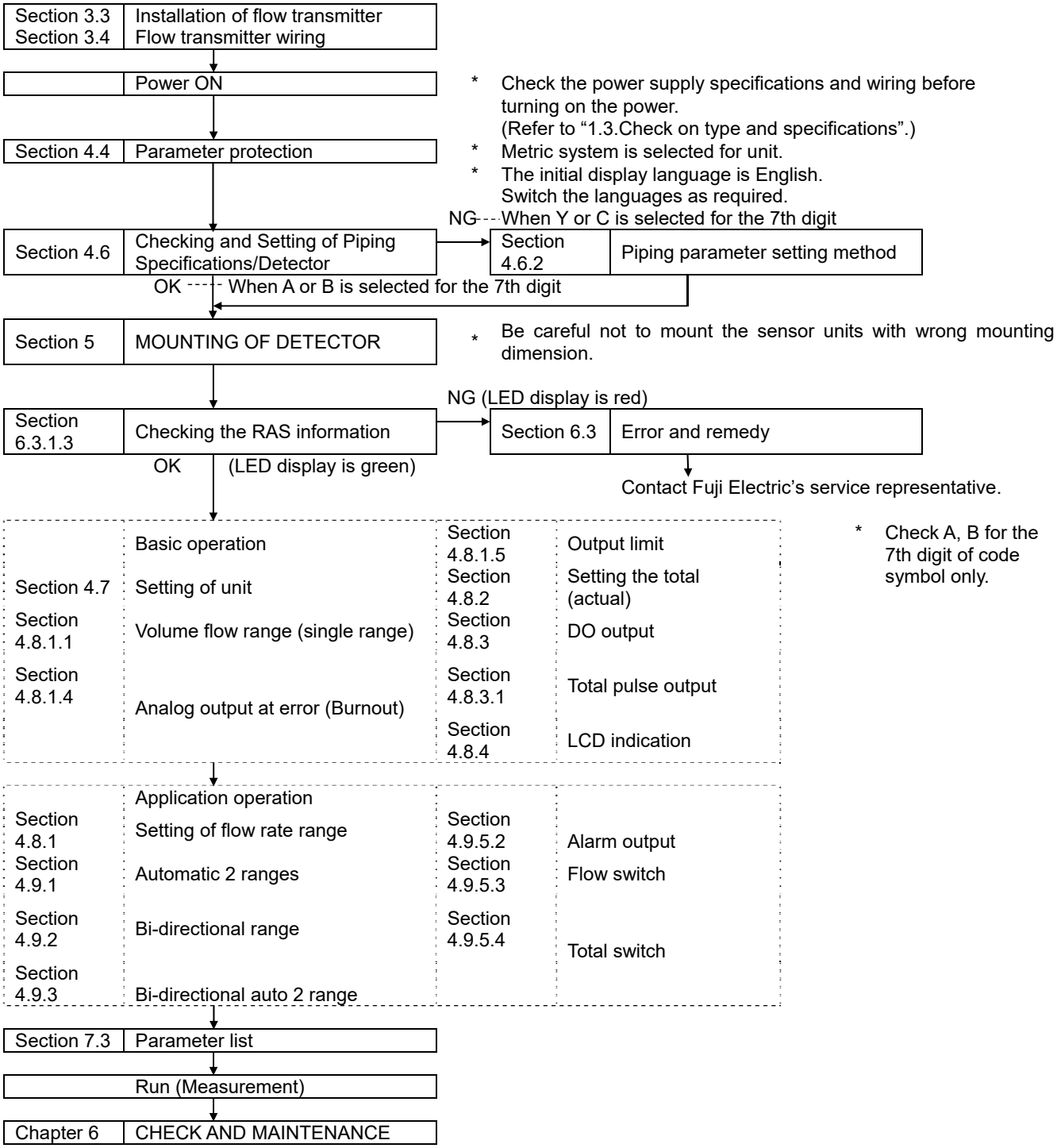
Pre-amplifier unit

No.	Name	Description
(1)	Pre-amplifier body	Amplifies receipt signals.
(2)	Sensor connection terminals	These are connectors used for connecting sensor cables.
(3)	Flow transmitter connection terminal	This is a connector used to connect the dedicated signal cable to the flow transmitter.
(4)	Pre-amplifier mounting bracket	This is one of the brackets used to mount the pre-amplifier unit.

2. OPERATION PREPARATION

2.1. Outline of installation procedure

Install the flowmeter according to the following procedure.



Note) When making changes to settings, do so after turning OFF parameter protection.

2.2. Tools required for installation

Tools required for installation (list)

Tools	Specification	Process
Spanner	Width across flat: 13 mm	Converter installation
	Width across flat: 21 mm	Sensor mounting, bracket mounting
	Width across flat: 10 mm	Sensor mounting
Socket wrench or spanner	Width across flat: 10 mm	Pre-amplifier mounting
	Width across flat: 7 mm	
Phillips screwdriver		Converter cover opening/closing
Precision screwdriver	0.6 × 3.5 mm (flathead screwdriver) Small type (Phillips screwdriver)	Wiring connection
Torque driver or torque wrench (if work space is limited)	Adjustment torque: 5 Nm	Noise elimination frame mounting
	Adjustment torque: 2 Nm	Sensor mounting
Bit (for torque driver or torque wrench)	Shape: hexagonal, size: H4	Noise elimination frame mounting
	Shape: hexagonal, size: H5	Sensor mounting
Hexagonal wrench	Width across flat: 4 mm	Noise elimination frame mounting
	Width across flat: 5 mm	Sensor mounting

3. INSTALLATION

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

⚠ CAUTION

(1) A place where ambient temperature and humidity are -20 to +60°C and 95% RH or less for flow transmitter (FSJ)
(2) A place not exposed to direct sunshine nor inclement weather.
(3) Space for periodic inspection and wiring work is available.
(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 that provides enough place for the length of the straight pipe.
(11) A place where drainage is discharged with steam traps and the steam humidity is small.
(12) Avoid places with rapid pressure fluctuation of 0.1 MPaG or above in 10 seconds.

3.1. Installation location of flow transmitter

Secure at least 100 mm of space between the flow transmitter and nearby wall. Also secure a space of opening the front cover in case of maintenance.
Allow space for cable wiring under the case.

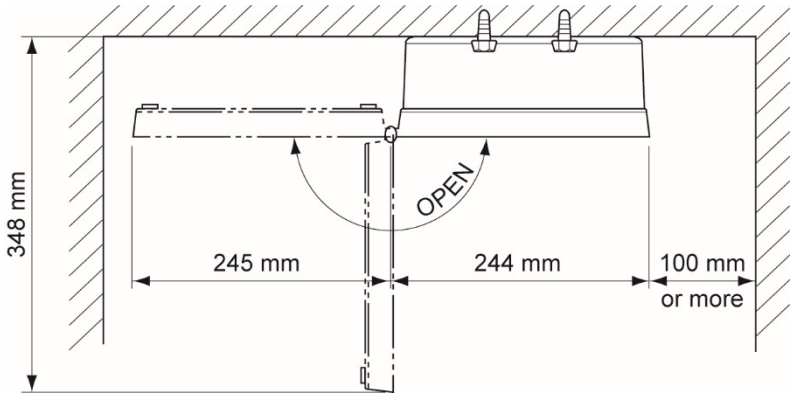


Fig. 3.1 Top view of mounting

3.2. Detector installation location

The detector mounting location, in other words on pipe at which flow rate is measured, will greatly affect measurement accuracy, and therefore a location which satisfies the following conditions should be selected.

① Location with straight pipe indicated in "3.2.1 Conditions on straight pipe“
② There should be a space for maintenance around the pipe to which the detector is to be mounted. (Refer to "Fig. 3-2 Fig. 3-3“.)
③ The length of the sensor cable between the pre-amplifier unit and sensor unit is 2 m, and therefore the detector should be installed in such a way that connection is possible.
④ The drainage should be discharged with steam traps and the steam humidity should be small.
⑤ Avoid places with rapid pressure fluctuation of 0.1 MPaG or above in 10 seconds.

Note) Ensure a space at both sides of the pipe to allow workers to carry out installation.

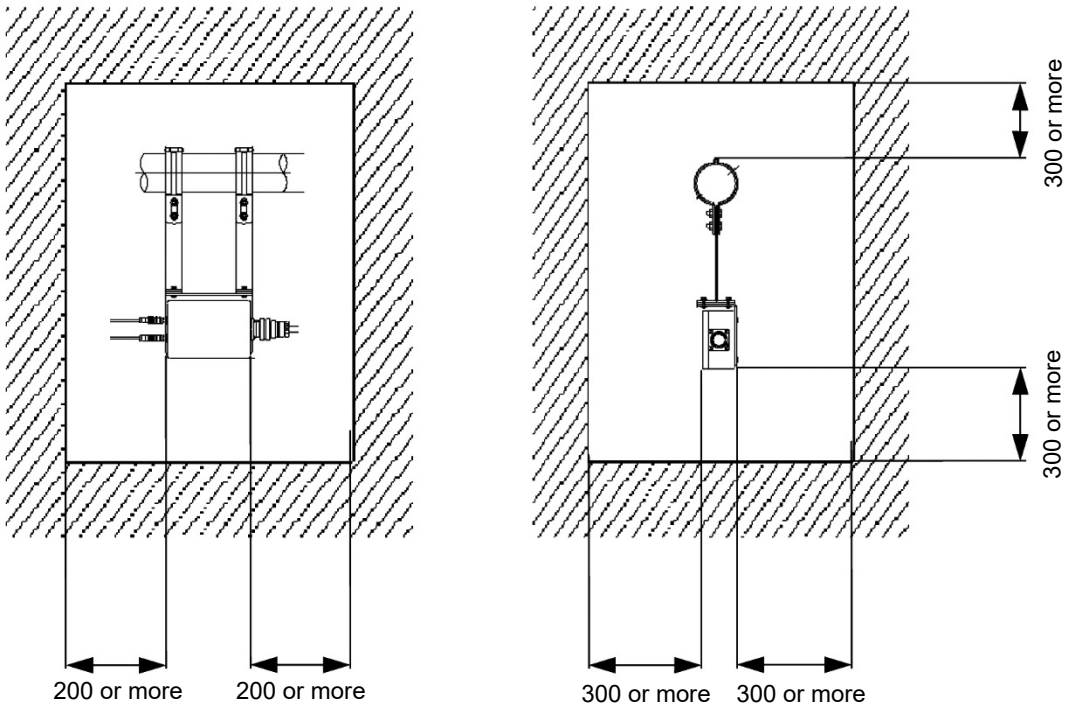


Fig. 3-2 Space required for pre-amplifier unit mounting location

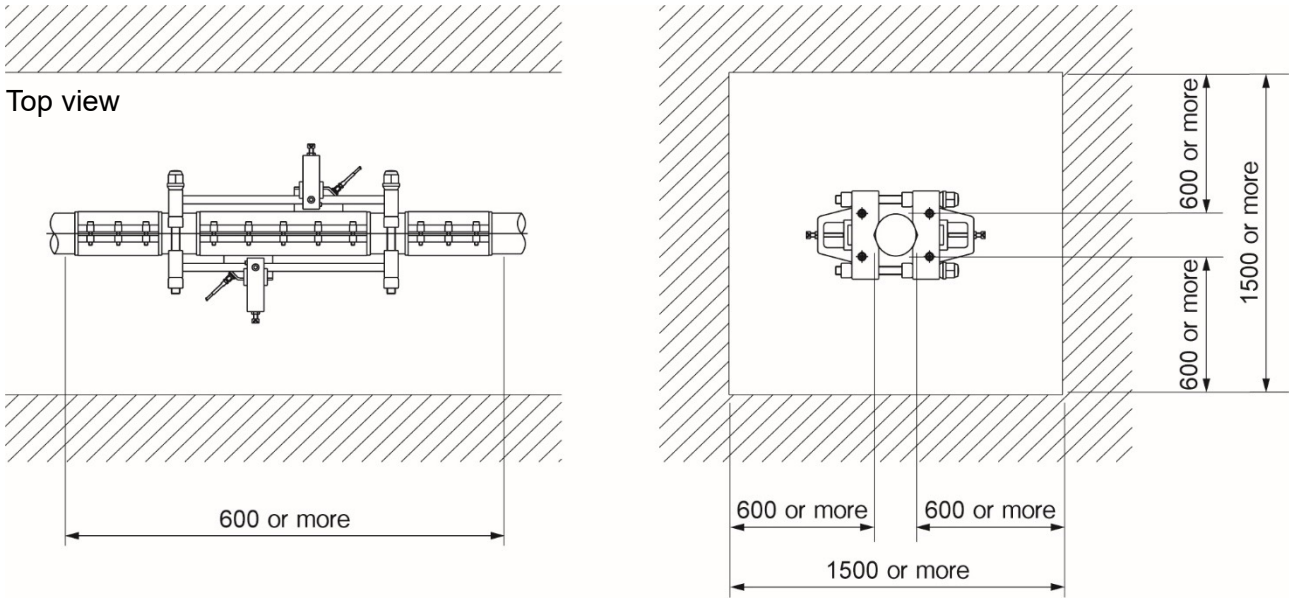
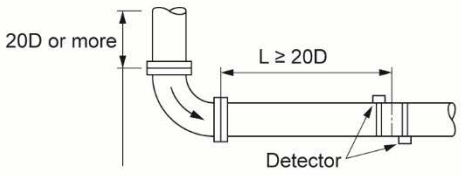
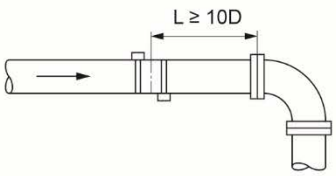
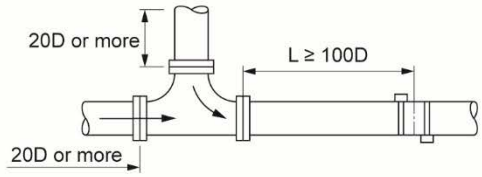
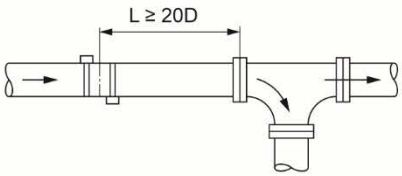
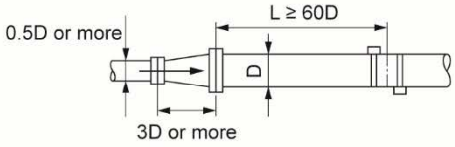
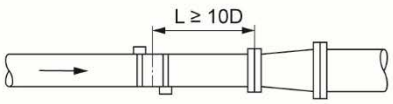
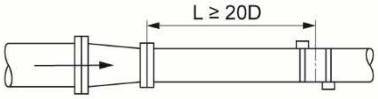
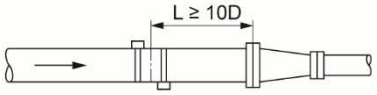
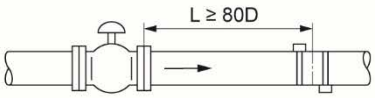
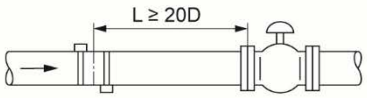
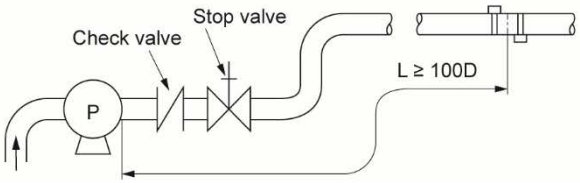


Fig. 3-3 Space required for detector mounting location

3.2.1. Conditions on straight pipe

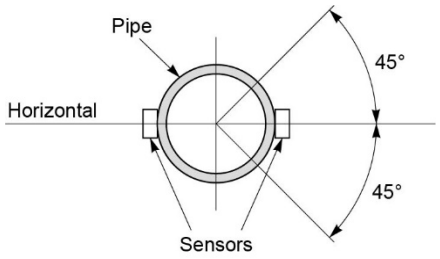
(D : Inside diameter of pipe)

Classification	Upstream side	Downstream side
90º bend		
Tee		
Diffuser		
Reducer		
Various Valve	 In case that flow control valve exists on upstream side.	 In case that flow control valve exists on downstream side.
Pump		

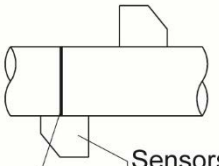
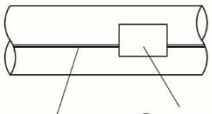
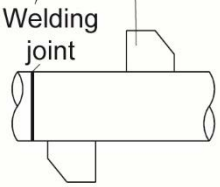
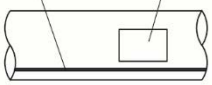
3.2.2. Mounting orientation

This instrument can be mounted vertically, horizontally, or at any other angle, however, it is necessary to pay attention to the following items.

(1) If installing on a horizontal pipe, mount sensors within ±45° of the center plane.
If installing on a vertical pipe, sensors may be mounted anywhere on the outer perimeter.



(2) Do not mount in an area where the pipe is deformed, where there is a flange, or where there are welding joints.

	Radial direction	Axial direction
NG		
OK		

3.3. Installation of flow transmitter

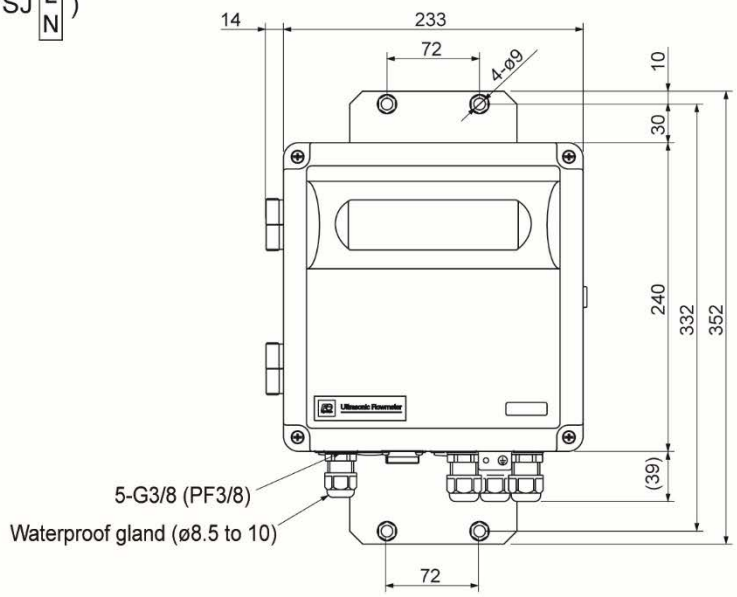
The flow transmitter may be mounted on a wall or 2B pipe stand (option).

3.3.1. Wall mounting

For wall mounting, use four M8 bolts.
Drill holes according to the mounting hole dimensions shown below, and fasten the flow transmitter using the M8 bolts.

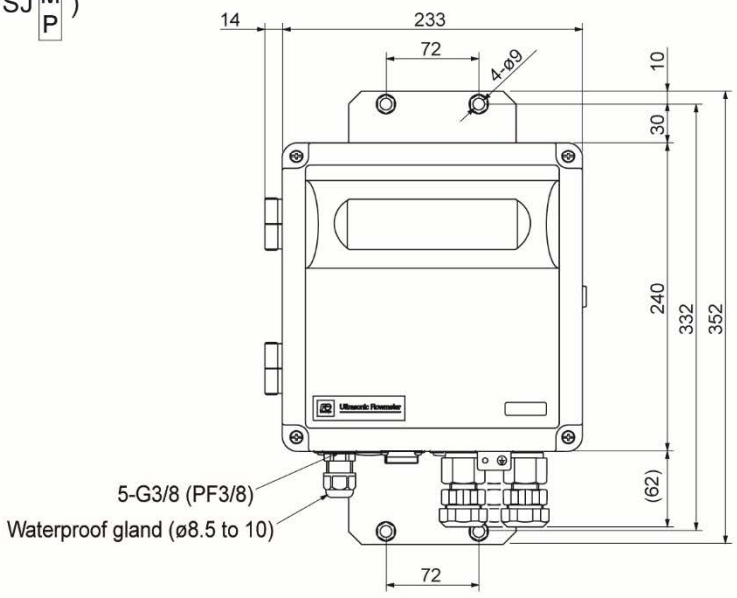
Flow transmitter

(Type: FSJ L N)



Flow transmitter

(Type: FSJ M P)



Nominal	Standard tightening torque
M8	12.5 [N·m]

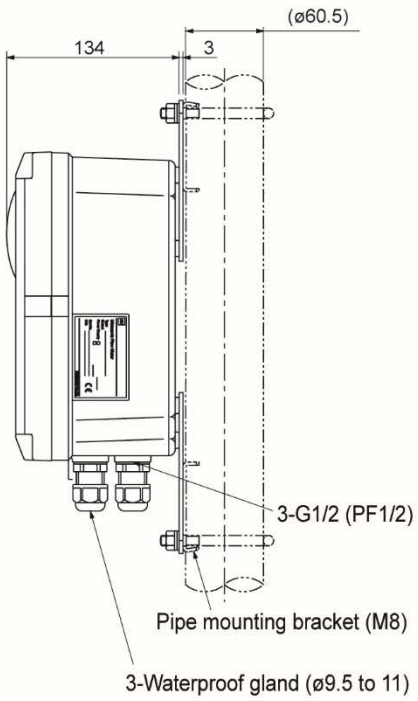
3.3.2. 2B pipe stand mounting

⚠ CAUTION

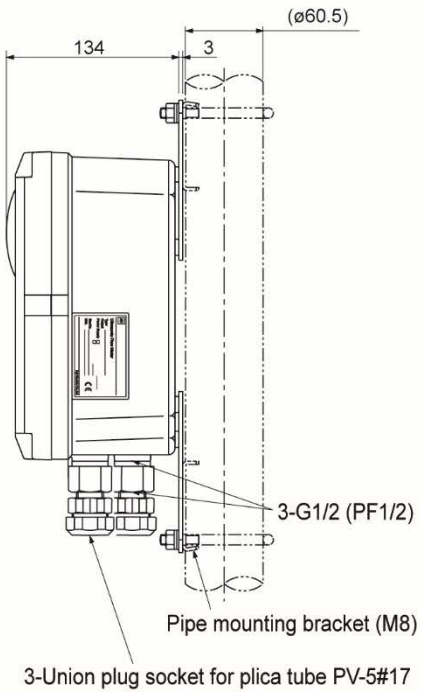
When mounting on 2B pipe, be sure to use a complete set of fixtures (U bolt, support fixture, plain washer, spring washer, nut) furnished if optionally designated. Tighten the nut by hand. If any support fixture is not used or if the assembly is excessively tightened by tool, the wall mounting fixture may be deformed.

Mount the instrument on 2B pipe stand as illustrated below.

Flow transmitter
(Type: FSJ L/N)



Flow transmitter
(Type: FSJ M/P)



4th digit of the code symbols	Conduit connection	Applicable cable	
		G1/2	G3/8
*L, N	Waterproof gland	φ9.5～11	φ8.5～10
*M, P	Waterproof gland with union plug (for plica tube PV-5#17)	max. φ13	

3.4. Flow transmitter wiring

3.4.1. Cautions in wiring

⚠ CAUTION

(1) Use a dedicated signal cable (FLYE) for the signal cable between the pre-amplifier unit and flow transmitter (FSJ). Furthermore, do not connect a relay cable to any part of the dedicated signal cable.
(2) Be sure to pass the dedicated signal cable between the pre-amplifier unit and flow transmitter along a metal conduit.
To avoid inductive interference, do not pass the cable along the conduit together with the power cable.
(3) Try as best as possible to use shielded wire for the input/output signal cable.
(4) To prevent noise intrusion, do not run the signal cable inside the same duct as that used for wires such as power lines.
(5) If the power cable has an integrated ground wire, ground it as is.
(6) This instrument is not equipped with a power switch, and therefore a separate switch or breaker must be installed for each flowmeter.
Furthermore, please observe the following in order to comply with safety standards.
• Integrate the switch or breaker into the equipment.
• Locate the switch or breaker appropriately, and ensure that they can be easily accessed.
• Clearly indicate that the switch or breaker is an equipment disconnecting device.
• Use a switch or breaker that conforms to local standards in the region in which they are used, or to international standards.
(7) Seal up wiring ports that are not used with the sealing caps provided.
(8) Connect a load resistor of 500 Ω or less to ensure a stable maximum output current of 120%.
(9) If greater than 500 Ω, but less than or equal to 600 Ω, the maximum stable current that can be output will be 105% (20.8 mA).

3.4.2. Applicable wires

Use the following cables.

- Power cable : 3-wire or 2-wire cabtyre cable (allowable temperature: 70°C or higher)
  Nominal sectional area 0.75mm^2 or more
  Outside diameter ø9.5 to ø 11mm
- Input/Output signal cable : 2-wire or multi-wire cabtyre cable as required (allowable temperature: 70°C or higher)
  Outside diameter ø 9.5 to ø 11mm
- Dedicated signal cable : cable between pre-amplifier and flow transmitter based on type designation
  (Type: FLYE) High-frequency coaxial double-shielded cable with characteristic impedance of 50 Ω (allowable temperature: 70°C or higher)
  With waterproof connector
  Finished outer diameter: ø 11.5 mm
- Extension cable for resistance bulb:
  3-wire or multi-wire cabtyre cable as required (allowable temperature: 70°C or higher)
  Nominal sectional area 0.75mm2 or more
  Outside diameter ø 9.5 to ø 11mm
- Communication cable : Twisted pair cable with shield (for RS-485) (allowable temperature: 70°C or higher)
  Outside diameter ø 8.8 to 10mm

3.4.3. Treatment of wiring port

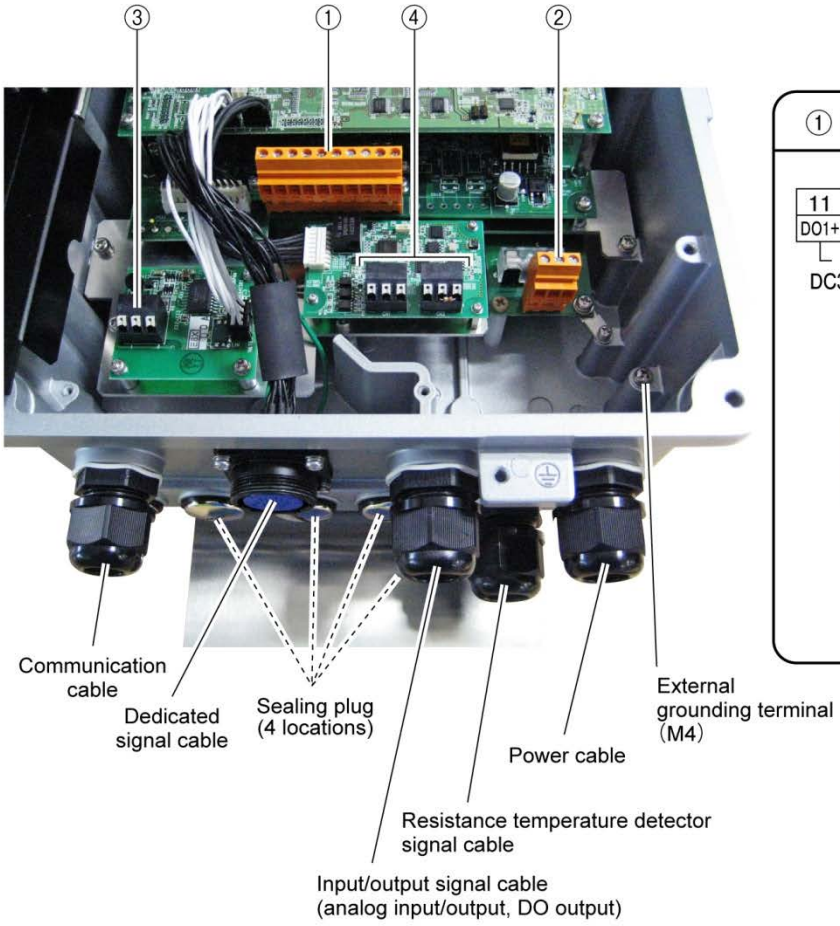
The casing of the flow transmitter is IP67. However, if installed in a humid place, the wiring ports must be made airtight to avoid ingress of moisture, condensation, etc. Be sure to use the waterproof glands furnished with the instrument in order to ensure the waterproof means. A gland, which is not ready to be used, should be sealed by supplied cover.

⚠ CAUTION

Do not install the instrument where there is a risk of flooding. Otherwise, it may cause electric shock or malfunction.

3.4.4. Wiring to each terminal

Carry out wiring to each terminal according to the following figure.



① Input/output terminal block

11	12	13	14	15	16	17	18	19	20
DO1+	DO1-	DO2+	DO2-	AI+	AI-	NC	NC	AO+	AO-

DC30V, 50mA max. OUTPUT
DC4-20mA INPUT
DC4-20mA OUTPUT

② Power terminal block

AC power supply
AC100-240V (+10%,-15%)
50/60Hz 20VA

1	2	3
L	N	NC

③ Communication board terminal block

RS-485

41	42	43
SG	A-	B+

SHIELD ⊖ ⊕

④ Temperature measurement board terminal block

RTD Pt100

21	22	23
B	B	A

RTD

31	32	33
NOT USE		

DO not remove

The dummy resistor in the temperature measurement board terminal block on the right should not be removed.

Note1) Terminal block is insertion type to connect a cable. Use bar terminal as crimp-style terminals.
Note2) Be sure to ground the external grounding terminal (M4). (Class D grounding)
Note3) For input/output signal, use multiple core cable as required.
Note4) Differential signal line of RS-485 consists of two pins. + means B+, - and means A-.
Note5) The wiring port tightening torque is as follows.
Power cable, resistance temperature detector signal cable, input/output signal cable wiring port: 1.5 to 2.2 [N·m]
Communication cable wiring port: 1.2 to 1.8 [N·m]
Note6) Do not remove sealing plugs. If accidentally removed, reattach with tightening torque of 2.3 to 2.7 [N·m].

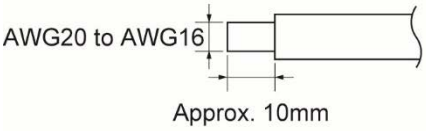
3.4.5. How to connect to terminal block

3.4.5.1. Cable treatment

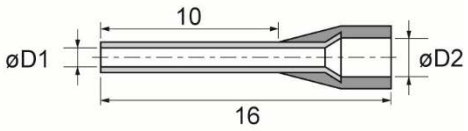
Although the cables can be connected to the terminals with bare wire, we recommend using bar terminal (ferrule) for connecting cables.

Usable wiring materials

・Wire
Gauge：AWG20 (0.5mm²) to AWG16 (1.5mm²)
Strip off length：approx.10mm



・Bar terminal
Wire end ferrule (with insulation cover)
Weidmuller
www.weidmuller.com



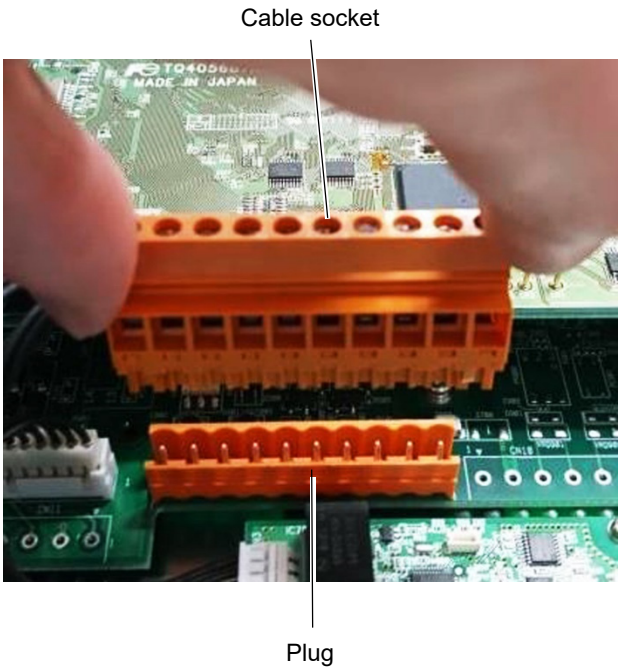
Wire size (mm²)	AWG	ϕD1（mm）	ϕD2（mm）	Type
0.5	20	1	2.6	H0.5/16
0.75	18	1.2	2.8	H0.75/16
1	17	1.4	3	H1/16
1.5	16	1.7	3.5	H1.5/16

Note1) Make sure to use PZ6/5(H0.25 to H6 for sleeve) as a crimp tool for caulking.
Note2) Applicable sleeve is required for electric wire.
Note3) Insert the electric wire to the end of ferrule so as to crimp.
Note4) Length of stripped wire is 12mm.

3.4.5.2. How to connect to power supply/signal terminal block

Please prepare a flathead screwdriver (head size: 0.6 × 3.5mm) or a small-sized Phillips head screwdriver so as to tighten the cable.

(1) Pull off the cable socket from the plug on the substrate with holding the right side of the socket by hand.
(2) If cable entry is closed, turn the screw counterclockwise to open.
(3) Insert the cable and turn the screw clockwise to fix the cable. Check that the cable does not come out.
(4) Install the cable socket side to the plug on the substrate.

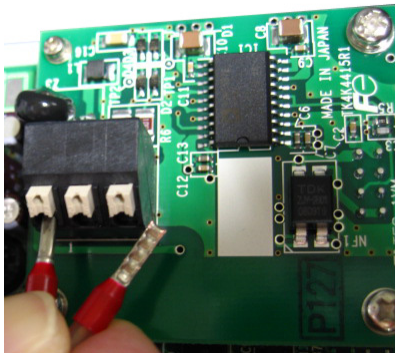


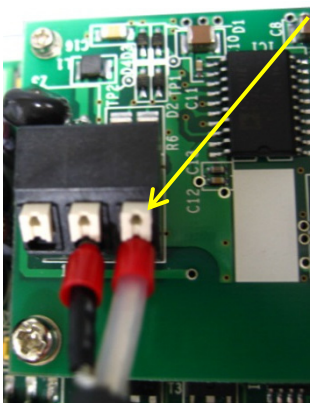
Note) Make sure to conduct the procedure not to damage the printed-circuit board when you remove and install the cable socket.

3.4.5.3. Method for connecting to communication board and temperature measurement board terminal block

In the case of rod terminals, push in until they hit against the terminal block hole, and ensure that they do not come out.

In the case of bare wire, press the clamp with a finger or with tweezers, etc. to open the insertion port, push the bare wire in until it hits against the terminal block hole,
release the clamp to secure the wire, and ensure that it does not come out.





3.5. Operation

3.5.1. Points of caution when operating equipment

CAUTION

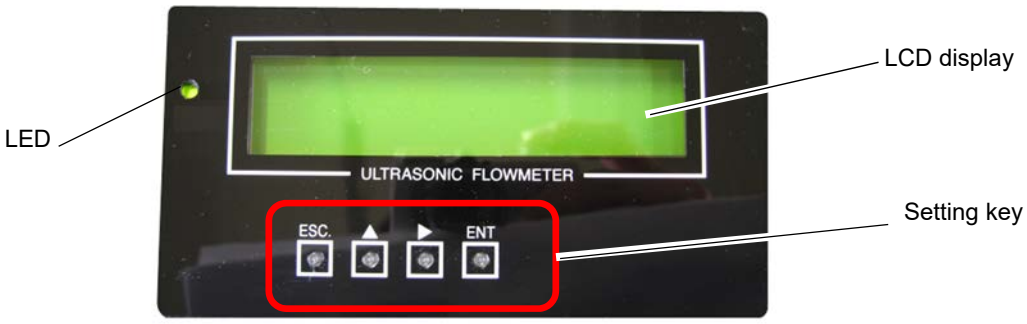
If steam begins to flow through the steam pipe at approximately room temperature, the detector temperature will stabilize, taking about 10 minutes until normal operation is possible. (The time it takes until normal operation will depend on the equipment.)
During warm-up, it may not be possible to satisfy measurement accuracy specifications.
The above incorrect output can be prevented by wiring the resistance temperature sensor Pt100.
If the temperature of the resistance temperature sensor is 100°C or below, or if 10 minutes has elapsed since the temperature exceeded 100°C, “WARMING UP” will blink on the LCD and it will enter an error state.

4. PARAMETERS

4.1. Description of display/setting unit

Display unit and setting unit are as shown below.

4.1.1. Display/setting unit

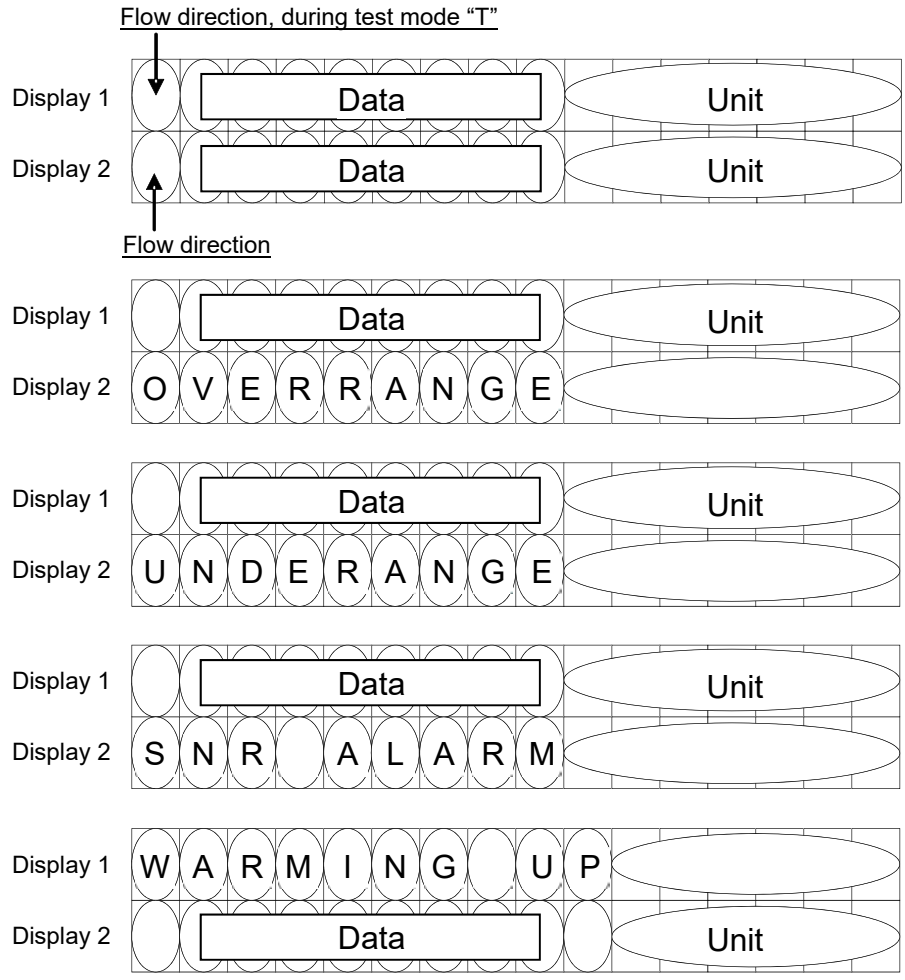


4.1.2. Description of display/setting unit

○ LCD display: Displays measurement values and setting values (16 digits × 2 rows).

"Measurement display"

The data area displays a maximum of 8 digits, including the decimal point.
If the value exceeds the number of display digits, "<" is displayed at the highest digit.
If the value exceeds the range, "OVERRANGE" or "UNDERANGE" blinks in Display 2.
The displays also blink if the analog input temperature or pressure exceeds the range, or if a cable break occurs.
The displays also blink if the resistance temperature detector measurement range (-45 to 205°C) has been exceeded, or if a cable break occurs. If the ultrasonic receipt signal sensitivity drops, "SNR ALARM" blinks in Display 2.
If the temperature of the resistance temperature sensor is 100°C or below, or if 10 minutes has elapsed since the temperature exceeded 100°C, "WARMING UP" will blink on the LCD and it will enter an error state.

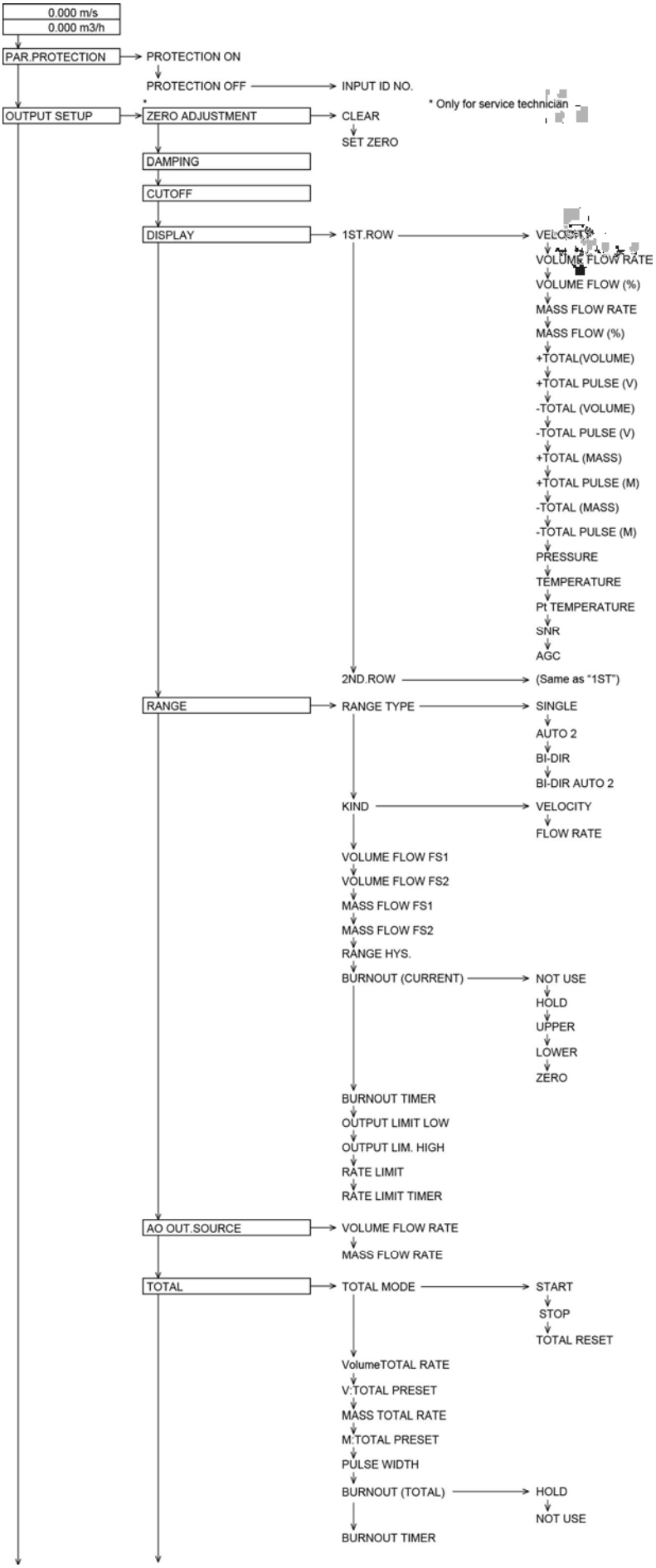


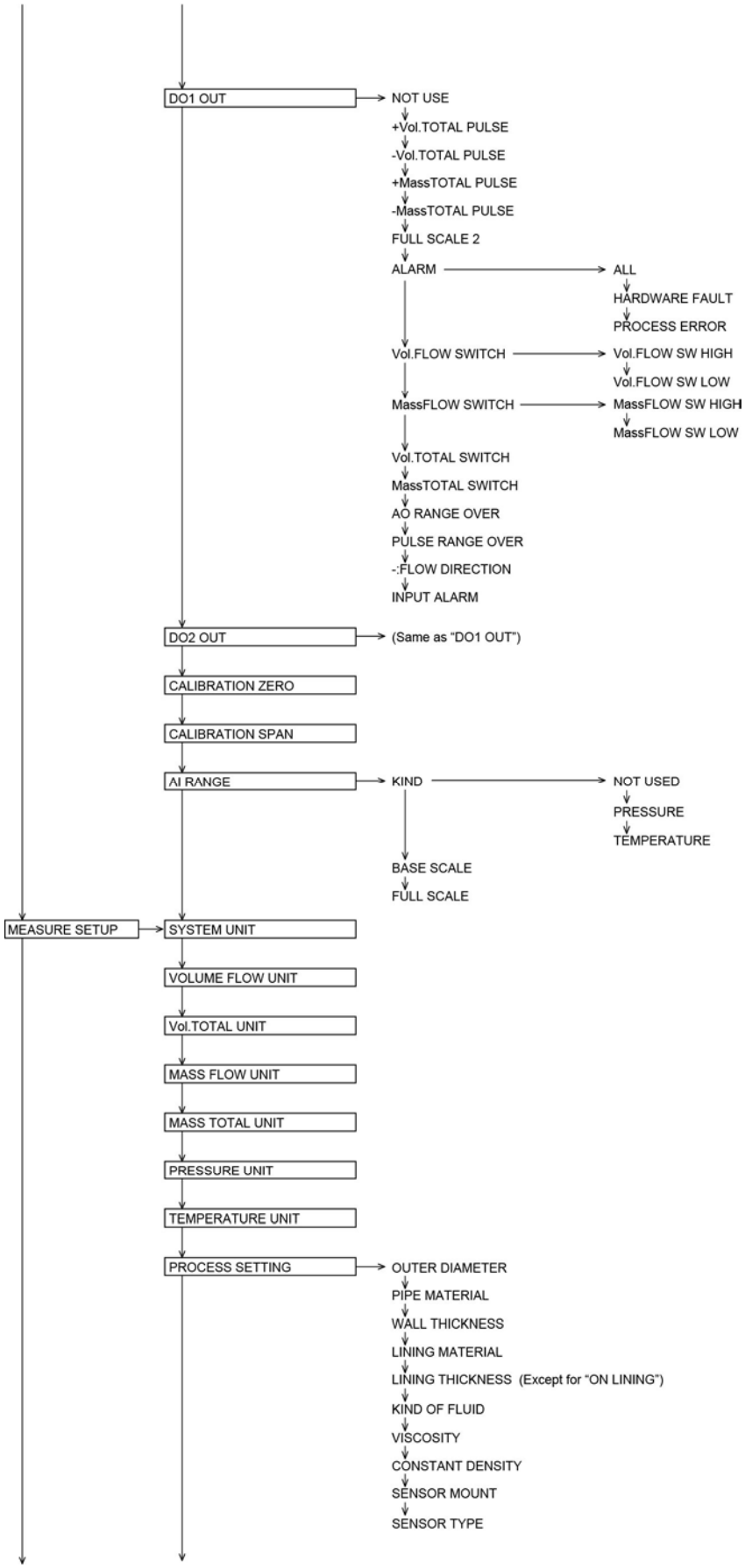
LED lamp: Indicates the received wave is normal or not.
(Green) Received ware is normal, (red) Received ware is abnormal

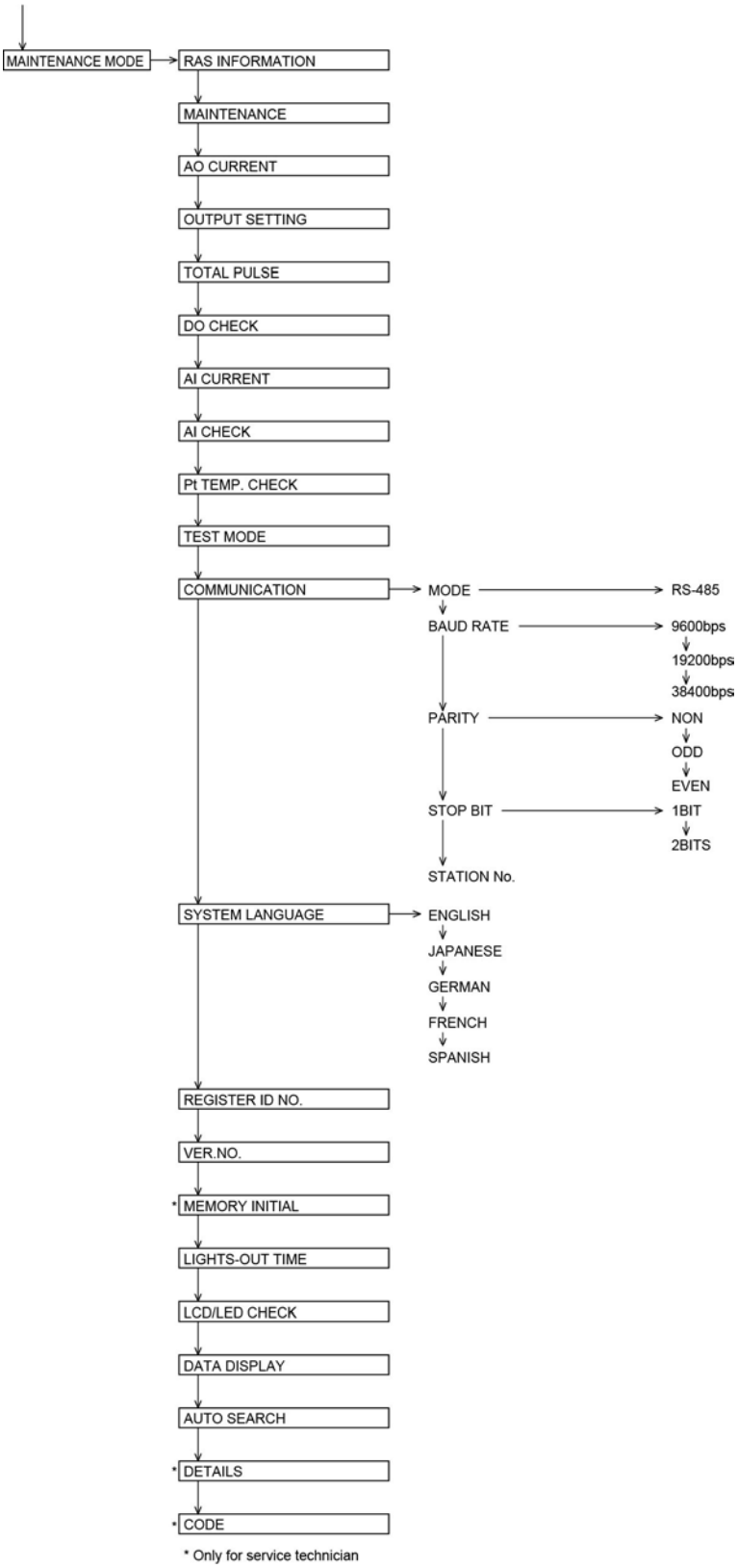
Set the parameter with setting keys.

ESC	ESCAPE key	: Returns to the next-higher menu level or cancels the set status.
△	UP key	: Selects items, numeric values, and symbols.
▷	SHIFT key	: Moves the cursor and selects decimal place.
ENT	ENTRY key	: Enters a selection or registers a setting. Note) For changing the parameter, enter the changed value, and press this key to confirm that it is registered.
▷ + △	DOWN key	: DOWN key function is conducted by pressing UP key while holding down SHIFT key. Use DOWN key for selecting items, values, and codes.

4.2. Composition of key operation




DO1 OUT
NOT USE
+Vol.TOTAL PULSE
-Vol.TOTAL PULSE
+MassTOTAL PULSE
-MassTOTAL PULSE
FULL SCALE 2
ALARM
ALL
HARDWARE FAULT
PROCESS ERROR
Vol.FLOW SWITCH
Vol.FLOW SW HIGH
Vol.FLOW SW LOW
MassFLOW SWITCH
MassFLOW SW HIGH
MassFLOW SW LOW
Vol.TOTAL SWITCH
MassTOTAL SWITCH
AO RANGE OVER
PULSE RANGE OVER
-:FLOW DIRECTION
INPUT ALARM
DO2 OUT
(Same as "DO1 OUT")
CALIBRATION ZERO
CALIBRATION SPAN
AI RANGE
KIND
NOT USED
PRESSURE
TEMPERATURE
BASE SCALE
FULL SCALE
MEASURE SETUP
SYSTEM UNIT
VOLUME FLOW UNIT
Vol.TOTAL UNIT
MASS FLOW UNIT
MASS TOTAL UNIT
PRESSURE UNIT
TEMPERATURE UNIT
PROCESS SETTING
OUTER DIAMETER
PIPE MATERIAL
WALL THICKNESS
LINING MATERIAL
LINING THICKNESS (Except for "ON LINING")
KIND OF FLUID
VISCOSITY
CONSTANT DENSITY
SENSOR MOUNT
SENSOR TYPE


MAINTENANCE MODE
RAS INFORMATION
MAINTENANCE
AO CURRENT
OUTPUT SETTING
TOTAL PULSE
DO CHECK
AI CURRENT
AI CHECK
Pt TEMP. CHECK
TEST MODE
COMMUNICATION
MODE
RS-485
BAUD RATE
9600bps
19200bps
38400bps
PARITY
NON
ODD
EVEN
STOP BIT
1BIT
2BITS
STATION No.
SYSTEM LANGUAGE
ENGLISH
JAPANESE
GERMAN
FRENCH
SPANISH
REGISTER ID NO.
VER.NO.
*MEMORY INITIAL
LIGHTS-OUT TIME
LCD/LED CHECK
DATA DISPLAY
AUTO SEARCH
*DETAILS
*CODE
* Only for service technician

4.3. Parameter initial value list

Factory-set value is shown below. (When parameter setting is not provided)

	Setting unit	Setting range	Initial value	Setting range Setting value
1	ID No.	0000 to 9999	0000	
2	LANGUAGE	No. of menu: 5	English	English, Japanese, German, French, Spanish
3	SYSTEM UNIT	No. of menu: 2	Metric	Metric or Inch
4	VOLUME FLOW UNIT	No. of menu: 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
5	VOL.TOTAL UNIT	No. of menu: 8	m^3	m^3 mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBB
6	MASS FLOW UNIT	No. of menu: 12	kg/h	g/s, g/min, g/h, g/d, kg/s, kg/min, kg/h, kg/d, t/s, t/min, t/h, t/dL
7	MASS TOTAL UNIT	No. of menu: 3	kg	g, kg, t
8	PRESSURE UNIT	No. of menu: 2	MPa (G)	MPa(G), bar(G) (G:gaugepressure)
9	TEMPERATURE UNIT	No. of menu: 3	°C	°C, K, °F
10	OUTER DIAMETER	6.00 t 6200.00mm	60.50 mm	[mm, in]
11	PIPE MATERIAL	No. of menu: 2	Carbon steel	Carbon steel, Stainless
12	WALL THICKNESS	2.80 to 4.00mm	3.80 mm	[mm,in]
13	Lining material	No. of menu: 1	No lining	No lining
14	Lining thickness			[mm,in]
15	Kind of fluid	No. of menu: 4	Steam	Steam
16	Dynamic viscosity coefficient	0.001 to 999.999 ×10-6m^2/s	1.0038 ×10-6m^2/s	[×10-6m^2/s, ft^2/s]
17	DENSITY	No. of menu: 3 Fixed value 0.000000 To 999.9999kg/m^3	Fixed value 2.667378 kg/m^3	AI Current, Pt TEMPERATURE, Fixed value (DENSITY: [kg/m^3])
18	Sensor mounting method	No. of menu: 1	N method	N method
19	Sensor type	No. of menu: 4	FSX5	FSX5 (FSX6, FSX8, FSXA)
20	Zero adjustment	No. of menu: 1	Clear (unadjusted)	Clear
21	DAMPING	0.0 to 100.0sec	5.0 sec	[sec]
22	LOW FLOW CUT	0 to 5m/s in terms of flow velocity	2.40 m^3/h	[5.UNIT]
23	1ST.ROW	No. of menu: 18	VELOCITY (m/s)	VELOCITY, VOLUME FLOW RATE, VOLUME FLOW (%), MASS FLOW RATE, MASS FLOW (%), +TOTAL (VOLUME), +TOTAL PULSE (V), -TOTAL (VOLUME), -TOTAL PULSE (V), +TOTAL (MASS), +TOTAL PULSE (M), -TOTAL(MASS), -TOTAL PULSE (M), PRESSURE, TEMPERATURE, Pt TEMPERATURE, SNR, AGC
24	DECIMAL POINT POSITION		****.***	□□□□□□□□ (Specified digit check)
25	2ND.ROW	No. of menu: 18	FLOW RATE (m^3/h)	VELOCITY, VOLUME FLOW RATE, VOLUME FLOW (%), MASS FLOW RATE, MASS FLOW (%), +TOTAL (VOLUME), +TOTAL PULSE (V), -TOTAL (VOLUME), -TOTAL PULSE (V), +TOTAL (MASS), +TOTAL PULSE (M), -TOTAL (MASS), -TOTAL PULSE (M), PRESSURE, TEMPERATURE, Pt TEMPERATURE, SNR, AGC
26	DECIMAL POINT POSITION		****.***	□□□□□□□□ (Specified digit check)
27	AO OUT.SOURCE	No. of menu: 2	VOLUME FLOW RATE	VOLUME FLOW RATE, MASS FLOW RATE
28	KIND	No. of menu: 2	Flow rate	Velocity, Flow rate
29	RANGE TYPE	No. of menu: 4	Single	Single, Auto 2, Bi-dir, Bi-dir Auto 2
30	VOLUME FLOW FS1	0,±0.3 to ±50m/s in terms of flow velocity	80.000 m^3/h	[5.UNIT]
31	VOLUME FLOW FS2	0,±0.3 to ±50m/s in terms of flow velocity	0.000 m^3/h	[5.UNIT]
32	MASS FLOW FS1	±99999999	0.000 kg/h	[7.UNIT]
33	MASS FLOW FS2	±99999999	0.000 kg/h	[7.UNIT]
34	HYSTERESIS	0.00 to 20.00	10.00%	%
35	BURNOUT (CURRENT)	No. of menu: 5	Hold	Not used, Hold, Lower, Upper and Zero
36	BURNOUT TIMER	10 to 900sec	10 sec	[sec]

	Setting unit	Setting range	Initial value	Setting range Setting value
37	OUTPUT LIMIT LOW	-20 to 0%	-20%	[%]
38	OUTPUT LIMIT HIGH	100 to 120%	120%	[%]
39	RATE LIMIT	0,±0.3 to ±50m/s in terms of flow velocity	40.000 m^3/h	This is the initial value of 50 A pipe size. Change the setting when using a pipe size above 50 A. 65 A: 65 m^3/h, 80 A: 92 m^3/h, 100 A: 156 m^3/h
40	RATE LIMIT TIMER	0 to 900sec	1 0 sec	[sec]
41	TOTAL MODE	No. of menu: 3	STOP	START, STOP, TOTAL RESET
42	VolumeTOTAL RATE	0.000000 to 99999999	0 m3	[5.UNIT]
43	V:TOTAL PRESET	0.000000 to 99999999	0 m3	[5.UNIT]
44	MASS TOTAL RATE	0.000000 to 99999999	0 m3	[7.UNIT]
45	M:TOTAL PRESET	0.000000 to 99999999	0 kg	[7.UNIT]
46	PULSE WIDTH	No. of menu: 7	50.0 msec	5.0 msec, 10.0 msec, 50.0 msec, 100.0 msec, 200.0 msec, 500.0 msec, 1000.0 msec
47	BURNOUT (TOTAL)	No. of menu: 2	Hold	Not used, Hold
48	BURNOUT TIMER	10 to 900sec	10 sec	[sec]
49	DO1 OUTPUT TYPE	No. of output content menu: 16 No. of alarm menu: 3 VOL. Flow switch range 0 to 50m/s in terms of flow velocity Mass Flow switch range 0.000000 to 99999999 Vol.Total switch range 0.0 to 99999999 Mass Total switch range 0.000000 to 99999999	Not used	• +Vol.TOTAL PULSE • -Vol.TOTAL PULSE • +MassTOTAL PULSE • -MassTOTAL PULSE • FULL SCALE 2 * Note1 • ALARM [ALL, HARDWARE FAULT, PROCESS ERROR] • Vol.FLOW SWITCH • Vol.FLOW SW HIGH [[4.UNIT]] • Vol.FLOW SW LOW [[4.UNIT]] • MassFLOW SWITCH • MassFLOW SW HIGH [[6.UNIT]] • MassFLOW SW LOW [[6.UNIT]] • Vol.TOTAL SWITCH [[5.UNIT]] • MassTOTAL SWITCH [[7.UNIT]] • AO RANGE OVER • PULSE RANGE OVER • -: FLOW DIRECTION • INPUT ALARM • MAINTENANCE
50	DO1 OUTPUT OPERATION	No. of menu: 2	Active ON	Active ON, Active OFF
51	DO2 OUTPUT TYPE	No. of output content menu: 16 No. of alarm menu: 3 VOL. Flow switch range 0 to 50m/s in terms of flow velocity Mass Flow switch range 0.000000 to 99999999 Vol.Total switch range 1.0 to 99999999 Mass Total switch range 0.000000 to 99999999	Not used	• +Vol.TOTAL PULSE • -Vol.TOTAL PULSE • +MassTOTAL PULSE • -MassTOTAL PULSE • FULL SCALE 2 * Note1 • ALARM [ALL, HARDWARE FAULT, PROCESS ERROR] • Vol.FLOW SWITCH • Vol.FLOW SW HIGH [[4.UNIT]] • Vol.FLOW SW LOW [[4.UNIT]] • MassFLOW SWITCH • MassFLOW SW HIGH [[6.UNIT]] • MassFLOW SW LOW [[6.UNIT]] • Vol.TOTAL SWITCH [[5.UNIT]] • MassTOTAL SWITCH [[7.UNIT]] • AO RANGE OVER • PULSE RANGE OVER • -: FLOW DIRECTION • INPUT ALARM • MAINTENANCE
52	DO2 OUTPUT OPERATION	No. of menu: 2	Active ON	Active ON, Active OFF
53	Zero calibration	-5 to 5m/s in terms of flow velocity	0.000m^3/h	[7.UNIT]
54	Span calibration	-200.00 to 200.00%	100.00%	%
55	AI RANGE KIND	No. of menu: 3	NOT USED	NOT USED, PRESSURE, TEMPERATURE
56	AI BASE SCALE	±99999999	0	[8. or 9.UNIT]
57	AI FULL SCALE	±99999999	0	[8. or 9.UNIT]
58	Communication mode	No. of menu: 1	RS-485	RS-485
59	COMMUNICATION BAUD RATE	No. of menu: 3	38400 bps	9600 bps, 19200 bps, 38400 bps
60	COMMUNICATION PARITY	No. of menu: 3	Odd	None, Odd, Even
61	COMMUNICATION STOP BIT	No. of menu: 2	1 bit	1 bit, 2 bits
62	COMMUNICATION STATION NO.	1 to 31	1	
63	LIGHTS-OUT TIME	0 to 99min	0	[min]
64	MAINTENANCE	No. of menu: 2	STOP	STOP, START

4.4. Parameter protection

4.4.1. Protection ON/OFF

Description
- Parameters can be protected so that the flow meter settings will not carelessly be changed.
- Parameters can be protected by setting the "ID No." (Note) in the maintenance mode.
  Note) ID number should be 4 digits. The factory setting is "0000". (Refer to Section 4.11.10.)

  Settable range: PROTECTION ON : Parameter cannot be changed.
  PROTECTION OFF : Parameter can be changed.
  * 1 hour after “PROTECTION OFF” is set, “PROTECTION ON” is automatically set.
  * The device starts in protection ON status.

For actual keying, refer to the typical operation indicated below.

Operation (example)	Change the protection from ON to OFF (suppose 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 key ENT 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" (as factory set), press the ENT key to release the protection.	INPUT ID NO. 0000
△ ▷ ▼	Enter ID No. “2234” by the △ key or the ▷ key	INPUT ID NO. 2234
ENT	Press the ENT key once. * If ID No. does not coincide, "INPUT ERROR" appears, and the input screen is resumed. ——— Protection canceled. ———	INPUT ID NO. ** COMPLETE ** ↓ PAR.PROTECTION PROTECTION OFF

⚠ CAUTION

About the change of parameter setting
When you change parameters of converter in current use which analog output or alarm has been set, if you change items which affect to the output or alarm, the output may change suddenly after display of "** COMPLETE**" and may generate alarm. If, especially, the output signal is being used for control, perform the signal lock on the system side prior to changing parameters.

Caution on change of parameter setting
When you change parameter settings, parameters will be saved in non-volatile memory on return to measuring display. Saved parameters have been maintained even power is off. However, when you change the parameter and turn off the power before returning to the measuring display, parameters will not be saved. Thus you should set the parameter again.

4.5. Display language

4.5.1. How to select the language

Description
- Indication language (English, Japanese, German, French, and Spanish) is selectable.

Setting contents
ENGLISH (default setting), JAPANESE, GERMAN, FRENCH, SPANISH

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Select English for the display language.	
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 0000H”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 11 times to display “SYSTEM LANGUAGE”.	SYSTEM LANGUAGE JAPANESE
ENT ▼	Press the ENT key once to blink on the 2nd line.	SYSTEM LANGUAGE JAPANESE
△ ▼	Press the △ key for 4 times to display “ENGLISH”.	SYSTEM LANGUAGE ENGLISH
ENT ▼	Press the ENT key once to register.	SYSTEM LANGUAGE ** COMPLETE ** ↓
	——— English has been registered. ———	SYSTEM LANGUAGE ENGLISH
ESC △	Press the ESC key or the △ key to display the measurement mode.	0.000 m/s 0.000 m3/h

Operation (example)	Select Japanese for the display language.	
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 0000H”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 11 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 ** ↓
	——— Japanese has been registered. ———	ゲンゴ （ＬＡＮＧＵＡＧＥ） ニホンゴ（ＪＡＰＡＮＥＳＥ）
ESC △	Press the ESC key or the △ key to display the measurement mode.	0.000 m/s 0.000 m3/h

4.6. Checking and Setting of Piping Specifications/Detector

4.6.1. Checking piping parameter

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 7 times to display “PROCESS SETTING”.	PROCESS SETTING S= 70.00mm
ENT ▼	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER 60.50 mm
△ ▼	Press the △ key once to display “PIPE MATERIAL”.	PIPE MATERIAL CARBON STEEL
△ ▼	Press the △ key once to display “WALL THICKNESS”.	WALL THICKNESS 3.80 mm
△ ▼	Press the △ key once to display “LINING MATERIAL”.	LINING MATERIAL NO LINING
△ ▼	Press the △ key once to display “KIND OF FLUID”.	KIND OF FLUID STEAM
△ ▼	Press the △ key once to display “VISCOSITY”.	VISCOSITY 7.000000 E-6m2/s
△ ▼	Press the △ key once to display “CONSTANT DENSITY”.	CONSTANT DENSITY 2.667378 kg/m3
△ ▼	Press the △ key once to display “SENSOR MOUNT”.	SENSOR MOUNT N METHOD
△ ▼	Press the △ key once to display “SENSOR TYPE”.	SENSOR TYPE FSX5
ESC △	Press the ESC key twice, and the △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.6.2. Piping parameter setting method

Description
- Set the pipe and target fluid parameters, and calculate the sensor unit mounting interval.
- The sensor mounting dimensions are calculated automatically. Refer to “5.1.1.Mounting of detector.”

⚠ CAUTION

Before mounting sensors on pipes, be sure to set the following parameters, and mount sensors based on the mounting dimensions between them.
Set the correct pipe outer diameter and wall thickness dimensions. Performance may be impaired.
- The measurement error will increase if not mounted at the precise sensor unit interval.
- Wave receipt errors may also occur.

Item
1. Pipe outer diameter : 6.00 to 6200.00 [mm] (factory set at 60.50 [mm]).
2. Piping material : CARBON STEEL (factory set), STAINLESS STEEL
3. Wall thickness : 2.80 to 4.00 [mm] (factory set at 3.80 [mm]).
4. Lining material : NO LINING (factory set)
5. Target fluid : STEAM (factory default)
   Other (sonic velocity: 300 to 2500 [m/s])
6. Viscosity coefficient : 0.0010 to 999.999 × 10^{-6} [m^2/s] (factory default: 7.0000 × 10^{-6} [m^2/s])
7. Density: AI CURRENT, Pt TEMPERATURE
   FIXED DENSITY (density: 0.000000 to 999.9999 kg/m^3) (factory default: 2.667378 [kg/m^3])
   Select the density when deriving the mass flow rate from volume flow rate.
   - If AI CURRENT selected: Density is calculated from the thermometer or pressure gauge analog input.
   - If Pt TEMPERATURE selected: Density is calculated from the resistance temperature detector temperature input.
   - If FIXED DENSITY selected: Mass flow rate is calculated from the set density.
8. Detector mounting method : N method (factory set),
9. Detector type : FSX5 (factory set)

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand.(See Section 4.4.1.)

Operation (example)	Specify settings if using an FSX5 sensor to measure steam flowing to a Schedule 10S stainless steel pipe with nominal diameter of 50 A. Use the AI current for density.	
Key operation	Description	Display
		0. 000 m/s 0. 000 m3/h
△ ▼	Press the △ key 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
△ ▼	Press the △ key 7 times to display “PROCESS SETTING”.	PROCESS SETTING S= 70.00mm
ENT ▼	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER 60. 50 mm
	As 60.5 mm (factory default) has already been registered for the outer diameter of Schedule 10S stainless steel pipe, proceed to the next setting.	
△ ▼	Press the △ key once to display “PIPE MATERIAL”.	PIPE MATERIAL CARBON STEEL
ENT ▼	Press the ENT key once to make the second row blink.	PIPE MATERIAL CARBON STEEL
△ ▼	Press the △ key once to display “STAINLESS STELL”.	PIPE MATERIAL STAINLESS STEEL
ENT ▼	Press the ENT key once to register “PIPE MATERIAL”.	PIPE MATERIAL ** COMPLETE ** ↓
	——— Pipe material has been registered. ———	PIPE MATERIAL STAINLESS STEEL

△ ▼

Press the △ key once to display “WALL THICKNESS”.

WALL THICKNESS
3. 80 mm

ENT ▼

Press the ENT key once to blink the cursor.

WALL THICKNESS
003. 80 mm

003. 80 mm

△ ▷ ▼

Move the cursor by the ▷ key, and change the numeric value by the △ key.

WALL THICKNESS
002. 80 mm

The Schedule 10S pipe thickness for stainless steel pipe is 2.8 mm based on the Piping data in section 7.4, and therefore “2” should be entered.

ENT ▼

Press the ENT key once to register “WALL THICKNESS”.

WALL THICKNESS
** COMPLETE **
↓
WALL THICKNESS
2. 80 mm

——— Wall thickness has been registered. ———

△ ▼

Press the △ key once to display “LINING MATERIAL”.

LINING MATERIAL
NO LINING

As “NO LINING” (factory default) has already been registered, proceed to the next setting.

(Note) If there is a lining, press the ENT key here. Next press the △ key, and select the material. Or enter the sonic velocity. Proceed to “LINING MATERIAL”, and enter the lining thickness dimension. This is not displayed in the case of “NO LINING”.

△ ▼

Press the △ key once to display “KIND OF FLUID”.

KIND OF FLUID
STEAM

Similarly, as “STEAM” (factory default) has already been registered, proceed to the next setting.

(Note) When the target fluid is other than steam, press the ENT key here and select the menu. Or enter the sonic velocity.

△ ▼

Press the △ key once to display “VISCOSITY”.

VISCOSITY
7. 0000E-6m2/s

Enter the target fluid viscosity coefficient.
As a viscosity coefficient of 7.0000E-6 [m^2/s] (factory default) has already been registered for steam at 180°C, proceed to the next setting.

△ ▼

Press the △ key once to display “FIXED DENSITY”.

FIXED DENSITY
2. 667378 kg/m3

ENT ▼

Press the ENT key once to make the second row blink.

FIXED DENSITY
2. 667378 kg/m3

△ ▼

Press the △ key once to display “AI CURRENT ”.

DENSITY
AI CURRENT

ENT ▼

Press the ENT key once to register “DENSITY”.

DENSITY
** COMPLETE **
↓
DENSITY
AI CURRENT

——— Density has been registered. ———

△

Press the △ key twice to display “SENSOR TYPE”.

SENSOR TYPE
FSX5

As “FSX5” (factory default) has already been registered, proceed to the next setting.

(Note) When the nominal diameter is not 50 A, press the ENT key here and then the △ key. Select “FSX6” for 65 A, “FSX8” for 80 A, and “FSXA” for 100 A.

——— Sensor type has been registered. ———

ESC ▼

Press the ESC key for 1 times to display “PROCESS SETTING”.

PROCESS SETTING
S= 70mm

“S = 70 mm” is displayed in the second row.
Set the sensor unit mounting interval to 70 mm, and mount the sensor on the pipe. Note: When the sensor type is FSXA, “S = 90 mm” is displayed.

ESC △

Press the ESC key once and the △ key twice to return to the measurement mode.

0. 000 m/s
0. 000 m3/h

4.7. Setting of unit

4.7.1. Unit system

Description
- Measurement unit can be selected from metric or inch system.
- Metric system (factory set)

Length ····· mm
Flow velocity ····· m/s
Volume flow rate unit ····· 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
Flow rate total unit ····· mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
Mass flow rate unit ····· g/s, g/min, g/h, g/d, kg/s, kg/min, kg/h, kg/d, t/s, t/min, t/h, t/d
Mass total unit ····· g, kg, t
Viscosity coefficient ····· $E^{-6}m^2/s$
Pressure ····· MPa (G), bar (G) (G: gauge pressure)
Temperature unit ····· °C, K, °F
Density ····· kg/m^3

<Note> Set the total mode to “STOP” before setting this parameter. (See Section 4.8.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Change the unit system from inch system to metric system.	
Key operation	Description	Display
	Measurement mode display before changes	0.000 ft/s 0.000 ft3/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 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

4.7.2. Volume flow unit Setting method

Description
- Select the unit for the instantaneous VOLUME FLOW.
- Metric system

  Flow rate ····· L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h (factory set), m^3/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d

<Note> First, set the unit system (metric) according to Section 4.7.1

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set a flow total 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 “VOLUME FLOW UNIT”.	VOLUME FLOW UNIT m3/h
ENT ▼	Press the ENT key once to blink the cursor.	VOLUME FLOW UNIT m3/h
△ ▼	Press the △ key several times to display “L/min”.	VOLUME FLOW UNIT L/min
ENT ▼	Press the ENT key once to register.	VOLUME FLOW UNIT ** COMPLETE **
	——— “L/min” has been registered. ———	↓ VOLUME FLOW UNIT L/min
ESC △	Press the ESC key once and △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.7.3. Volume total unit setting method

Description
- Select the unit of total volume.
- Metric system
  Flow total unit ····· mL, L, m^3(factory set), km^3, Mm^3, mBBL, BBL, kBBL

<Note> First, set the unit system (metric) according to Section 4.7.1
Set the total mode to “STOP” before setting this parameter. (See Section 4.8.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set a vol. 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 twice to display “Vol.TOTAL UNIT”.	Vol.TOTAL UNIT m3
ENT ▼	Press the ENT key once to blink the cursor.	Vol.TOTAL UNIT m3
△ ▼	Press the △ key twice to display “L”.	Vol.TOTAL UNIT L
ENT ▼	Press the ENT key once to register.	Vol.TOTAL UNIT ** COMPLETE **
	——— “L” has been registered. ———	↓ Vol.TOTAL UNIT L
ESC △	Press the ESC key once and △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.7.4. Mass flow unit setting method

Description
- Select the instantaneous mass flow rate unit.
- Metric system
  Mass flow rate unit ····· g/s, g/min, g/h, g/d, kg/s, kg/min, kg/h (factory default), kg/d, t/s, t/min, t/h, t/d

<Note> First, set the unit system (metric system) based on section 4.7.1.

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the flow rate unit to “kg/min”.	
Key operation	Description	Display
△ ▼	Press the △ key 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
△ ▼	Press the △ key 3 times to display “MASS FLOW UNIT”.	MASS FLOW UNIT kg/h
ENT ▼	Press the ENT key once to blink the cursor.	MASS FLOW UNIT kg/h
△ ▼	Press the △ key 11 times to display “kg/min”.	MASS FLOW UNIT kg/min
ENT ▼	Press the ENT key once to register.	MASS FLOW UNIT ** COMPLETE **
	——— “kg/min” registered. ———	↓ MASS FLOW UNIT kg/min
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.7.5. Mass total unit setting method

Description
- Select the mass total unit.
- Metric system
  Mass total unit……g, kg (factory default), t

<Note> First, set the unit system (metric system) based on section 4.7.1.
When setting, set the total mode to STOP. (See section 4.8.2)

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the mass total unit to “kg”.	
Key operation	Description	Display
△ ▼ ENT ▼ △ ▼	Press the △ key 3 times to display “MEASURE SETUP”.	MEASURE SETUP
	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
	Press the △ key 4 times to display “MASS TOTAL UNIT”. “kg” (factory default) is already registered. If setting another unit, change using the ENT key and △ key.	MASS TOTAL UNIT kg
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.7.6. Pressure unit setting method

Description
- Select the pressure unit for the analog input AI read from pressure gauge output.
- Metric system
  Pressure unit ····· MPa (G) (factory default), bar (G) (G: gauge pressure)

<Note> First, set the unit system (metric system) based on section 4.7.1.

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the pressure unit to “MPa (G)”.	
Key operation	Description	Display
△ ▼	Press the △ key 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “SYSTEM UNIT”.	SYSTEM UNIT METRIC
△ ▼	Press the △ key 5 times to display “PRESSURE UNIT”. “MPa (G)” (factory default) is already registered. If setting another unit, change using the ENT key and △ key.	PRESSURE UNIT MPa (G)
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.7.7. Temperature unit

Description
- Select the unit of temperature for the analog input AI acquired from the thermometer.
- Select the unit of temperature for the temperature input acquired from the resistance temperature sensor.
- Metric system
  Temperature unit · °C (factory set), K, °F

<Note> First, set the unit system (metric) according to Section 4.7.1.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set a temperature unit to "°C".	
Key operation	Description	Display
△ ▼	Press the △ key 3 times to display "MEASURE SETUP".	MEASURE SETUP
ENT ▼	Press the ENT key once to display "SYSTEM UNIT".	SYSTEM UNIT METRIC
△ ▼	Press the △ key 6 times to display "TEMPERATURE UNIT". °C (factory setting) has been registered. Use ENT key and △ key to change the unit.	TEMPERATURE UNIT °C
ESC △	Press the ESC key once, and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

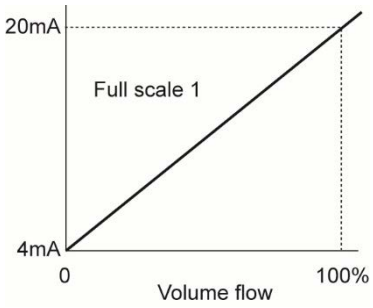
4.8. Output Setting

4.8.1. Setting of flow rate range

4.8.1.1. Volume flow range (single range)

Description
- The range (full scale) of flow rate to be measured is set.
  * The analog output (4-20mA) corresponds to the range setting.
- Settable range: 0.3 to 50 [m/s] in terms of flow velocity in piping
  * The piping parameters and FLOW UNIT must be set beforehand.
  * If a value beyond the settable range is inputted, "INPUT ERROR" appears and then last setting is resumed.
  * If you change the "piping parameters" or "FLOW UNIT" after setting the range, do over the range setting again.

<Note> The flow rate unit is as selected by " VOLUME FLOW UNIT " in the "MEASURE SETUP" mode. (Refer to Section 4.7.2)



- Setting range of the full scale flow rate

<Note> • Converted flow rate in the Table 1 is the calculation results obtained by using the internal diameters of pipes in the left columns. Perform calculation using the actual internal diameters for accuracy.
• Simple formula for flow velocity calculation.

$$\text{velocity [m/s]} \fallingdotseq 353.7 \times \frac{flowrate[m^3/h]}{(pipediameter[mm])^2}$$

$$\text{velocity [m/s]} \fallingdotseq 21.22 \times \frac{flowrate[l/\min]}{(pipediameter[mm])^2}$$

Flow velocity range : 0.3 ～ 50 [m/s] <Table 1>

int. dia. of pipes [mm]	Flow rate unit	
	[m³/h]	[L/min]
25	0.530 to 88.4	8.84 to 147
50	2.12 to 353	35.3 to 589
80	5.43 to 905	90.5 to 1,508
100	8.48 to 1,414	141 to 2,356
150	19.1 to 3,181	318 to 5,301
200	33.9 to 5,655	565 to 9,425
300	76.3 to12,723	1272 to 21,206

<Note> When the VOLUME FLOW output is analog, set the VOLUME FLOW based on the analog output source specification (Section 4.8.1.3).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the range type to single range and “FULL SCALE1” to flow rate of 60m³/h. * Set the piping parameters and " VOLUME FLOW UNIT " beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE SINGLE
	As SINGLE (factory default) has already been registered, proceed to the next setting.	
△ ▼	Press the △ key once to display “KIND”.	KIND VELOCITY
	As “VELOCITY” (factory default) has already been registered, proceed to the next setting.	
△ ▼	Press the △ key once to display “VOLUME FLOW FS1”.	VOLUME FLOW FS1 80.000 m3/h
ENT ▼	Press the ENT key once to display the cursor.	VOLUME FLOW FS1 00080.000 m3/h
△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key.	00080.000 m3/h 00060.000 m3/h 00060.000 m3/h
	Change the full scale1 to “65”. Note) To change the decimal point position, align the cursor with a place to change to and press the △ key likewise.	VOLUME FLOW FS1 00065.000 m3/h

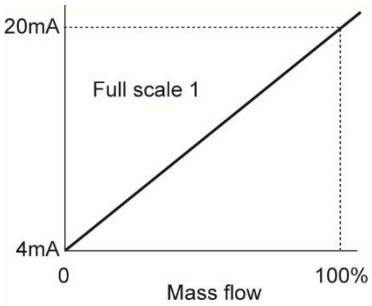
ENT ▼	Press the ENT key once to register. ——— The full scale1 has been registered. ———	VOLUME FLOW FS1 ** COMPLETE ** ↓ VOLUME FLOW FS1 00065.000 m3/h
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.1.2. Setting the mass flow rate range (single range)

Description
- Set the range value (full scale value) for the mass flow rate being measured.
  * The analog output (4 to 20 mA) corresponds to the range setting.
- Setting range: ±99999999
  * The MASS FLOW UNIT must be set beforehand.

<Note> The mass flow rate unit is the unit selected at “MASS FLOW UNIT” in “MEASURE SETUP” mode. (See Section 4.7.4)

<Note> If an analog value is output for mass flow rate, set the mass flow rate with the analog output source designation (see section 4.8.1.3).



For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set “RANGE TYPE” to “SINGLE”, and “MASS FLOW FS F1” to a mass flow rate of 170.0797 kg/h. * Set the pipe parameters and “MASS FLOW UNIT” beforehand.	
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 CLEAR
△ ▼	Press the △ key 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE SINGLE
		KIND FLOW RATE
△ ▼	Press the △ key 4 times to display “MASS FULL SCALE 1”.	MASS FLOW FS1 0. 000 kg/h
ENT ▼	Press the ENT key once to display the cursor.	MASS FLOW FS1 00000. 000 kg/h
△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key. Change the mass flow rate full scale to “170.079”. (Note) If changing the position of the decimal point, align the cursor with the digit to be changed, and change in the same way by pressing the △ key.	00000. 000 kg/h 00100. 000 kg/h 00100. 000 kg/h 00170. 000 kg/h 00170. 000 kg/h 00170. 070 kg/h 00170. 070 kg/h 00170. 079 kg/h
ENT ▼	Press the ENT key once to register. ——— Full scale 1 has been registered. ———	MASS FLOW FS1 ＊＊ COMPLETE ＊＊ ↓ MASS FLOW FS1 170. 079 kg/h
ESC △	Press the ESC key twice and the △ key 3 times to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.8.1.3. The source of analog output

Description
- Specify whether volume flow rate (incl. flow velocity) or mass flow rate is output for analog output AO.
  AO output: Volume flow rate (factory default), mass flow rate

  <Note> The LCD display shows both volume flow rate and mass flow rate.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set mass flow rate for analog output AO.	
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 CLEAR
△ ▼	Press the △ key for 5 times to display “AO OUT.SOURCE”.	AO OUT.SOURCE VOLUME FLOW RATE
ENT ▼	Press the ENT key once to blink the cursor.	AO OUT.SOURCE VOLUME FLOW RATE
△ ▼	Press the △ key once to display “MASS FLOW RATE”.	AO OUT.SOURCE MASS FLOW RATE
ENT ▼	Press the ENT key once to register.	AO OUT.SOURCE ** COMPLETE **
	——— “AO OUT.SOURCE” has been registered. ———	↓ AO OUT.SOURCE MASS FLOW RATE
ESC △	Press the ESC key once and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.1.4. Analog output at error (Burnout)

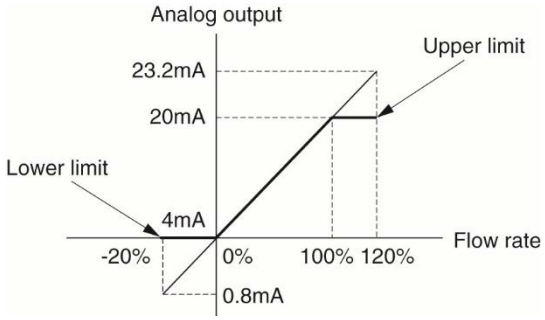
Description
- Establish measures for dealing with analog output in the case where wave receipt errors, etc. occur due to device errors or splash contamination inside the pipe.
- Settable range
  (1) Analog output (4to20mA) at error
  HOLD : Outputs a current value preceding the error (factory set).
  UPPER : Sets analog output to upper of the output limit (over scale).
  LOWER : Sets analog output to lower of the output limit (under scale).
  ZERO : Outputs 4mA.
  (2) BURNOUT TIMER (time from error detection to BURNOUT processing) 10 to 900 seconds (factory set at 10 sec). Please set 10 seconds or more.
  * During BURNOUT processing, LCD display interlocks with analog output.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set “UPPER” to BURNOUT. Set “20sec” to BURNOUT TIMER. * Set the “PIPE PARAMETER” and “VOLUME FLOW UNIT” or “MASS FLOW UNIT” beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE SINGLE
△ ▼	Press the △ key for 4 times to display “RANGE”.	BURNOUT (CURRENT) HOLD
ENT ▼	Press the ENT key once to blink the cursor.	BURNOUT (CURRENT) HOLD
△ ▼	Press the △ key once to display “UPPER”.	BURNOUT (CURRENT) UPPER
ENT ▼	Press the ENT key once to register.	BURNOUT (CURRENT) ** COMPLETE ** ↓
	——— “UPPER” has been registered. ———	BURNOUT (CURRENT) UPPER
△ ▼	Press the △ key once to display “BURNOUT TIMER”.	BURNOUT TIMER 10 sec
ENT ▼	Press the ENT key once to display 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 ** COMPLETE ** ↓
	——— “BURNOUT TIMER” has been registered. ———	BURNOUT TIMER 020 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

4.8.1.5. Output limit

Description
- Upper and lower limits can be set within the range of analog output 0.8mA to 23.2mA (-20% to 120%).
- Settable range
  (1) Output lower limit: -20% to 0% (0.8mA to 4mA)
  (2) Output upper limit: 100% to 120% (20mA to 23.2mA)



⚠ CAUTION

- Connect a load resistor of 500 Ω or less to ensure a stable maximum output current of 120%.
- If greater than 500 Ω, but less than or equal to 600 Ω, the maximum stable current that can be output will be 105% (20.8 mA).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set "-10% (2.4mA)" to lower limit, and "110% (21.6mA)" to upper limit. * Set the "PIPE PARAMETER" and "VOLUME FLOW UNIT" beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display "RANGE".	RANGE
ENT ▼	Press the ENT key once to display "RANGE TYPE".	RANGE TYPE SINGLE
△ ▼	Press the △ key for 9 times to display "OUTPUT LIMIT LOW".	OUTPUT LIMIT LOW -20%
ENT ▼	Press the ENT key once to display 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 "2".	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 once to set "1".	OUTPUT LIM. HIGH 110%

ENT ▼ ▼	Press the ENT key once to register. ——— “OUTPUT LIM. HIGH” has been registered. ———	OUTPUT LIM. HIGH ** COMPLETE ** ↓ 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

4.8.2. Setting the total (actual)

4.8.2.1. Total flow pulse (total flow rate, pulse width)

Description

- Set output pulse as following description before totalizing flow rate.
- Total rate: Total amount (volume) per pulse.
  A pulse is outputted when the total volume has attained an amount set by the total rate, and adds to the total pulse count (in case of total pulse indication). Settable range: 0.000001 to 99999999
  * Set the flow total unit before setting the total rate. (See Section 4.7.3.)
- Pulse width: Width of total pulse output.
  Select a pulse width according to a corresponding total meter out of menus. Settable range: 5ms, 10ms, 50ms, 100ms, 200ms, 500ms, 1000ms.
- Restrictions in the setup:
  Output of total pulses involves the following restrictions depending on the DO output port (DO1 and DO2).

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 condition 1 and condition 2 indicated below are satisfied.
Otherwise, accurate result may not be obtained.

Condition 1:

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

Condition 2:

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

Note 1) The range of 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.
Note 2) The output frequency on the output ports is limited when the flow rate exceeds the set range. Therefore, if such a setup that the maximum frequency per range occurs at the time of 100% flow rate, there is possibility that the total pulse output will be incapable of following when the flow rate exceeds 100%, and accurate total value cannot be obtained if over-range continues for a long time. If there are cases where the flow rate exceeds 100%, modify the set range and total rate so that the maximum frequency will not exceed the restricted level.

Example of calculation

Calculate the range that permits setup of the total rate under the range and pulse width indicated below.
When the range and the pulse width are as follows:

FLOW SPAN -1: 36[m^3/h] (=0.01[m^3/s]), Pulse width:50[ms]

Condition 1

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

$$= 0.0001\ [m^3] = 0.1\ [L]$$

As above:
0.1 [L] ≤ TOTAL RATE ·· A

Condition 2

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

$$= 0.001\ [m^3] = 1\ [L]$$ ························ B

The settable range of the total rate that satisfies both of condition 1 and condition 2 is as follows from results of calculation A and B.
1 [L] ≤ TOTAL RATE

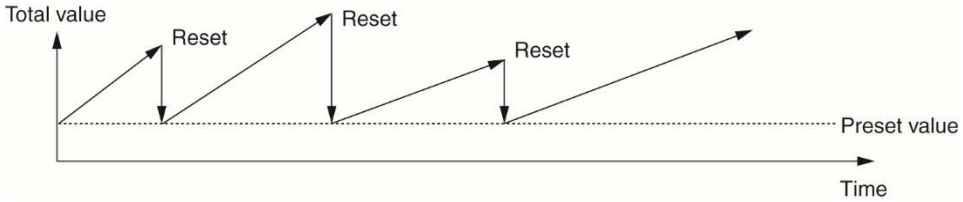
Note) When the total rate is set to “0”, total pulse is not output.
Note) Set the total mode to STOP before start setting.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set total rate to 0.1m³/pulse, and pulse width to 100ms. * Set the flow total unit beforehand.	
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 CLEAR
△ ▼	Press the △ key for 6 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key once to display “VolumeTOTAL RATE”.	VolumeTOTAL RATE 0 m3
ENT ▼	Press the ENT key once to display the cursor.	VolumeTOTAL RATE 00000000 m3
▷ ▼	Press the ▷ key for 7 times to move the cursor.	VolumeTOTAL RATE 00000000 m3
△ ▼	Press the △ key several times to display a decimal point.	VolumeTOTAL RATE 0000000.0 m3
▷ ▼	Press the ▷ key once to move the cursor.	VolumeTOTAL RATE 0000000.0 m3
△ ▼	Press the △ key once to display “1”.	VolumeTOTAL RATE 0000000.1 m3
ENT ▼	Press the ENT key once to register.	VolumeTOTAL RATE ** COMPLETE ** ↓
	——— “VolumeTOTAL RATE” has been registered. ———	VolumeTOTAL RATE 0.1 m3
△ ▼	Press the △ key for 4 times 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 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 press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.2.2. Preset value for total flow

Description
- Preset value: Value which appears on the total counter when the total value has been reset.
  Settable range: 0 to 99999999
  <Note> A resetting action simultaneously resets both forward total memory and reverse total memory.
  Set the total unit beforehand in MEASURE SETUP. (Refer to section 4.7.3.)
  Set the total mode to STOP before setting the preset value.



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the preset value to 100m³. * Set the flow total unit beforehand.	
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 CLEAR
△ ▼	Press the △ key for 6 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key twice to display “V:TOTAL PRESET”.	V:TOTAL PRESET 0 m3
ENT ▼	Press the ENT key once to display the cursor.	V:TOTAL PRESET 0000000
▷ ▼	Press the ▷ key for 6 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	V:TOTAL PRESET 0000000 m3
△ ▼	Press the △ key once to display “1”.	V:TOTAL PRESET 0000100 m3
ENT ▼	Press the ENT key once to register.	V:TOTAL PRESET ** COMPLETE ** ↓
	——— “V:TOTAL PRESET” has been registered. ———	V:TOTAL PRESET 100 m3
△ ▼	Press the △ key for 6 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 to 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 press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.2.3. Setting the MASS TOTAL pulse (MASS TOTAL rate, pulse width)

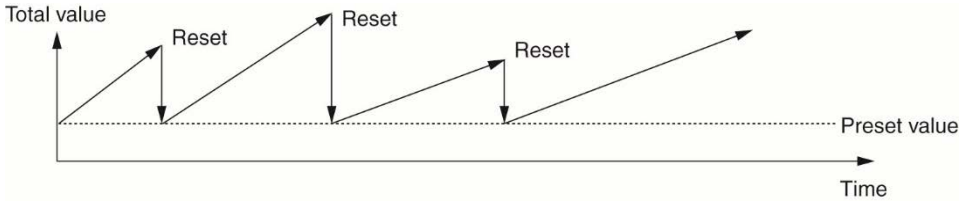
Description
- If integrating mass into the integrator when measuring mass flow rate, specify the output pulse as follows. Mass can be integrated at the same time as flow rate integration.
- Total rate: Total amount per pulse.
  A pulse is outputted when the total volume has attained an amount set by the total rate, and adds to the total pulse count (during total pulse indication). Settable range: 0.000001 to 99999999
  * Set the mass total unit before setting the mass integrating factor. (See Section 4.7.5)
- Regarding pulse width and setup restriction, refer to “4.8.2.1 Total flow pulse (total flow rate, pulse width)”.
  <Note> Total pulse is not output when TOTAL RATE is set to “0”.
  <Note> Set the total mode to STOP before start setting.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the mass integrating factor to 100 kg/pulse. * Set the mass total unit beforehand. * Setting of the pulse width is the same as described in “4.8.2.1 Total flow pulse (total flow rate, pulse width)”, and therefore the description has been omitted.	
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 CLEAR
△ ▼	Press the △ key for 6 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key for 3 times to display “MASS TOTAL RATE”.	MASS TOTAL RATE 0 kg
ENT ▼	Press the ENT key once to display the cursor.	MASS TOTAL RATE 00000000 kg
▷ ▼	Press the ▷ key for 6 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	MASS TOTAL RATE 00000000 kg
△ ▼	Press the △ key once to display “1”.	MASS TOTAL RATE 00000100 kg
ENT ▼	Press the ENT key once to register.	MASS TOTAL RATE ** COMPLETE **
	——— “MASS TOTAL RATE” has been registered. ———	MASS TOTAL RATE 00000100 kg
△ ▼	Press the △ key for 5 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 to 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 press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.2.4. Setting the MASS TOTAL preset value

Description
- Preset value: Value which appears on the total counter when the total value has been reset.
  Settable range:0 to 99999999
  <Note> If a reset is performed, both the forward direction mass total memory and reverse direction mass total memory are reset simultaneously.
  Set the total unit (thermal) beforehand in the MEASURE SETUP mode. (Refer to section 4.7.5.)
  Set the total mode to STOP before start setting.



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the preset value to 10000kg. * Set the total unit (thermal) beforehand	
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 CLEAR
△ ▼	Press the △ key for 6 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key for 4 times to display “M:TOTAL PRESET”.	M:TOTAL PRESET 0 kg
ENT ▼	Press the ENT key once to display the cursor.	M:TOTAL PRESET 00000000 kg
▷ ▼	Press the ▷ key for 4 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	M:TOTAL PRESET 00000000 kg
△ ▼	Press the △ key once to display “1”.	M:TOTAL PRESET 00010000 kg
ENT ▼	Press the ENT key once to register.	M:TOTAL PRESET ** COMPLETE ** ↓
	——— “M:TOTAL PRESET” has been registered. ———	M:TOTAL PRESET 000010000 kg
△ ▼	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 to 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 press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.2.5. TOTAL mode (total reset, start, stop)

Description
- The total is started, stopped or reset.
- Settable range: START, STOP, TOTAL RESET
  START : Starts totalizing. Totalizes continuously from the stopped status.
- STOP : Stops totalizing. Setting cannot be changed when it is not stopped.
- RESET : Resets the total memory to the reset value, and starts totalizing.
  <Note> If a reset is performed, both the forward direction volume total memory and reverse direction volume total memory, and the forward direction mass total memory and reverse direction mass total memory are reset simultaneously.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Reset the total value (reset value 0m3), and restart a total. *Set the “TOTAL UNIT” beforehand. Refer to “4.8.4”	
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 CLEAR
△ ▼	Press the △ key for 6 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 once to execute “TOTAL RESET”.	TOTAL MODE ** COMPLETE ** ↓
	——— The total operation is started. ———	TOTAL MODE TOTAL RESET
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

4.8.2.6. Totalization processing at error (Burnout)

Description
BURNOUT (TOTAL)
- Set integration processing for measurement errors that may occur due to such reasons as splash contamination in the fluid. (same for both total display, total pulse output)
- Settable range:
  HOLD : Stops the total (as factory set).
  NOT USED : Continues the total according to the measured value marked immediately before the error occurrence.

BURNOUT TIMER
- Sets the time from error occurrence to error processing.
- Settable range: 10 to 900sec (factory set: 10sec) Please set 10 seconds or more.
  The total continues until the burnout timer is activated.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Change the processing from "BURNOUT" to "HOLD", and change the burnout timer setting from 10 seconds 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 CLEAR
△ ▼	Press the △ key for 6 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE START
△ ▼	Press the △ key for 6 times to display “BURNOUT(TOTAL)”. Because HOLD (factory set) is already registered, go to the next step. Note) For setting “NOT USED”, press the △ key, and the △ key to select “NOT USED”.	BURNOUT(TOTAL) HOLD
△ ▼	Press the ENT 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 display “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 press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.8.3. DO output

Description
- Select the total pulse and status (warning and flow rate switch, total switch, etc.) output.

- DO output types (common to DO1 and DO2):

Settable range

NOT USED	:	Does not use the contact output.
+Vol.TOTAL PULSE	:	Outputs the forward total flow pulses.
-Vol.TOTAL PULSE	:	Outputs total flow pulse in reverse direction.
+MassTOTAL PULSE	:	Outputs the forward total flow pulses.
-MassTOTAL PULSE	:	Outputs the reverse total flow pulses.
FULL SCALE 2	:	Contact output is activated during FULL SCALE 2 measurement status. (Automatic 2-range, bi-directional range, bi-directional automatic 2-range) Activates with either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3).
ALARM		
ALL	:	Contact output is activated at HARDWARE FAULT or PROCESS ERROR.
HARDWARE FAULT	:	Contact output is activated at a circuit error (of memory etc.). Contact output is activated when the resistance temperature detector breaks.
PROCESS ERROR	:	Contact output is activated when no waves are received, or waves are unstable.
Vol.FLOW SWITCH		
Vol.FLOW SW HIGH	:	Contact output is activated when the instantaneous volume flow rate exceeds the setting value.
Vol.FLOW SW LOW	:	Contact output is activated when the instantaneous volume flow rate drops below the setting value.
MASS SWITCH		
Vol.FLOW SW HIGH	:	Contact output is activated when the instantaneous mass flow rate exceeds the setting value.
Vol.FLOW SW LOW	:	Contact output is activated when the instantaneous mass flow rate drops below the setting value.
Vol.TOTAL SWITCH	:	Contact output is activated when the flow rate total value is equal to or greater than the setting value.
MassTOTAL SWITCH	:	Contact output is activated when the mass total value is equal to or greater than the setting value.
RANGE OVER	:	Contact output is activated when either the range upper limit setting or lower limit setting for either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3) is exceeded.
PULSE RANGE OVER	:	Contact output is activated when flow rate total pulse output and mass total pulse output exceed the maximum frequency limit.
-:FLOW DIRECTION	:	Contact output is activated when the flow is in reverse direction.
INPUT ALARM	:	Contact output is activated when the analog input AI range exceeds 120% or -20%. Contact output is activated when the resistance temperature detector measurement range (-45 to 205°C) is exceeded.
MAINTENANCE	:	The contact output is activated when the maintenance period has elapsed. The maintenance period is set for two years.
CONTACT ACTION		
ACTIVE ON	:	Normally off
ACTIVE OFF	:	Normally on

⚠ CAUTION

- If the contact action is set to “ACTIVE OFF”, DO output is provided when the power is turned on. Check if DO output can be modified before setting.

<Note> DO output specifications

DO1/DO2 : Open collector, Contact capacity 30V DC, 50mA
When total pulse output is selected (Note: See 4.8.2.1)
100 pulses/s or less (at full scale flow rate)
Pulse width: 5, 10, 50, 100, 200,500 and 1000ms.

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

4.8.3.1. Total pulse output

Description
- Sets the total pulse output for DO1 OUT and/or DO2 OUT
  +Vol.TOTAL PULSE: Outputs flow rate total pulse in forward direction.
  -Vol.TOTAL PULSE: Reverse flow rate total pulse output.
  +MassTOTAL PULSE: This is the forward mass flow rate total pulse output.
  -MassTOTAL PULSE: This is the reverse mass flow rate total pulse output.
  Note) Refer to Section 4.8.2.1 to set the flow total rate, pulse width, etc.
  Note) Refer to Section 4.8.2.3 to set the energy total rate, pulse width, etc.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “+ TOTAL PULSE”. Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 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 once to display “+Vol.TOTAL PULSE” on the 2nd line. * Press the △ key one more time when selecting the “- VOLUME TOTAL pulse”. * Press the △ key several times when selecting the “+ MASS TOTAL pulse”. * Press the △ key several times when selecting the “- MASS TOTAL pulse”.	DO1 OUT +Vol.TOTAL PULSE
ENT ▼	Press the ENT key once to register “+Vol.TOTAL PULSE”. ——— “+Vol.TOTAL PULSE” 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 m/s 0.000 m3/h

4.8.4. LCD indication

Description
- Flow velocity display
  Selectable flow velocity unit: m/s (if meters selected at SYSTEM UNIT) (See section 4.7.1.)
  <Note> The decimal point position is fixed.(3 decimal points)
- Instantaneous volume flow rate display
  Selectable instantaneous volume flow rate display: actual scale display, % display
  <Note> The display unit is the unit selected at VOLUME FLOW RATE UNIT. (See Section 4.7.2)
- Instantaneous mass flow rate display
  Selectable instantaneous mass flow rate display: actual scale display, % display
  <Note> The display unit is the unit selected at MASS FLOW RATE UNIT. (See Section 4.7.4)
- Volume flow rate total display
  Selectable total display: volume flow rate total actual scale (forward/reverse), flow rate total pulse count (forward/reverse)
  <Note> The display unit is the unit selected at FLOW RATE TOTAL UNIT. (See Section 4.7.3)
  Mass total display
  Selectable total display: mass flow rate total actual scale (forward/reverse), mass total pulse count (forward/reverse)
  <Note> The display unit is the unit selected at MASS TOTAL UNIT. (See Section 4.7.5)
- Pressure display
  Pressure gauge pressure display read from analog input AI: actual scale display
  <Note> The display unit is the unit selected at PRESSURE UNIT. (See Section 4.7.6)
- Temperature display
  Thermometer temperature display read from analog input AI: actual scale display
  <Note> The display unit is the unit selected at TEMPERATURE UNIT. (See section 4.7.7.)
  The decimal point position is fixed.(°C: 1 decimal point, K: 2 decimal points)
- Pt temperature display
  Resistance temperature detector temperature input temperature display: actual scale display
  <Note> The display unit is the unit selected at TEMPERATURE UNIT. (See section 4.7.7.)
  The decimal point position is fixed.(°C: 1 decimal point, K, °F: 2 decimal points)
- SNR display
  S/N ratio display: dB
  <Note> The decimal point position is fixed. (2 decimal points)
- AGC display
  Wave receipt strength display: %
  <Note> The decimal point position is fixed. (2 decimal points)
- Display setting method
  Select DISPLAY setting mode “1st ROW” (1-row display) or “2nd ROW” (2-row display), and then select the display content.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the 1st ROW of the LCD display to the VOLUME FLOW % display.	
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 CLEAR
△ ▼	Press the △ key for 3 times to display “DISPLAY”.	DISPLAY
ENT ▼	Press the ENT key once to blink the cursor.	DISPLAY 1ST.ROW
ENT ▼	Press the ENT key again to select “1ST. LOW”.	1ST. LOW VELOCITY
△ ▼	Press the △ key twice to display “VOLUME FLOW(%)”.	1ST. LOW VOLUME FLOW(%)
ENT ▼	Press the ENT key once, and select and fix “VOLUME FLOW(%)” 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. ——— “VOLUME FLOW(%)” has been registered. ———	1:DECIMAL POINT ** COMPLETE ** ↓ 1:DECIMAL POINT *****.**
ESC △	Press the ESC key for 3 times and then press the △ key for 3 times to enter the measurement mode.	0.00 % 0.000 m3

4.8.5. Damping

Description
- Used for attenuating the variation of measured value.
  A time constant is set (response time of about 63%).

  Settable range: 0.0 to 100.0sec in 0.1 sec steps

  Note) In case you set to 0 sec, response time become as below.
  • System cycle 0.2sec
  • Dead time 0.2sec or less, time constant 0.1sec

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

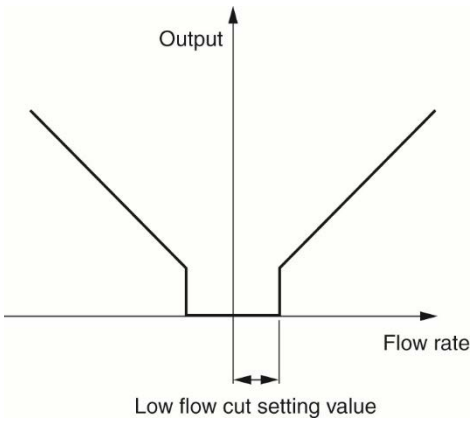
Operation (example)	Change the damping from 5 to 20 sec.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT CLEAR
△ ▼	Press the △ key once to display “DAMPING”.	DAMPING 5.0 sec
ENT ▼	Press the ENT key once to display the cursor.	DAMPING 005.0 sec
△ ▷ ▼	Set “20” by the △ key and the ▷ key.	DAMPING 005.0 sec 025.0 sec 025.0 sec 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.8.6. Low flow rate cutting

Description
- The output can be cut when the flow rate is too small.
- Effective for indication, analog output (4-20mA) and total operation.

Settable range: 0 to 5 [m/s] in terms of flow velocity.
(Factory set: 0.150 [m³/h])

Note 1) As required, set the low flow rate cut because the flow meter may read a flow rate when the fluid in the piping is moving on account of convection, etc. even if the valves are closed.
Note 2) The flow rate unit is as selected by "VOLUME FLOW UNIT" in "MEASURE SETUP". (See section 4.7.2)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

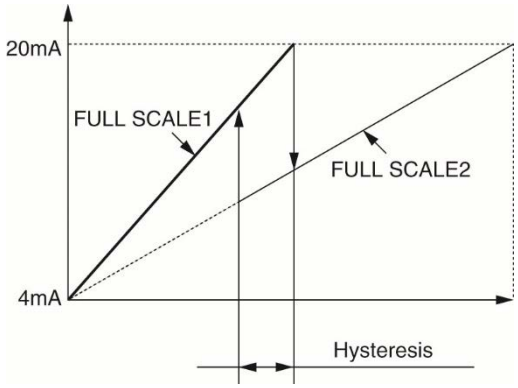
Operation (example)	Set the low flow rate cut point to 0.5 [m3/h]. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key twice to display “CUT OFF”	CUT OFF 0.150 m3/h
ENT ▼	Press the ENT key once to display the cursor.	CUT OFF 0000.150 m3/h
△ ▷ ▼	Set “0.5” by the △ key and the ▷ key.	CUT OFF 0000.150 m3/h 0000.550 m3/h 0000.550 m3/h 0000.500 m3/h
ENT ▼	Press the ENT key once to register.	CUT OFF ** COMPLETE ** ↓
	——— “CUT OFF” has been registered. ———	CUT OFF 0000.500 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

4.9. Application operation of parameter

4.9.1. Automatic 2 ranges

Description

- This function is used to perform measurement while changing the range based on flow rate.
- Current output changes based on the working range as shown in the diagram on the right.
- Current is output for either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3).
- Hysteresis can be set between 0 and 20% of the smaller range.
- By setting DO1 or DO2 to “FULL SCALE 2”, contact output is activated when “FLOW RATE FS2” is activated. Set “ACTIYE ON” or “ACTIYE OFF” separately. (See Section 4.9.5)
- Setting range:
  Both VOLUME FLOW FS1 and VOLUME FLOW FS2 are in the ±0.3 to ±50 [m/s] range based on the flow velocity calculated inside the pipe.
  Both MASS FLOW FS1 and MASS FLOW FS2 are ±99999999.
  * It is necessary to set the piping parameters, as well as the VOLUME FLOW UNIT and MASS FLOW UNIT beforehand.
  * If a setting value that exceeds the setting range is entered, “INPUT ERROR” is displayed, and the value returns to the original setting value.
  * If “FLOW RATE UNIT” is changed after setting the range, set the range again.
  * If not using FLOW RATE FS2 (if single range), set FLOW RATE FS2 to “0”.



<Note> The flow rate unit is the unit selected at “VOLUME FLOW UNIT” and “MASS FLOW UNIT”. Specify the “FLOW RATE UNIT” setting before setting the range. (See section 4.7.2) (See section 4.7.4)

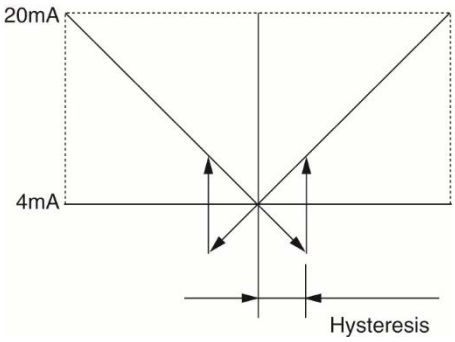
Specify the “FLOW RATE UNIT” setting before setting the range. (See section 4.7.2)

Operation (example)	Set “AUTO 2” to “RANGE TYPE”, 10[m³/h] to “VOLUME FLOW FS1”, and 60[m³/h] to “VOLUME FLOW FS2”. Set “RANGE HYS.” to 7%. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE SINGLE
ENT ▼	Press the ENT key once to blink the cursor.	RANGE TYPE SINGLE
△ ▼	Press the △ key once to display “AUTO 2”.	RANGE TYPE AUTO 2
ENT ▼	Press the ENT key once to select “AUTO 2”.	RANGE TYPE AUTO 2
△ ▼	Press the △ key twice to display “VOLUME FLOW FS1”.	VOLUME FLOW FS1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	VOLUME FLOW FS1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	VOLUME FLOW FS1 002 0.0000 m3/h
△ ▼	Press the △ key several times to change to “1”. Note) To change the decimal point position, align the cursor with a place to change to, and press the △ key.	VOLUME FLOW FS1 001 0.0000 m3/h
ENT ▼	Press the ENT key once to register.	VOLUME FLOW FS1 ** COMPLETE ** ↓

▼	——— “VOLUME FLOW FS1” has been registered. ———	VOLUME FLOW FS1 10.0000 m3/h
△ ▼	Press the △ key once to display “VOLUME FLOW FS2”.	VOLUME FLOW FS2 0.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	VOLUME FLOW FS2 0000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	VOLUME FLOW FS2 0000.0000 m3/h
△ ▼	Press the △ key for 6 times to set “6”.	VOLUME FLOW FS2 0060.0000 m3/h
ENT ▼	Press the ENT key once to register.	VOLUME FLOW FS2 ** COMPLETE ** ↓
	——— “VOLUME FLOW FS2” has been registered. ———	VOLUME FLOW FS2 60.0000 m3/h
△ ▼	Press the △ key for 3 times 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.2. Bi-directional range

Description
- This function is used to measure both the forward and reverse flow rates based on flow direction while changing the range.
- Current output changes based on the working range as shown in the diagram on the right.
- Current is output for either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3).
- Hysteresis can be set in the 0 to 20% working range.
- By setting DO1 or DO2 to “FULL SCALE 2”, contact output is activated when “FLOW RATE FS2” is activated.
  Set “ACTIVE ON” or “ACTIVE OFF” separately. (See Section 4.9.5)
- Setting range:
  Both VOLUME FLOW FS1 and VOLUME FLOW FS2 are in the ±0.3 to 50 [m/s] range based on the flow velocity calculated inside the pipe.
  Both MASS FLOW FS1 and MASS FLOW FS2 are ±99999999.
  * It is necessary to set the piping parameters, as well as the VOLUME FLOW UNIT and MASS FLOW UNIT beforehand.
  * If a setting value that exceeds the setting range is entered, “INPUT ERROR” is displayed, and the value returns to the original setting value.
  * If “FLOW RATE UNIT” is changed after setting the range, set the range again.
  * If not using FLOW RATE FS2 (if single range), set FLOW RATE FS2 to “0”.



<Note> The flow rate unit is the unit selected at “VOLUME FLOW UNIT” and “MASS FLOW UNIT”. Specify the “FLOW RATE UNIT” setting before setting the range. (See section 4.7.2) (See section 4.7.4)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

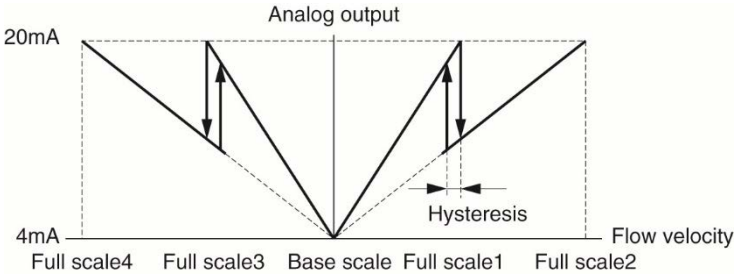
Operation (example)	Set “BI-DIR” to “RANGE TYPE”, 20[m³/h] to “VOLUME FLOW FS1”, and -10[m³/h] to “VOLUME FLOW FS2”. Set “RANGE HYS.” to 7%. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	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 “RANGE TYPE”.	RANGE TYPE SINGLE
ENT ▼	Press the ENT key once to blink the cursor.	RANGE TYPE SINGLE
△ ▼	Press the △ key twice to display “BI-DIR”.	RANGE TYPE BI-DIR
ENT ▼	Press the ENT key once to select “BI-DIR”.	RANGE TYPE BI-DIR
△ ▼	Press the △ key once to display “BI-DIR”.	VOLUME FLOW FS1 50.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	VOLUME FLOW FS1 0050.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “5”.	VOLUME FLOW FS1 0050.0000 m3/h
△ ▼	Press the △ key several times to set “2”.	VOLUME FLOW FS1 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.	VOLUME FLOW FS1 ** COMPLETE ** ↓
	——— “VOLUME FLOW FS1” has been registered. ———	VOLUME FLOW FS1 20.0000 m3/h
△ ▼	Press the △ key once to display “VOLUME FLOW FS2”.	VOLUME FLOW FS2 0.0000 m3/h

ENT ▼	Press the ENT key once to blink the cursor.	VOLUME FLOW FS2 0000.0000 m3/h
△ ▼	Press the △ key several times to display “-” on the 1st line.	VOLUME FLOW FS2 -000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	VOLUME FLOW FS2 -000.0000 m3/h
△ ▼	Press the △ key once to set “1”.	VOLUME FLOW FS2 -010.0000 m3/h
ENT ▼	Press the ENT key once to register.	VOLUME FLOW FS2 ** COMPLETE ** ↓
	——— “VOLUME FLOW FS2” has been registered. ———	VOLUME FLOW FS2 -10.0000 m3/h
△ ▼	Press the △ key for 3 times 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.3. Bi-directional auto 2 range

Description

- This function is used to measure both the forward and reverse flow rates based on flow rate and flow direction while changing the range.
- Current output changes based on the working range as shown in the diagram on the right.
- Current is output for either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3).
- Hysteresis can be set in the 0 to 20% range for the smaller of the span for full scale 1 and full scale 2, or full scale 3 and full scale 4.
- By setting DO1 or DO2 to “FULL SCALE 2”, contact output is activated when “FLOW RATE FS2” is activated.
  Set “ACTIVE ON” or “ACTIVE OFF” separately. (See Section 4.9.5)



- Setting range:
  Both VOLUME FLOW FS1 and VOLUME FLOW FS2 are in the ±0.3 to 50 [m/s] range based on the flow velocity calculated inside the pipe.
  Both MASS FLOW FS1 and MASS FLOW FS2 are ±99999999.
  By setting FLOW FS1 and FLOW FS2, FLOW FS3 and FLOW FS4 are set automatically.
  The relationship between FLOW FS1 and FLOW FS3, and FLOW FS2 and FLOW FS4 is shown below.
  |FULL SCALE 1 | =|FULL SCALE 3 |
  |FULL SCALE 2 | =|FULL SCALE 4 |
  * It is necessary to set the piping parameters, as well as the VOLUME FLOW UNIT and MASS FLOW UNIT beforehand.
  * If a setting value that exceeds the setting range is entered, “INPUT ERROR” is displayed, and the value returns to the original setting value.
  * If “FLOW RATE UNIT” is changed after setting the range, set the range again.
  * If not using FLOW RATE FS2 (if single range), set FLOW RATE FS2 to “0”.

(Note 1) The flow rate unit is the unit selected at “VOLUME FLOW UNIT” and “MASS FLOW UNIT”. Specify the “FLOW RATE UNIT” setting before setting the range. (See section 4.7.2) (See section 4.7.4)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set “BI-DIR AUTO 2” to “RANGE TYPE”, 10[m³/h] to “VOLUME FLOW FS1”, and 60[m³/h] to “VOLUME FLOW FS2”. Set “RANGE HYS.” to 7%. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE SINGLE
ENT ▼	Press the ENT key once to blink the cursor.	RANGE TYPE SINGLE
△ ▼	Press the △ key for 3 times to display “BI-DIR AUTO 2”.	RANGE TYPE BI-DIR AUTO 2
ENT ▼	Press the ENT key once to select “BI-DIR AUTO 2”.	RANGE TYPE BI-DIR AUTO 2
△ ▼	Press the △ key twice to display “VOLUME FLOW FS1”.	VOLUME FLOW FS1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	VOLUME FLOW FS1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	VOLUME FLOW FS1 0020.0000 m3/h
△ ▼	Press the △ key several times to change to “1”. Note) To change the decimal point position, align the cursor with a place to change to, and press the △ key.	VOLUME FLOW FS1 0010.0000 m3/h

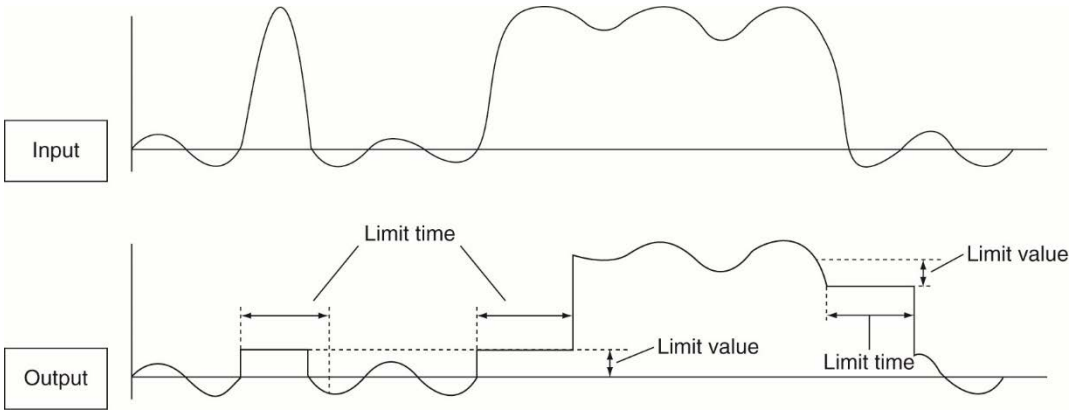
ENT ▼	Press the ENT key once to register.	VOLUME FLOW FS1 ** COMPLETE **
	——— "VOLUME FLOW FS1" has been registered. ———	↓ VOLUME FLOW FS1 10.0000 m3/h
△ ▼	Press the △ key once to display "VOLUME FLOW FS2".	VOLUME FLOW FS2 0.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	VOLUME FLOW FS2 0000.0000 m3/h
▷ ▼	Press the ▷ key twice to move the cursor.	VOLUME FLOW FS2 0000.0000 m3/h
△ ▼	Press the △ key for 6 times to set "6".	VOLUME FLOW FS2 0060.0000 m3/h
ENT ▼	Press the ENT key once to register.	VOLUME FLOW FS2 ** COMPLETE **
	——— "VOLUME FLOW FS2" has been registered. ———	↓ VOLUME FLOW FS2 60.0000 m3/h
△ ▼	Press the △ key for 3 times 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.4. Rate limit

Description
- Spike noise input such as that caused by splashing can be cut and output.
- Settable range

(1) RATE LIMIT 0 to 5 [m/s] in terms of flow velocity. Absolute value is input (Factory default: 40 [m^3/h] 5 m/s equivalent (50 A pipe size))
Set the rate limit value for each pipe size. 50 A 40 m^3/h (65 A 65 m^3/h, 80 A 92 m^3/h, 100 A 156 m^3/h under development)

(2) RATE TIMER Enter in the range of 0 to 900 sec. (Factory set: 10sec)



(Note 1) When input exceeding a limit value continues more than limit time, it is output as a true signal.
(Note 2) When the limit time is set to 0sec, this function does not operate.
(Note 3) The flow rate unit is the unit selected at "VOLUME FLOW UNIT".
Specify the "FLOW RATE UNIT" setting before setting the range. (See section4.7.2)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set 5m^3/h to RATE LIMIT, and 10 sec to RATE LIMIT TIMER. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
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 CLEAR
△ ▼	Press the △ key for 4 times to display "RANGE".	RANGE
ENT ▼	Press the ENT key once to display "RANGE TYPE".	RANGE TYPE SINGLE
△ ▼	Press the ENT key for 11 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 ** COMPLETE **
	——— "RATE LIMIT" has been registered. ———	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

▷ ▼ △ ▼ ENT ▼	Press the ▷ key once to align the cursor. Press the △ key several times to set “1”. Press the ENT key once to register. ——— RATE LIMIT TIMER has been registered. ———	RATE LIMIT TIMER 000 sec RATE LIMIT TIMER 010 sec RATE LIMIT TIMER ** COMPLETE ** ↓ RATE LIMIT TIMER 10 sec
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.5. DO output

4.9.5.1. FULL SCALE 2 output

Description
- Select a contact output as DO1 and/or DO2 at FULL SCALE2 measurement status.
- RANGE FULL SCALE 2 contact output is activated for either the volume flow rate or mass flow rate set with the analog output source designation (see section 4.8.1.3).

FULL SCALE 2 : Contact output is activated during FULL SCALE2 measurement. (AUTO 2, BI-DIR, BI-DIR AUTO2)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “FULL SCALE2”. Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”.	DO1 OUT NOT USED
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”. ——— “FULL SCALE2” 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

4.9.5.2. Alarm output

Description
- Select a contact output as DO1 and/or DO2 when received wave or FRAM is abnormal.
- Settable range

ALL	:	Select a contact output when hardware and received wave (nothing, unstable) are abnormal.
HARDWARE FAULT	:	Contact output is activated when a circuit error (memory, etc.) or a temperature circuit error occurs. Contact output is activated when the resistance temperature detector breaks.
PROCESS ERROR	:	Select a contact output when received wave is abnormal.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

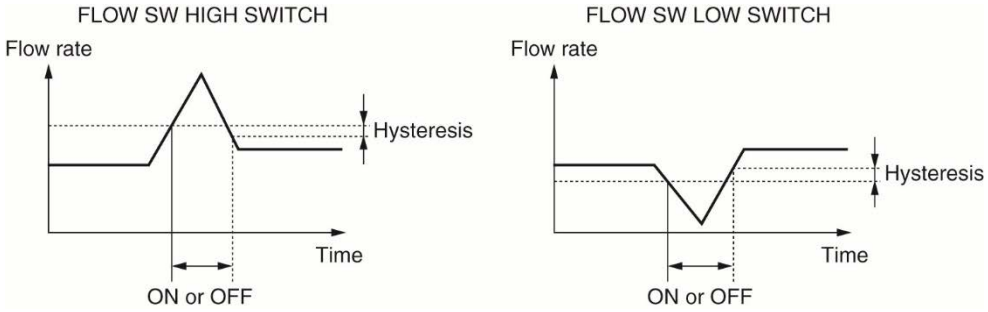
Operation (example)	Set the DO1 output to “PROCESS ERROR”. Also, set the contact to “ACTIVE ON”.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 6 times to display “ALARM” on the 2nd line.	DO1 OUT ALARM
ENT ▼	Press the ENT key once to display the ALARM select screen.	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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

Burnout timer
The time between error occurrence and contact output can be changed by a setting of the burnout timer.
Make a setting according to the section “4.8.1.4”.

Note) If “Process error” or “All” is issued, the burnout timer is enabled. If “Device error” is issued, the burnout timer is disabled.

4.9.5.3. Flow switch

Description
- Contact output is activated for DO1 and DO2 when the instantaneous volume flow rate exceeds the setting value.
- Contact output is activated for DO1 and DO2 when the instantaneous mass flow rate exceeds the setting value.



- Settable range
  Volume flow rate range : 0 to 50m/s in terms of flow velocity.
  Mass flow rate range : 0 to 99999999
  Action : Vol.FLOW SW HIGH or Vol.FLOW SW LOW
  Mass FLOW SW HIGH or Mass FLOW SW LOW(Thermal)
  Contact action : ACTIVE ON: DO1/DO2: Normally off
  ACTIVE OFF: DO1/DO2: Normally on
  Note) The hysteresis value set in Section 4.8.1" is applied to the action range.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

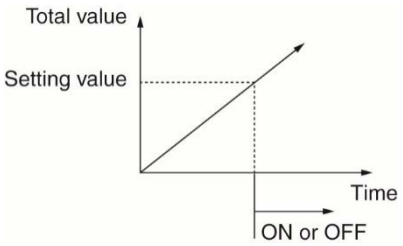
Operation (example)	Set the DO1 output to "Vol.FLOW SW HIGH", and upper limit flow rate to 12 [m³/h]. Also, set the contact to "ACTIVE ON". * Set the VOLUME FLOW UNIT beforehand.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT CLEAR
△ ▼	Press the △ key for 7 times to display "DO1 OUT". * Use the △ key to select "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 "Vol.FLOW SWITCH" on the 2nd line.	DO1 OUT Vol.FLOW SWITCH
ENT ▼	Press the ENT key once to display the flow rate setting screen of "Vol.FLOW SW HIGH". * Press the △ key once to display the flow rate setting screen of "Vol.FLOW SW LOW".	Vol.FLOW SW HIGH 10.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	Vol.FLOW SW HIGH 0010.0000 m3/h
▷ ▼	Press the ▷ key for 3 times to move the cursor.	Vol.FLOW SW HIGH 0010.0000 m3/h
△ ▼	Press the △ key twice to set "2".	Vol.FLOW SW HIGH 0012.0000 m3/h
ENT ▼	Press the ENT key once to register. ——— "FLOW SW HIGH" has been registered. ———	Vol.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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.5.4. Total switch

Description
- This function is used to activate DO1 and DO2 contact output when the volume flow rate total value exceeds the setting value.
- This function is used to activate DO1 and DO2 contact output when the mass flow rate total value exceeds the setting value.

Settable range : 0.000001 to 99999999
Action : Vol.TOTAL SWITCH, Mass TOTAL SWITCH
Contact action:
ACTIVE ON : DO1/DO2: Normally off
ACTIVE OFF : DO1/DO2: Normally on
Note) Different values can be assigned to DO1 and DO2.



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “Vol.TOTAL SWITCH”, and change the setting value from 10000[m³] to 100[m³]. Also, set the contact to “ACTIVE ON”. * Set the TOTAL UNIT beforehand.	
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 CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 9 times to display “Vol.TOTAL SWITCH” on the 2nd line.	DO1 OUT Vol.TOTAL SWITCH
ENT ▼	Press the ENT key once to display the setting screen of “Vol.TOTAL SWITCH”.	Vol.TOTAL SWITCH 10000 m3
ENT ▼	Press the ENT key once to blink the cursor.	Vol.TOTAL SWITCH 00010000 m3
▷ ▼	Press the ▷ key for 3 times to move the cursor.	Vol.TOTAL SWITCH 00010000 m3
△ ▼	Press the △ key for 10 times to set “0”.	Vol.TOTAL SWITCH 00000000 m3
▷ ▼	Press the ▷ key twice to move the cursor.	Vol.TOTAL SWITCH 00000000 m3
△ ▼	Press the △ key once to set “1”.	Vol.TOTAL SWITCH 00000100 m3
ENT ▼	Press the ENT key once to register.	Vol.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). * To select normally on, press the △ key.	CONTACT ACTION ** COMPLETE **
	——— “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 % 0.000 m³

4.9.5.5. Range over output and pulse range over output

Description
- AO RANGE OVER : Contact output to DO1 and/or DO2 are activated when the flow rate is outside the setting range.
- PULSE RANGE OVER : Contact output to DO1 and/or DO2 are activated when the total pulse output exceeds the maximum output frequency value.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “AO RANGE OVER”. Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”.	DO1 OUT NOT USED
	* Use the △ key to select “DO2 OUT”.	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 11 times to display “AO RANGE OVER” on the 2nd line.	DO1 OUT AO RANGE OVER
	* Press the △ key again to display “PULSE RANGE OVER”.	
ENT ▼	Press the ENT key once to register “RANGE OVER”.	DO1 OUT ** COMPLETE **
	——— “RANGE OVER” 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 % 0.000 m3

4.9.5.6. Output at the minus flow direction

Description
- Select a contact output as DO1 and/or DO2 when the flow is in reverse direction.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to "-: FLOW DIRECTION". Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 times to display "DO1 OUT".	DO1 OUT NOT USED
	* Use the △ key to select "DO2 OUT".	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 13 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.9.5.7. Input alarm setting method

Description
- INPUT ALARM: Contact output is activated for DO1 and DO2 when the analog input AI range exceeds 120% or -20%, the analog input cable breaks, and when the resistance temperature detector measurement range (-45 to 205 °C) is exceeded.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “INPUT ALARM”. Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”.	DO1 OUT NOT USED
	* Use the △ key to select “DO2 OUT”.	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key 14 times to display “INPUT ALARM” on the second line.	DO1 OUT INPUT ALARM
ENT ▼	Press the ENT key once to register “INPUT ALARM”.	INPUT ALARM ** COMPLETE ** ↓
	——— “INPUT ALARM” 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 % 0.000 m3

4.9.5.8. How to set the maintenance period

Description
- MAINTENANCE: Contact output is activated for DO1 and DO2 when the maintenance period has elapsed.
  The maintenance period is two years.
  Two years after the maintenance period setting (Section 4.11.14) was set to START, contact output is activated for DO1 and DO2.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the DO1 output to “MAINTENANCE”. Also, set the contact 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 CLEAR
△ ▼	Press the △ key for 7 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key 15 times to display “MAINTENANCE” on the second row.	DO1 OUT MAINTENANC
ENT ▼	Press the ENT key once to register “INPUT ALARM”. ——— “MAINTENANCE” has been registered. ———	MAINTENANC ** 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 m/s 0.000 m3

4.9.6. Calibrating the measured value

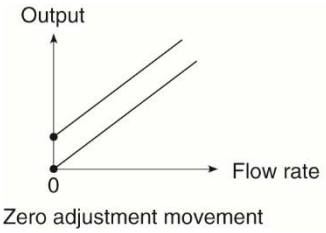
Description
- Measured value can be calibrated manually.
  Zero point and span adjustment can be made.
  Settable range
  (1) Zero point : -5 to +5 [m/s] in terms of flow velocity in piping.
  (2) Span : ±200%

The output value (reading, analog output and total output) is computed by the following expression.

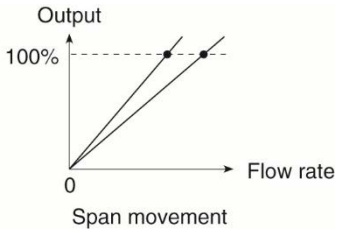
$$\text{Output} = \frac{\text{Measured value} \times [\text{Span set value \%}]}{100} + \text{Zero point}$$

<Note> The flow rate unit is the unit selected at "VOLUME FLOW UNIT".
Specify the "VOLUME FLOW UNIT" setting before setting. (See Section 4.7.2)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)



Zero adjustment movement



Span movement

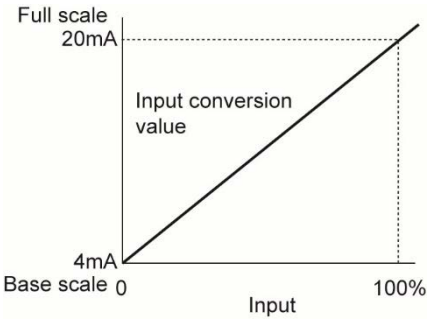
Operation (example)	Compensate the zero point to 0.5m3/h, and the span by +1%. * Set the PIPE PARAMETER and VOLUME FLOW UNIT beforehand.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT CLEAR
△ ▼	Press the △ key for 9 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 press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.10. Input settings

4.10.1. AI range setting (option)

Description

- Set the analog input range type and input range.
  * Input is converted corresponding to the analog input (4 to 20 mA) from the pressure gauge or thermometer.
- RANGE TYPE: NOT USE (factory default), PRESSURE, TEMPERATURE
  * Set to use with range of PRESSURE or TEMPERATURE.
    If PRESSURE is set: Density is calculated from the pressure for which input was converted.
    If TEMPERATURE is set: Density is calculated from the temperature for which input was converted.
  * It is necessary to set the “PRESSURE UNIT” or “TEMPERATURE UNIT” beforehand.
  * When “PRESSURE” or “TEMPERATURE” is set, set the piping parameter density to “AI CURRENT”.



<Note> To set AI current, select “AI CURRENT” at “DENSITY” in the “PROCESS SETTING”. (See Section 4.6.2)

- Base scale: Set the analog input 4 mA scale.
- Full scale: Set the analog input 20 mA scale.
  Setting range: ±99999999
  * If a setting value that exceeds the setting range is entered, “INPUT ERROR” is displayed, and the value returns to the original setting value.
  * If “PRESSURE UNIT” or “TEMPERATURE UNIT” is changed after setting the range, set the range again.

<Note> The pressure unit is the unit selected at “PRESSURE UNIT” in “MEASURE SETUP” mode. (See Section 4.7.6)
<Note> The temperature unit is the unit selected at “TEMPERATURE UNIT” in “MEASURE SETUP” mode. (See Section 4.7.7)

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the RANGE TYPE to “PRESSURE”, “BASE SCALE” to pressure of 0.1 MPa (G), and “FULL SCALE” to pressure of 10 MPa (G). * Set the piping parameters and “PRESSURE UNIT” beforehand. (If the RANGE TYPE is “TEMPERATURE”, set the “TEMPERATURE UNIT”.)	
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 11 times to display “RANGE”.	AI RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	KIND NOT USED
△ ▼	Press the △ ↑ key once to display “PRESSURE”.	KIND PRESSURE
ENT ▼	Press the ENT key once to register.	KIND ＊＊ COMPLETE ＊＊
	——— Kind has been registered. ———	KIND PRESSURE
△ ▼	Press the △ key once to display “BASE SCALE”.	BASE SCALE 0. 00000 MPa (G)
ENT ▼	Press the ENT key once to blink the cursor.	BASE SCALE 000. 00000 MPa (G)

△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key. Change the BASE SCALE to “0.1”. (Note) If changing the position of the decimal point, align the cursor with the digit to be changed, and change in the same way by pressing the △ key.	000. 00000 MPa (G) 000. 10000 MPa (G)
ENT ▼	Press the ENT key once to register. ——— Base scale has been registered. ———	BASE SCALE ＊＊ COMPLETE ＊＊ ↓ BASE SCALE 0. 10000 MPa (G)
△ ▼	Press the △ key once to display “FULL SCALE”.	FULL SCALE 0. 00000 MPa (G)
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE 000. 00000 MPa (G)
△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key. Change the BASE SCALE to “10”. (Note) If changing the position of the decimal point, align the cursor with the digit to be changed, and change in the same way by pressing the △ key.	000. 00000 MPa (G) 010. 00000 MPa (G)
ENT ▼	Press the ENT key once to register. ——— Full scale has been registered. ———	FULL SCALE ＊＊ COMPLETE ＊＊ ↓ FULL SCALE 10. 00000 MPa (G)
ESC △	Press the ESC key twice and the △ key 3 times to return to the measurement mode.	0. 000 m/s 0. 000 m3/h

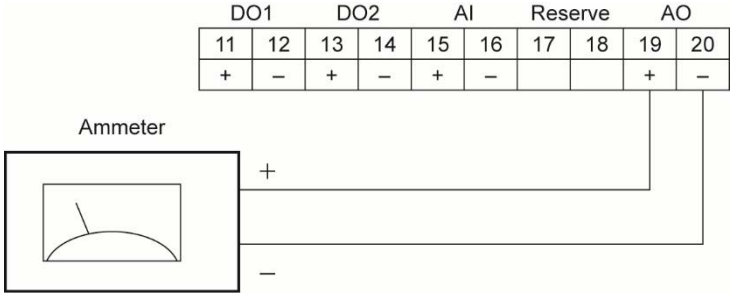
4.10.2. Temperature input setting (option)

Description
- Set when using the resistance temperature detector temperature input.
  * Density is calculated from the measured temperature.
- Measure the saturated steam temperature or pipe surface temperature.
  * Pt100: 1 point
  * Measurement range: -45 to 205°C
- Set the piping parameter density to “Pt TEMPERATURE”.
  <Note> To set Pt temperature, select “Pt TEMPERATURE” at “DENSITY” in the “PROCESS SETTING”. (See Section 4.6.2)
- Set the temperature unit.
  <Note> The temperature unit is the unit selected at “TEMPERATURE UNIT” in “MEASURE SETUP” mode. (See Section 4.7.7)

4.11. Maintenance mode

4.11.1. Calibrating the analog output

Description
- The calibration is performed so as to obtain 4mA and 20mA when the analog signal (4-20mA DC) output is 0% and 100%, respectively.
- Connect an ammeter to AO terminals as shown below. In the CURRENT CALIBRATION mode, select 4mA or 20mA, and operate the △ key (UP) or the ▷ key (Down).
- Destination analog output: AO: between terminal board (19 to 20)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Adjust the 4mA and 20mA analog outputs.	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key twice to display “AO CURRENT”.	AO CURRENT CARIBRATION
ENT ▼	Press the ENT key twice to enter the calibration mode of 4mA output.	AO CALIBRATION 4 mA
	Adjust the output to 4mA by the △ (UP) and the ▷ (down) key, while observing the output of calibration devices such as an ammeter.	
ENT ▼	Press the ENT key once to register the adjustment result.	AO CALIBRATION ** COMPLETE ** ↓
	——— 4mA adjustment result has been registered. ———	AO CARIBRATION 4 mA
△ ▼	Press the △ key once, and select 20mA.	AO CARIBRATION 20mA
ENT ▼	Press the ENT key twice to enter the calibration mode of 20mA output.	AO CARIBRATION 20mA
	Adjust the output to 20mA by the △ (UP) and the ▷ (down) key.	
ENT ▼	Press the ENT key once to register the adjustment result.	AO CARIBRATION ** COMPLETE ** ↓
	——— 20mA adjustment result has been completed. ———	AO CARIBRATION 20mA
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.2. Constant current output

Description
- Generates a fixed value output of analog signal.
  Application example: The operation of a connected receiver is checked by generating a fixed value output of analog signal.
- In the constant current setting mode (OUTPUT SETTING), set the constant current output value.
  Settable range: -20%(0.8mA) to +120%(23.2mA)

⚠ CAUTION

- Before operation, check whether it is permitted to change AO output.
- Connect a load resistor of 500 Ω or less to ensure a stable maximum output current of 120%.
- If greater than 500 Ω, but less than or equal to 600 Ω, the maximum stable current that can be output will be 105% (20.8 mA).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the constant current output of 50% (12mA).	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key 3 times 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) Constant current output starts.	
▷ △ ▼	Enter “5” by using the ▷ key 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. Note) Current output is in the measurement status.	CURRENT OUTPUT SETTING
ESC △	Press the ESC key once and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.3. Checking the total pulse output action

Description
- Checks the action of total pulse output.
  The output action can be checked upon designating the number of pulses to be outputted per second.
  Settable range: 1 to 100 pulses/s (when pulse width is 5ms, 10ms, 50ms,100ms or 200ms)

Note 1) The output pulse width is as selected currently. (See 4.8.2.1.)
Set the frequency taking the pulse width into account referring to the following expression.
The number of setting pulses ≤ 1000/(Pulse width[ms] × 2)
Example: If the pulse width is set to 50ms, select 10 pulses/s or less.
Note 2) When pulse width is 500ms and 1000ms, output action is performed at the rate of 1pulse/4seconds regardless of setting.

⚠ CAUTION

- This operation sets DO1 and the same contact action.
- Before operation, check whether DO output testing is permitted.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Perform pulse output 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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 4 times to display “TOTAL PULSE”.	TOTAL PULSE 1 PULSE/s
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL PULSE 001 PULSE/s
▼	Note) Start simulated pulse output.	
▷ ▼	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.	TOTAL PULSE ** COMPLETE ** ↓
	——— 5 PULSE/s has been registered. ———	TOTAL PULSE 005 PULSE/s
	5 PULSE/s simulated pulse is output.	
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 press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.4. Checking the status output

Deescription
- Check the status output.
  Setting content ON: Close the contact.
  OFF: Open the contact.

⚠ CAUTION

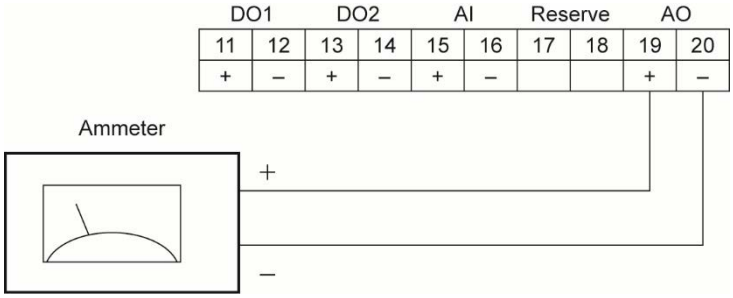
- This operation sets DO1 and DO2 the same contact action.
- Before operation, check whether DO output testing is permitted.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Check 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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 5 times to display “STATUS”.	DO CHECK OFF
ENT ▼	Press the ENT key once to blink the cursor. Note) Contact output is displayed at this time. “OFF” is given at right.	DO CHECK OFF
△ ▼	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. * It returns to contact output at the normal measurement status.	DO CHECK OFF
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. Analog input calibration method

Description
- Perform calibration so that the analog signal (4-20 mA DC) input is 0% at 4 mA and 100% at 20 mA.
- Connect the current generator to the AI terminal as shown in the figure below so that calibration corresponds to 4 mA and 20 mA in current input adjustment mode.
- Analog input destination: AI: Between terminal blocks (15-16)



⚠ CAUTION

- The analog input is calibrated at the factory.
- If calibration is interrupted, the calibration value may be lost. If interrupted, redo the calibration from the beginning.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Adjust the 4mA and 20mA analog inputs.	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 6 times to display “AI CURRENT”.	AI CURRENT CALIBRATION
ENT ▼	Press the ENT key twice to enter 4 mA calibration mode. Next, output 4 mA from the current generator and wait for the output to stabilize.	AI CALIBRATION 4mA
ENT ▼	Press the ENT key once to register the calibration result.	AI CALIBRATION ** COMPLETE ** ↓
	——— 4 mA Calibration Result Registration Complete ———	AI CALIBRATION 4mA
△ ▼	Press the △ key once to select 20 mA.	AI CALIBRATION 20mA
ENT ▼	Press the ENT key once to enter 20 mA calibration mode. Next, output 20 mA from the current generator and wait for the output to stabilize.	AI CALIBRATION 20mA
ENT ▼	Press the ENT key once to register the calibration result.	AI CALIBRATION ** COMPLETE ** ↓
	——— 20 mA Calibration Result Registration Complete ———	AI CALIBRATION 20mA
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.6. Analog input check method

Description
- This function is used to check the analog input signal current value.
- Connect a current generator to the AI terminal, and ensure that the current input is between 4 and 20 mA.
  Input range: -20% (0.8 mA) to +120% (23.2 mA)

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	The current generator outputs 12.0 mA.	
Key operation	Description	Display
△ ▼ ENT ▼ △ ▼ ENT ▼ ESC ▼ ESC △	Press the △ key 4 times to display “MAINTENANCE MODE”. Press the ENT key once to display “RAS”. Press the △ key 7 times to display “AI CHECK”. Press the ENT key once to display the current. Press the ESC key once to leave the check screen. Press the ESC key once and the △ key twice to return to the measurement mode.	MAINTENANCE MODE RAS 0000H 0000000000000000 AI CURRENT CHECK AI CURRENT 12. 000 mA AI CURRENT CHECK 0. 000 % 0. 000 m3

4.11.7. Confirming the input temperature

Description
- This function is used to check the resistance temperature detector temperature input temperature.
  Content to be checked - TS: Displays the temperature from the resistance temperature detector.
  TR: Displays the temperature, however, this is not used.

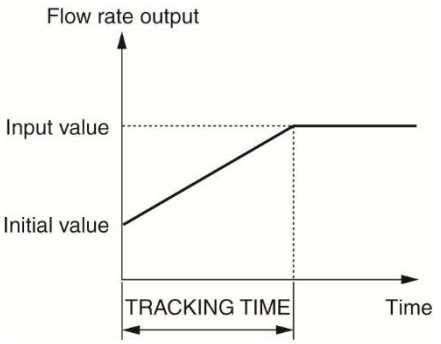
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Confirm the input temperature.	
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”.	RAS 0000H 0000000000000000
▼		
△	Press the △ key for 8 times to display “PT TEMP. CHECK”.	PT TEMP. CHECK
▼		
ENT	Press the ENT key once to display temperatures.	TS : 0. 0 °C TR : 0. 0 °C
▼		
ESC	Press the ESC key once to exit the confirmation screen.	PT TEMP. CHECK
▼		
ESC △	Press the ESC key once and then press the △ key once to enter the measurement mode.	0. 000 % 0. 000 m3

4.11.8. Test mode (simulated flow rate output)

Description

- Checks different outputs (LCD indication, analog output, DO output) upon simulating volume flow rate outputs.
  With the output at the actuated time as an initial value, the output changes up to the input value (simulated volume flow rate target value) in a selected TRACKING TIME, and at the input value, the output value becomes constant.
  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 (percentage of MV full scale).
TRACKING TIME	:	Time required to attain the simulated flow rate target (above input value).

Settable range

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

* For setting TRACKING TIME, 0sec is set to the damping (See section 4.8.5)

⚠ CAUTION

By performing the operation, the output of analog outputs AO1 and AO2, and output DO1 and DO2 will be changed depending on the setting.
Check beforehand whether it is permitted to change each parameter.

Be sure to resume "NOT USED" after the end of test.
Otherwise, the input value output status will be held until power is turned off.

If “START” or ”RESET” is selected as TOTAL MODE, the total value also changes. Select “STOP” to prevent the total value change.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the simulated flow rate target to 100%, and the tracking time to 100 [sec]. *Set the “FLOW RATE (%)” before hand. Refer to “4.8.4”	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 9 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 ▷ key 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 ▼	Press the △ key once to set “100”. Press the ENT key once to register. ——— “TRACKING TIME” has been registered. ——— * Simulating flow rate output is started.	TRACKING TIME 100 sec TRACKING TIME ** COMPLETE ** ↓ TRACKING TIME 100 s
ESC △	Display the measurement mode by the ESC key and the △ key. "T" blinks on the left end of 1st line of LCD, and the output changes. In 100 seconds (at which tracking time is set), the output becomes stable at 10 [m^3/h] (simulated flow rate target). (In case of full scale 10 [m^3/h]) Note) Be sure to return the TEST MODE to "NOT USED" after checking the output.	T 0.00 % 0.000 m3/h ↓ T 100.00 % 10.000 m3/h

4.11.9. Serial transmission (RS-485)

Description
- Sets a transmission before using the transmission function.
  Setting content
  Transmission type, transmission rate, parity, stop bits and slave No.

  Settable range
  Transmission type : RS-485.
  Transmission rate (BAUD RATE) : 9600 bps or 19200 bps, 38400bps (factory set).
  Parity : NONE, EVEN (factory set), ODD
  Stop bits : 1 BIT (factory set), 2 BITS
  Station No. : 1 to 31 (factory set: 1)

Note) For the transmission specifications, refer to the separate instruction manual “Ultrasonic Flowmeter Communication functions” (INF-TN5A4019-E).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the baud rate to 38400bp, the parity to "NONE", the stop bits to "1 BIT", and the slave 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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 10 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 “38400bps” 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 38400bps
△ ▼	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 △ key 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
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.10. Setting the ID No.

Description
- Set the ID No. for parameters (Section 4.4.1).
  If ID No. is set, the number must be inputted before canceling the protection.
  To set the protection, set the protection to "ON". (See Section 4.4.1.)

- ID No. settable range: 0000 to 9999 (4-digit number)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)
If you forget the ID number you set, contact us.

Operation (example)	Set “1106” as the ID No.	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 12 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 △ key 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 then press the △ key once to enter the measurement mode. Note) To set the protection, set the protection to "PROTECT ON". (See Section 4.4.1.)	0.000 % 0.000 m3

4.11.11. Confirming the software version

Description
- Indicates the software version.

For actual keying, refer to the typical operation indicated below.

Operation (example)	Check the 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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 13 times to display “VER. NO.”.	FSJ****1 Ver.02A 23
ESC △	After checking, display the measurement mode by the ESC key or the △ key.	0.000 % 0.000 m3/h

* The indicated version number is display example.

4.11.12. LCD backlight setting

Description
- Sets the operation of the LCD backlight.
  “BACKLIGHT OFF TIME”: The backlight can be set to turn OFF after the set time when always ON, or when turned ON by key operation.

- Setting content
  Lights-out time: sets the time for backlight to put out.
  When OFF is set, this function is enabled. [settable range: 0 to 99min]
  When you set the setting time to 0 min, backlight is OFF all the time.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Set the backlight ON time to 10minuites after key operation is completed.	
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”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 15 times to display “LIGHTS-OUT TIME”.	LIGHTS-OUT TIME 0min
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	LIGHTS-OUT TIME 00min
△ ▷ ▼	Enter “10” by the ▷ key and the △ key.	LIGHTS-OUT TIME 10min
ENT ▼	Press the ENT key once to register.	LIGHTS-OUT TIME ** COMPLETE **
	——— “INPUT DATA” has been registered. ———	↓ LIGHTS-OUT TIME 10min
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.11.13. Receipt signal auto search

Description
- Use this function to detect receipt signals automatically.
- Use when the flow transmitter power is turned OFF for a short while at such times as when carrying out a periodic inspection.
- Use when wave receipt errors occur.

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Perform a receipt signal auto search.	
Key operation	Description	Display
△ ▼	Press the △ key 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key 18 times to display “AUTO SEARCH”.	AUTO SEARCH EXECUTION
ENT ▼	Press the ENT key once to blink the cursor.	AUTO SEARCH EXECUTION
ENT ▼	Press the ENT key once to perform “EXECUTE”.	AUTO SEARCH ** ADJUSTMENT **
	——— COMPLETE ———	AUTO SEARCH ** COMPLETE **
ENT	Press the ENT key once to display “EXECUTE”.	AUTO SEARCH EXECUTE
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0. 000 % 0. 000 m3
		0. 000 m/3 0. 000 m3/h

4.11.14. Maintenance period setting

Description
- After the maintenance period elapses, this function provides display output for the measurement indicator and contact output for DO1 and DO2.
  "MAINTENANCE" will blink on Display 2.
- The maintenance period is two years.
- When using high-temperature grease (long-term type) for the acoustic coupler, reapply the grease to the noise damping frame and sensor unit transmission surface after the maintenance period elapses.
  After reapplying the grease, set the maintenance period to START.

Setting content
STOP : This stops the maintenance. The maintenance timer inside the converter is set to zero.
START : This starts the maintenance. The maintenance timer inside the converter starts from zero.
Note) Set STOP or START when you want to stop "MAINTENANCE" from blinking on the measurement indicator or you want to turn off the contact output to DO1 and DO2.

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.4.1.)

Operation (example)	Perform a receipt signal auto search.	
Key operation	Description	Display
△ ▼	Press the △ key 4 times to display "MAINTENANCE MODE".	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display "RAS".	RAS
△ ▼	Press the △ key once to display "MAINTENANCE".	MAINTENANCE STOP
ENT ▼	Press the ENT key once to blink the cursor.	MAINTENANCE STOP
ENT ▼	Press the ENT key once to display "START".	MAINTENANCE START
ENT ▼	Press the ENT key once to register.	↓ MAINTENANCE ** COMPLETE **
	——— "START" has been registered. ———	MAINTENANCE START
ESC △	Press the ESC key once and then press the △ key once to return to measurement mode.	0. 000 % 0. 000 m3

5. MOUNTING OF DETECTOR

5.1. Detector mounting procedure

Mount the sensor on the pipe, and perform the following steps in order before making measurement.

Ref. section	Work item	: Overview
5.1.1	Mounting of detector	: Obtain the sensor spacing beforehand.
↓		
5.2	Selecting the mounting location	: Straight pipes are long, and therefore a location with sufficient work space should be selected.
↓		
5.3	Treatment of detector mounting surface	: Pretreat the surface of the pipe to which the detector is to be mounted.
↓		
5.4	Mounting the noise elimination frame	: Mount the noise elimination frame on the pipe.
↓		
5.5	Sensor mounting bracket mounting	: Mount the sensor mounting bracket on the pipe.
↓		
5.6	Sensor mounting	: Mount the sensor on the sensor mounting bracket.
↓		
5.7	Pre-anplifier mounting	: Install the pre-amplifier.
↓		
5.8	Wiring connection	: Connect the sensor and pre-amplifier, and the pre-amplifier and flow transmitter.

⚠ CAUTION

When installing on hot pipes, pay attention to the following items when carrying out installation work. Failure to observe this may result in burns.

- Keep bare skin away from hot parts. If there is a risk of bare skin coming into contact with hot parts, cover the skin by wearing gloves, long-sleeves, long pants, and socks, etc.
- Take heat insulation measures if required for work (wearing heat-resistant gloves, etc.).
- Perform a safety check of the area below the installation location to ensure that there are no problems even if hot objects are dropped by accident.

5.1.1. Mounting of detector

For sensor spacing, select either method in advance.

- Calculate from flow transmitter

  Turn ON the flow transmitter.

  Enter the piping information, etc described in Section 4.6.2, and display it.

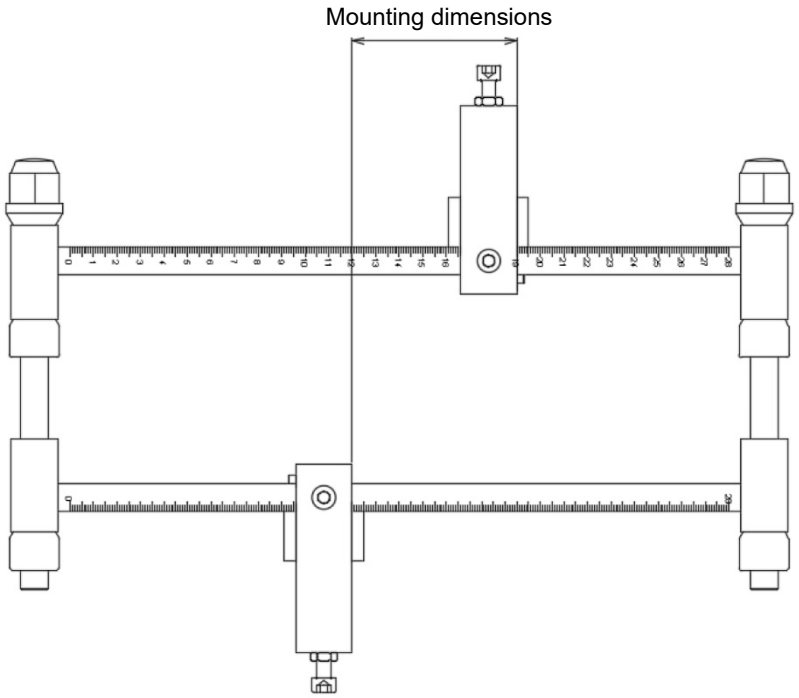
  Display example: PROCESS SETTING S=70mm

  When the sensor type is “FSX5” (50 A), “FSX6” (65 A), or “FSX8” (80 A), “S = 70 mm” is displayed. When the sensor type is “FSXA” (100 A), “S = 90 mm” is displayed.

  During wiring work, be sure to turn the power off.

5.1.2. Mounting dimensions diagram

The factory default mounting dimension is 70 mm. When the pipe diameter is 50 A, 65 A, or 80 A, the mounting dimension does not need to be changed. When the pipe diameter is 100 A, change the mounting dimension to 90 mm.



5.2. Selecting the mounting location

The detector mounting location, in other words on pipe at which flow rate is measured, will greatly affect measurement accuracy, and therefore a location which satisfies the following conditions should be selected.

① Location with straight pipe indicated in "3.2.1 Conditions on straight pipe "
② There should be a space for maintenance around the pipe to which the detector is to be mounted. (Refer to "Fig. 5-2".)
③ The length of the sensor cable between the pre-amplifier unit and sensor unit is 2 m, and therefore the detector should be installed in such a way that connection is possible.
④ The drainage should be discharged with steam traps and the steam humidity should be small.
⑤ Avoid places with rapid pressure fluctuation of 0.1 MPaG or above in 10 seconds.

Note) Ensure a space at both sides of the pipe to allow workers to carry out installation.

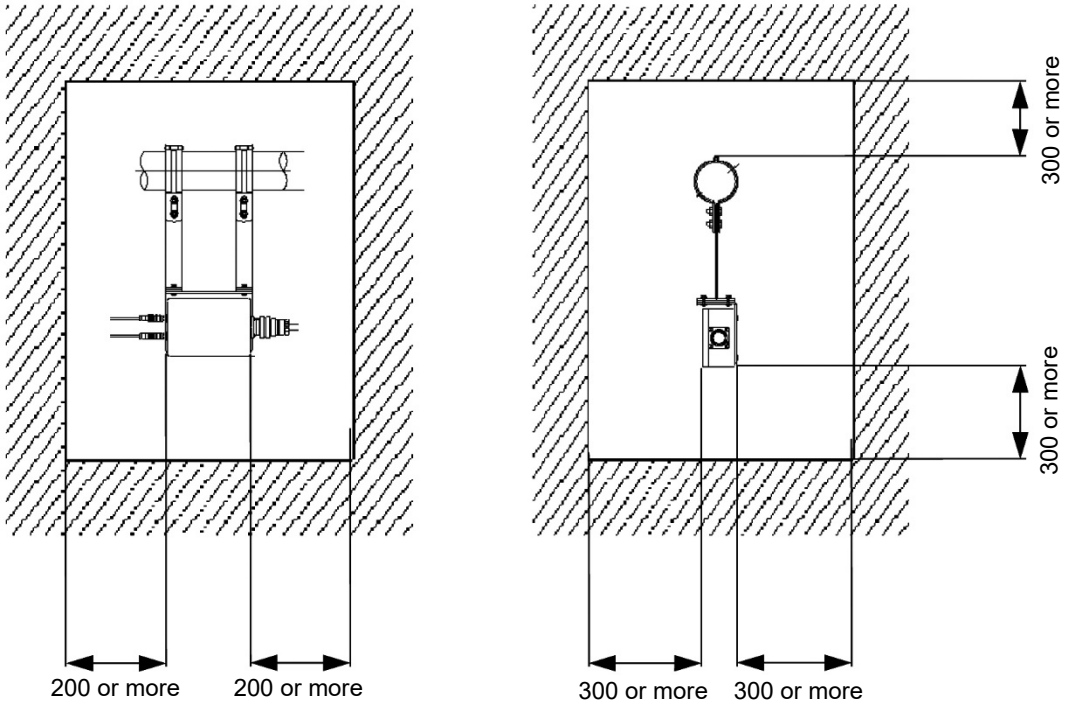


Fig. 5-1 Space required for pre-amplifier unit mounting location

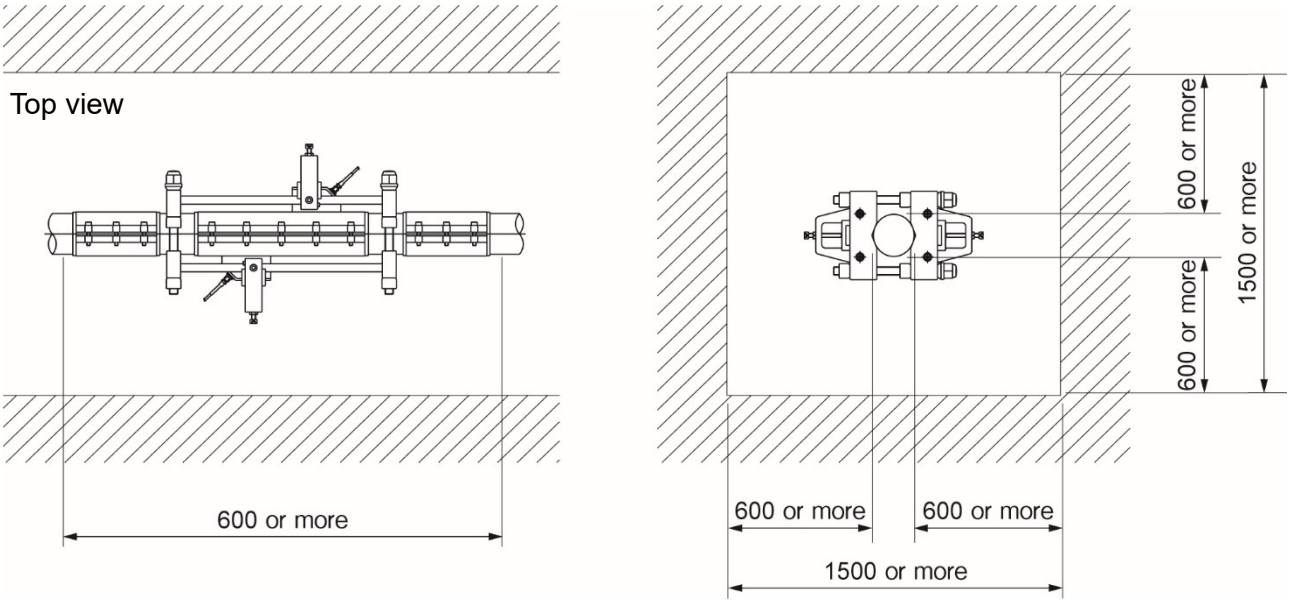
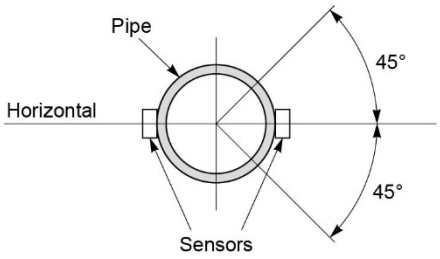


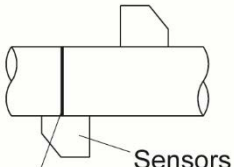
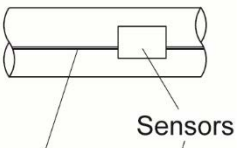
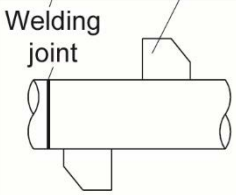
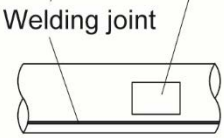
Fig. 5-2 Space required for detector mounting location

CAUTION

① If installing on a horizontal pipe, mount the sensor within ±45° of the center plane.
If installing on a vertical pipe, the sensor may be mounted anywhere on the outer perimeter.

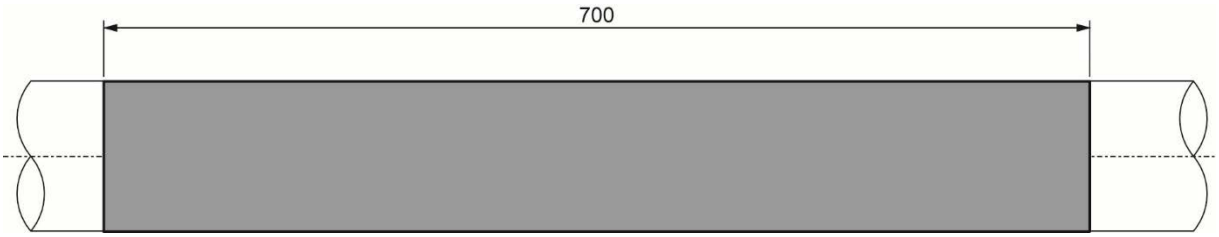


② Do not mount in an area where the pipe is deformed, where there is a flange, or where there are welding joints.

	Radial direction	Axial direction
NG		
OK		

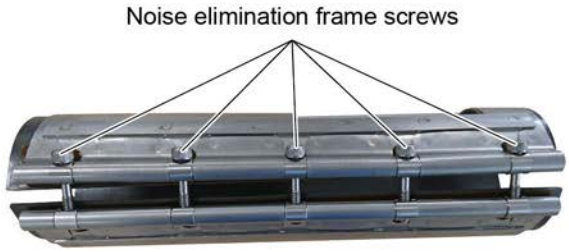
5.3. Treatment of detector mounting surface

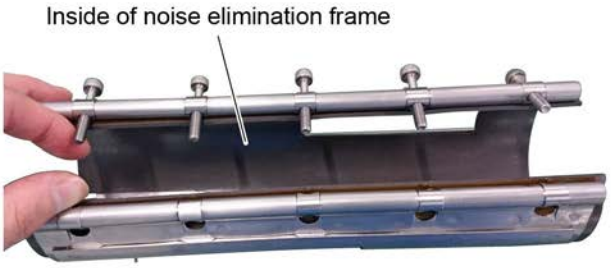
Remove the thermal insulating material, and then remove any pitches, grooves, or unevenness, etc. with solvent or sandpaper over a 700 mm (mounting dimension + 100 mm) area around the part to which the detector and noise elimination frame is to be mounted.



5.4. Mounting the noise elimination frame

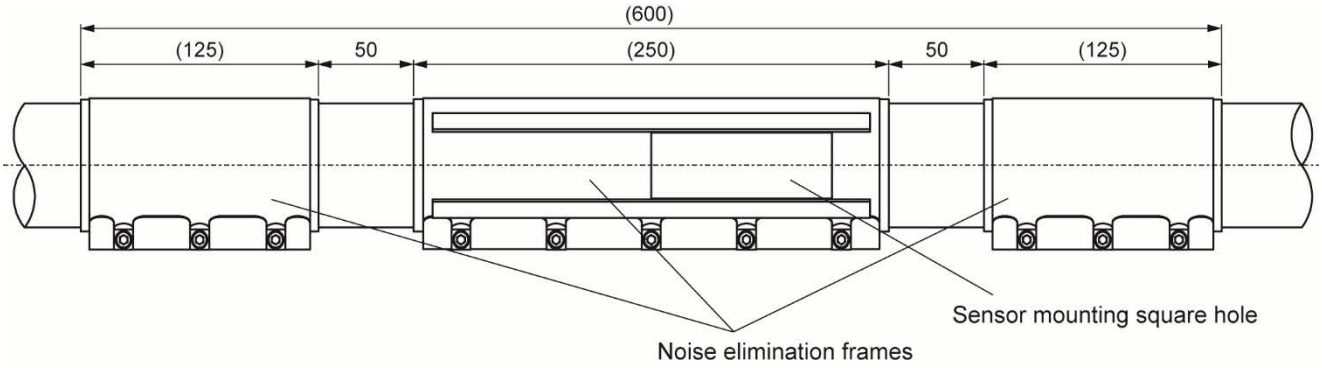
Remove the noise elimination frame screws, and apply acoustic coupler uniformly to the entire surface of the inside of the noise elimination frame.
Check that the noise elimination heat-resisting rubber is not damaged and the double-sided tape is not peeled off.





Mount three noise elimination frames to which acoustic coupler has been applied to the pipe.
Install each noise elimination frame so that there is an interval of 50 mm between them as shown in the following diagram.
After securing the noise elimination frame screws with an Allen wrench, tighten them fully with torque of 1.4 N·m using a torque driver or torque wrench (M5, width across flat of 4 mm).

Note) When it is difficult to tighten the screw, unscrew it and check that it has no foreign substances on and the engagement has no problem. Apply lubricating oil to the screw, and slowly tighten it to prevent it from being jammed.



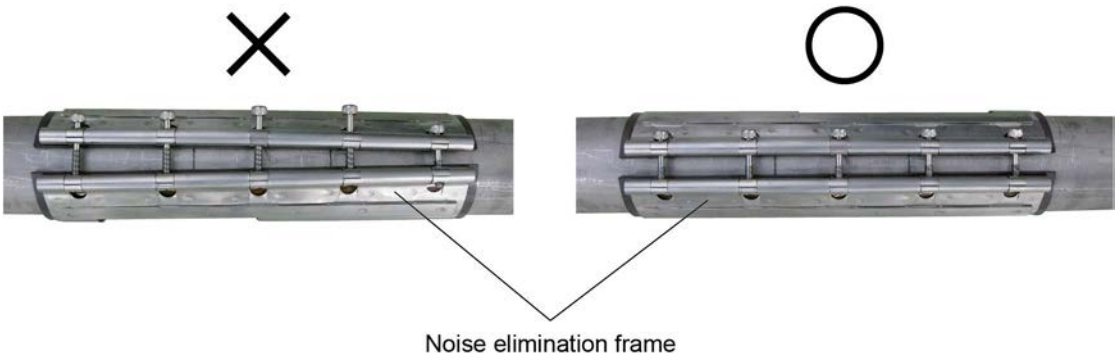
Note) When using high-temperature grease (long-term type), pay attention to the following:
- Use the gloves attached to the product to apply the grease. If the grease gets on your skin, wash it off with plenty of soap and water.
- Before using the product, refer to the grease precautions and safety data sheet attached to the product.
- Reapply the grease if the pipe temperature drops below -15°C when the equipment is shut off for a long time.

Note) Perform the work while making sure that water does not splash on the acoustic coupler.

Note) Store the acoustic coupler indoors in a cool and dark place. Since ultraviolet rays and foreign object contamination may cause deterioration, store it after securely closing the lid.

Note) Tighten all screws uniformly. If screws are overtightened at one particular location only, the noise elimination frame may become deformed, it may not be possible to obtain sufficient noise elimination benefit, and a measurement error may occur.

Note) Wipe any protruding acoustic coupler with a cleaning cloth, etc.



5.5. Sensor mounting bracket mounting

Remove the four securing nuts, and separate the sensor mounting bracket into two.

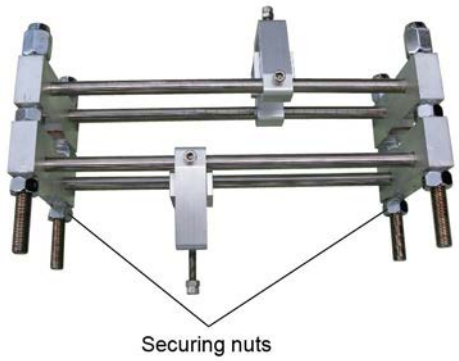


Fig. 5-3 When sensor mounting bracket delivered

Fig. 5-4 Sensor mounting bracket separated

Align the scale directions on the sensor mounting bracket, mount the bracket on the pipe so that the holder is at the front of the noise elimination frame square hole, and then tighten the nuts with a spanner to secure.

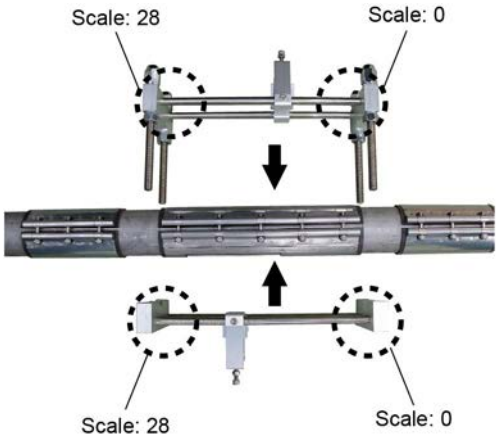


Fig. 5-5 Sensor mounting bracket scale direction alignment

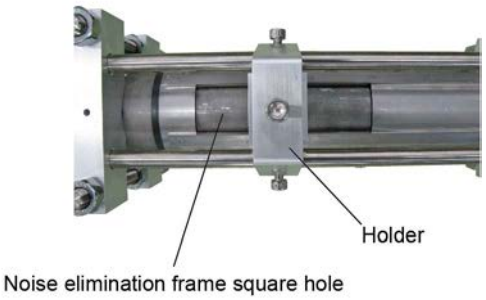


Fig. 5-6 Noise elimination frame holder positioning

Mount the sensor on the sensor mounting bracket holder, press it against the pipe, and ensure that the sensor is not in contact with the noise elimination frame. If the sensor is in contact with the noise elimination frame, loosen the sensor mounting bracket nuts, and adjust the position of the sensor mounting bracket so that the sensor is not in contact with the noise elimination frame.

After confirming that the sensor is not in contact with the noise elimination frame, tighten the nuts with the spanner to secure.

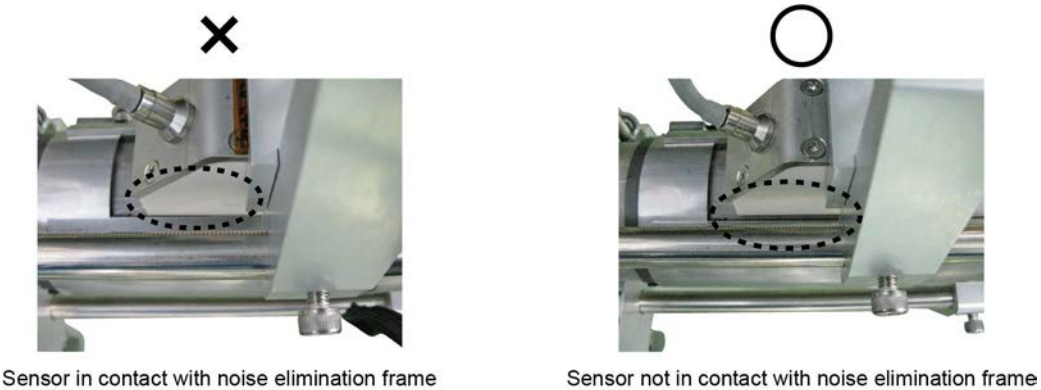


Fig. 5-7 Sensor mounting position

5.6. Sensor mounting

Apply acoustic coupler to the sensor transmission surface.
Mount the sensor with “+” tag on the upstream side of the sensor mounting bracket, and mount the sensor with “-” tag on the downstream side of the sensor mounting bracket.
After fitting the V-groove in the sensor to the sensor mounting bracket holder pin, tighten the screws, and press the sensors against the pipe. After tightening the screws with torque of 2 N·m using a hexagonal torque wrench (M6 screw, width across flat of 5 mm), secure with the lock nuts.

Note) When using high-temperature grease (long-term type), pay attention to the following:
- Use the gloves attached to the product to apply the grease. If the grease gets on your skin, wash it off with plenty of soap and water.
- Before using the product, refer to the grease precautions and safety data sheet attached to the product.
- Reapply the grease if the pipe temperature drops below -15°C when the equipment is shut off for a long time.

Note) Perform the work while making sure that water does not splash on the acoustic coupler.
Note) Store the acoustic coupler indoors in a cool and dark place. Since ultraviolet rays and foreign object contamination may cause deterioration, store it after securely closing the lid.

Fig. 5-8 Acoustic coupler application

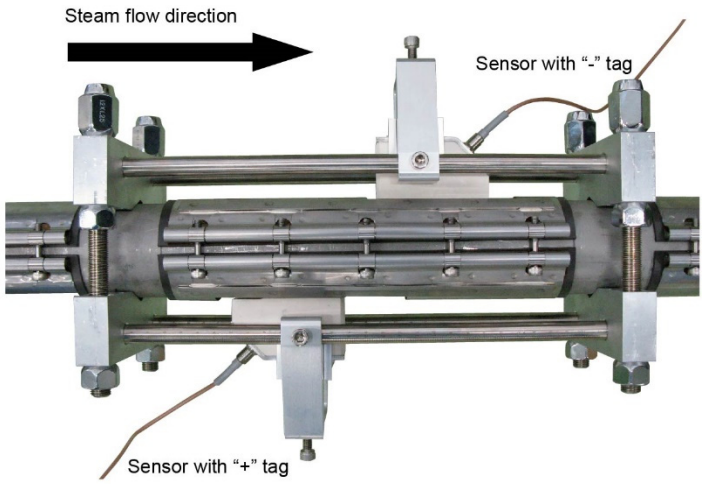


Fig. 5-9 Sensor mounting

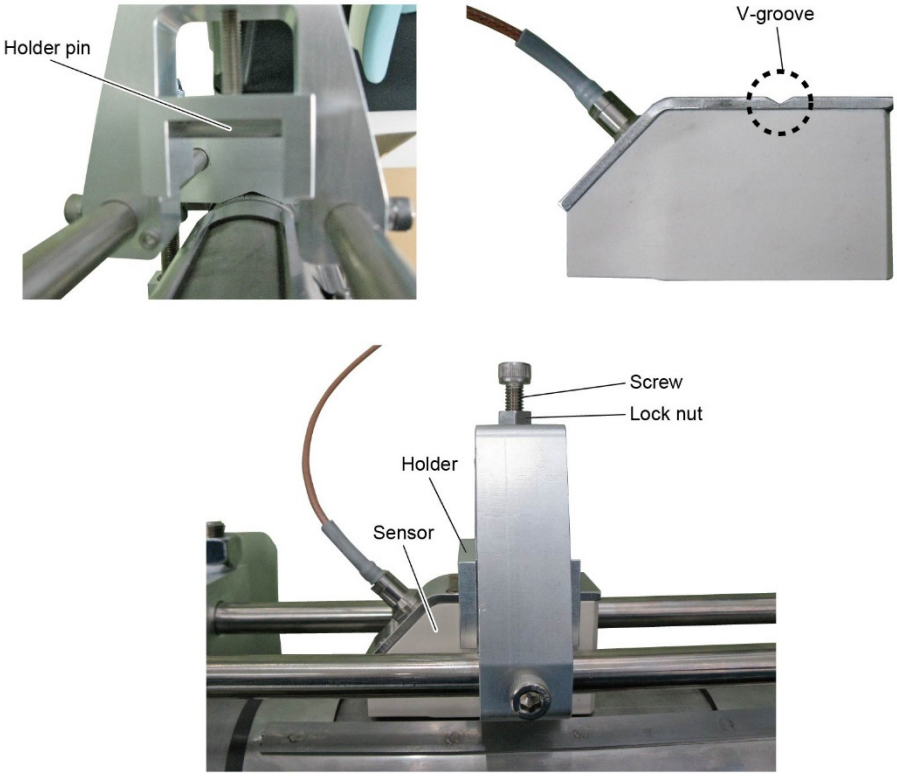


Fig. 5-10 Securing the sensor

5.7. Pre-anplifier mounting

Install the pre-amplifier near the sensor.
Note) The length of the sensor cable between the pre-amplifier unit and sensor unit is 2 m, and therefore the detector should be installed in such a way that connection is possible.
This manual describes the method for installing the pre-amplifier on a 50 A pipe.

Mount the Pre-amplifier mounting bracket on the pre-amplifier.

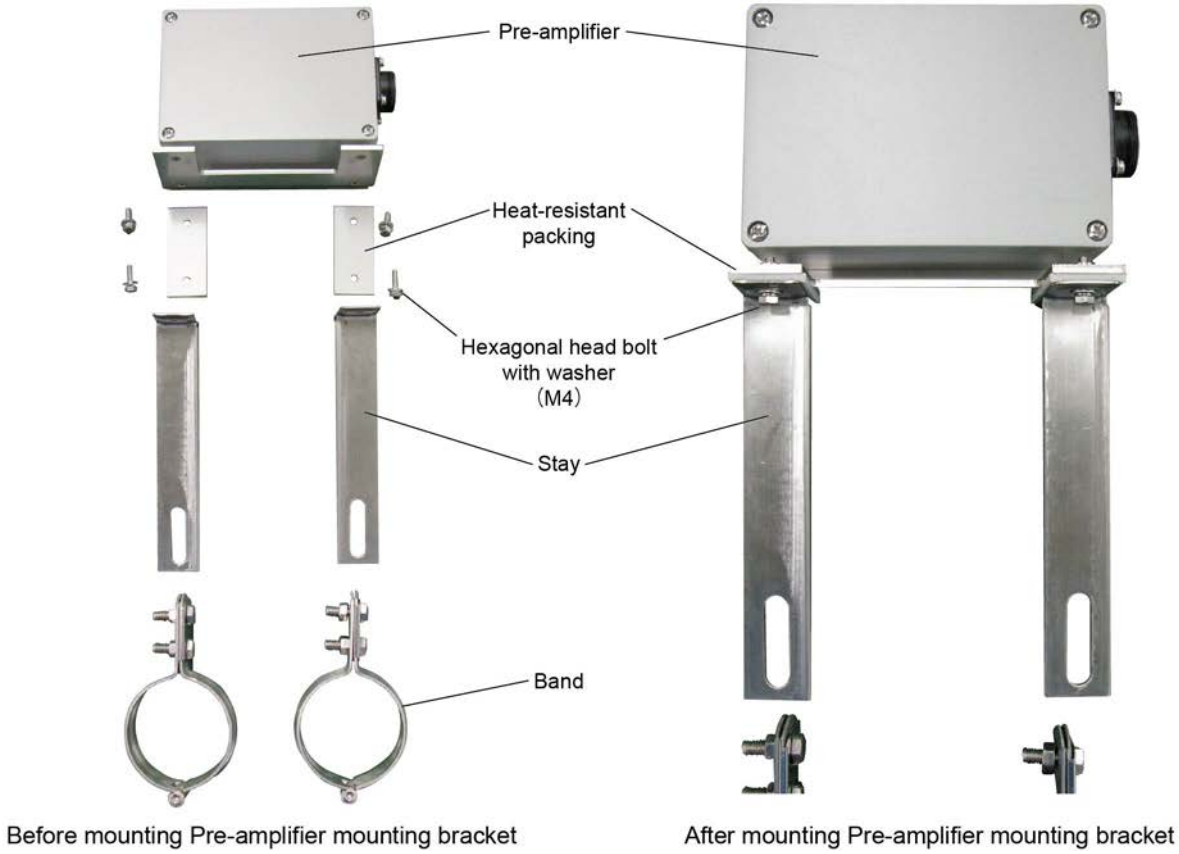


Fig. 5-11 Pre-amplifier mounting bracket mounting

After fitting the bands to the pipe, fit them to the stays, and then tighten the nuts to secure..

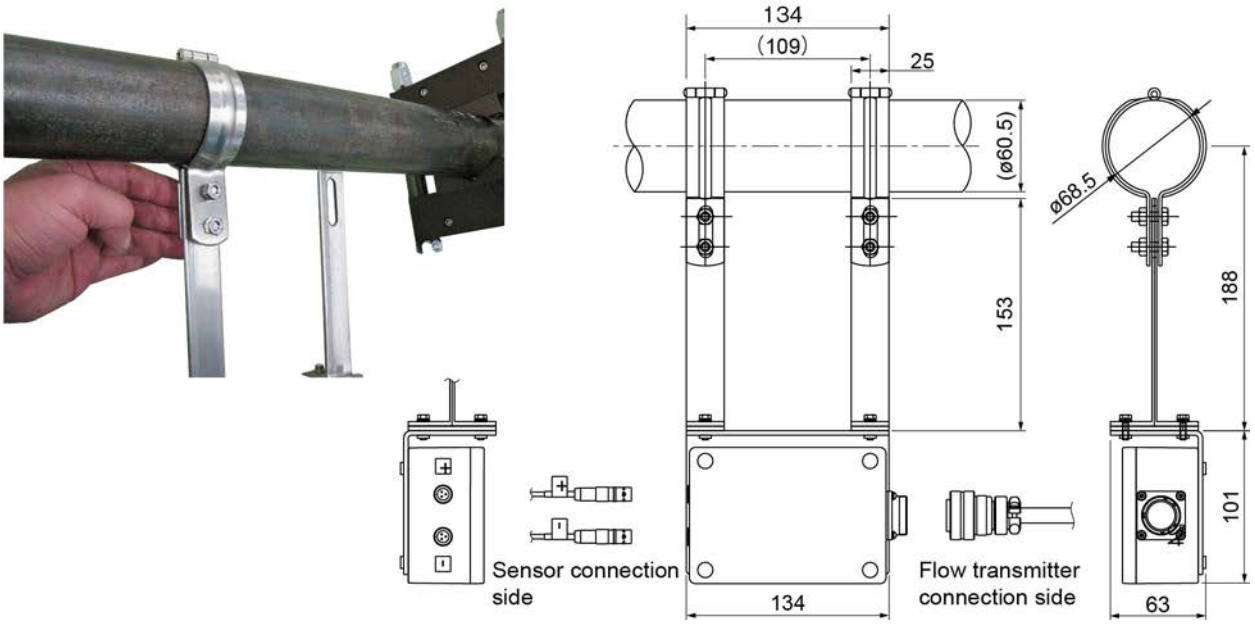
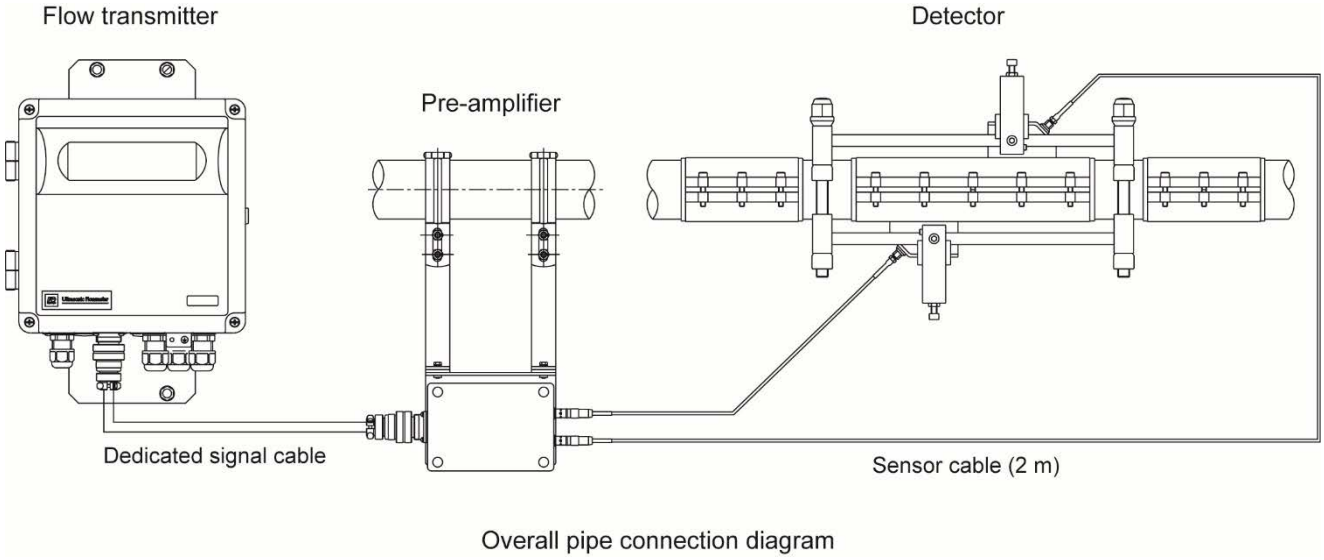


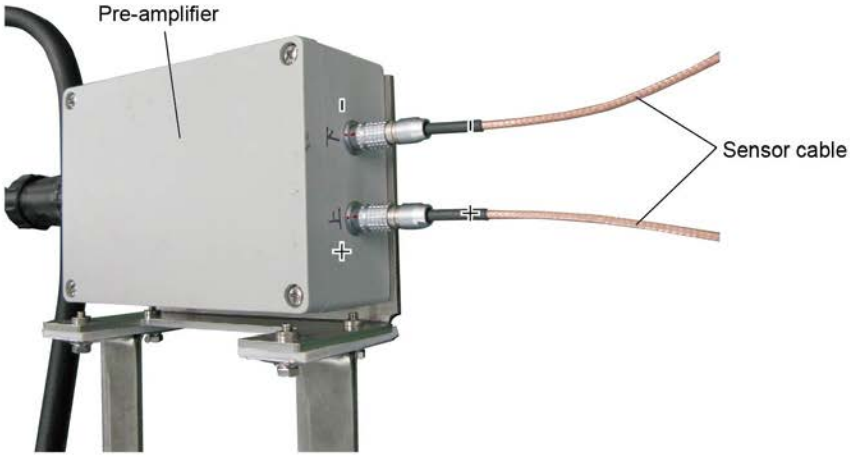
Fig. 5-12 Mounting on pipe

5.8. Wiring connection

Connect the upstream side sensor cable to the pre-amplifier “+” connector, and connect the downstream side sensor cable to the pre-amplifier “-” connector.
Connect the dedicated signal cable to the pre-amplifier and flow transmitter.



Overall pipe connection diagram



Pre-amplifier and sensor cable connection

Insert the dedicated signal cable all the way in, and then tighten the screw.

Pre-amplifier/flow transmitter and dedicated signal cable connection

5.9. Thermal insulating material application

To prevent energy loss or ultrasonic flowmeter measurement trouble due to drainage or condensation, be sure to apply thermal insulating material after mounting the detector to thermally insulate both the pipe and the detector.

CAUTION

① Failure to thermally insulate the detector may expose the detector to the effects of external environmental temperatures, possibly resulting in ultrasonic flowmeter measurement trouble, or preventing measurement accuracy satisfying the values indicated in the specifications.

② If steam flows from an environment at normal temperature, temperature will stabilize, and it will take approximately 10 minutes until normal operation is possible.

5.10. Precautions for removing the noise elimination frame

When removing the noise elimination frame from the piping, forcibly peeling it off may damage the heat-resisting rubber or peel off the double-sided tape between the stainless frame and the heat-resisting rubber. For removal, put in a spatula between the piping and the heat-resisting rubber, and slowly peel off the frame.

If the double-sided tape comes off, purchase a commercialized product “No. 760H #25 (thickness: 0.145 mm, width: 20 mm)” (manufactured by TERAOKA SEISAKUSHO CO., LTD.).

Before replacing the double-sided tape, wipe the stainless frame and the heat-resisting rubber with alcohol. Put on the double-sided tape on the heat-resisting rubber, and push out the air under the tape using a spatula.

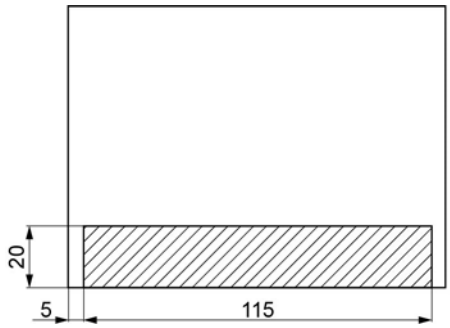


Fig. 5-13 Double-sided tape attachment position (with no opening)

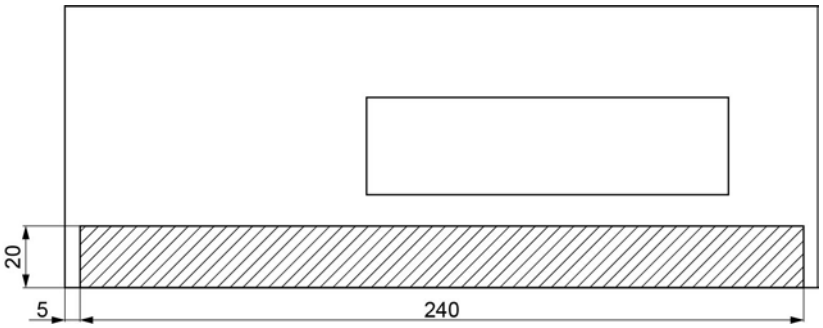


Fig. 5-14 Double-sided tape attachment position (with opening)

Mount the heat-resisting rubber with double-sided tape on to the stainless frame. After mounting the heat-resisting rubber on the stainless frame, mount the noise elimination frame on the piping to firmly stick the double-sided tape.

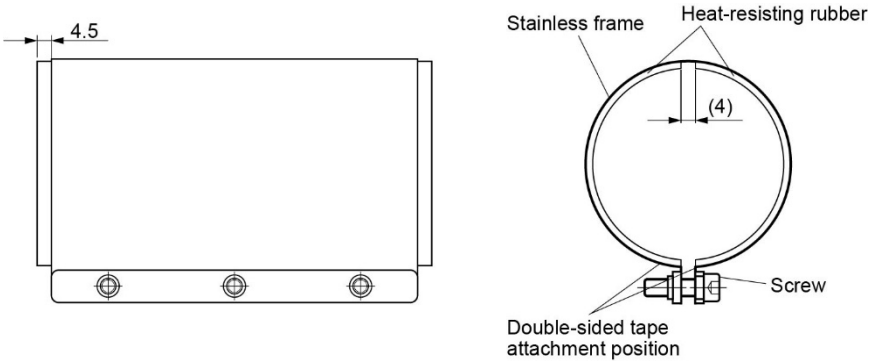


Fig. 5-15 Position for mounting the heat-resisting rubber on the stainless frame (with no opening)

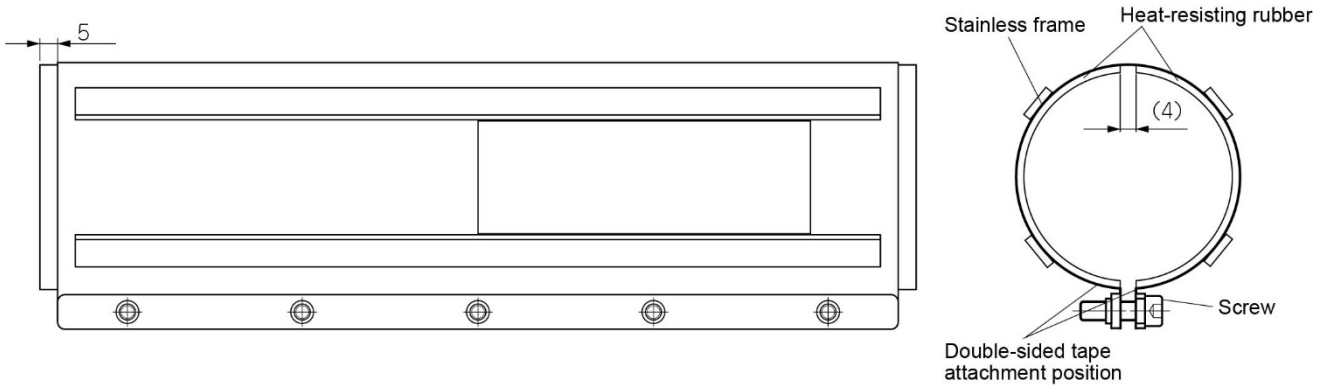


Fig. 5-16 Position for mounting the heat-resisting rubber on the stainless frame (with opening)

If the heat-resisting rubber gets damaged, prepare “Separate items prepared (consumables)” on the data sheet.

6. CHECK AND MAINTENANCE

6.1. Daily Check

Visually check the following items.

- Whether flow transmitter cover screws are loose. ⇒ Tighten.
- Whether cable glands are loose. ⇒ Tighten.
- Whether the detector stainless steel belt is loose. ⇒ Tighten.
- 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.
  Check at “6.3.1.2 Checking the LED lit in red (1)”.
- Whether temperature is abnormal (LED lit red). ⇒ Check whether the resistance temperature detector is broken, or whether the temperature exceeds the input range.
  Check at “6.3.1.2 Checking the LED lit in red (2)”.
- Is there any dirt or dust on the main unit? ⇒ Dampen a soft cloth with water and wipe it off. The display of the main unit scratches easily. Therefore, be careful when wiping it off.
  Note) Do not clean using volatile substances such as benzine and thinner. The paint may peel off.

6.2. Periodic Inspection

6.2.1. Reapplying grease

If using high-temperature grease as an acoustic coupler, reapply the high-temperature grease to the noise damping frame and sensor unit transmission surface approximately every 6 months for a short-term type and approximately every 2 years for a long-term type.

Note) When using high-temperature grease (long-term type), pay attention to the following:
- Use the gloves attached to the product to apply the grease. If the grease gets on your skin, wash it off with plenty of soap and water.
- Before using the product, refer to the grease precautions and safety data sheet attached to the product.
- Reapply the grease if the pipe temperature drops below -15°C when the equipment is shut off for a long time.

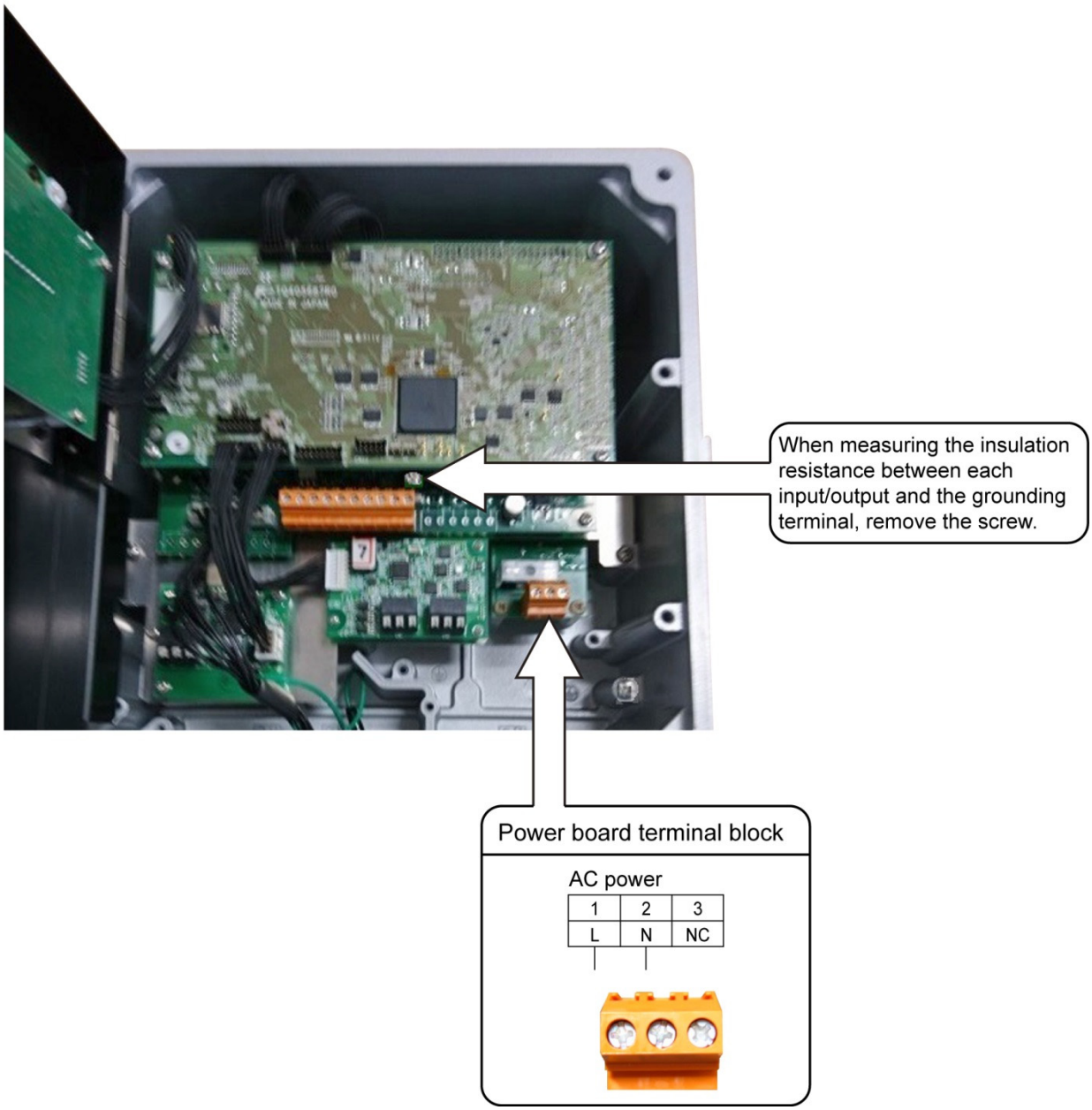
Note) Perform the work while making sure that water does not splash on the acoustic coupler.

Note) Store the acoustic coupler indoors in a cool and dark place. Since ultraviolet rays and foreign object contamination may cause deterioration, store it after securely closing the lid.

6.2.2. How to measure the insulation resistance

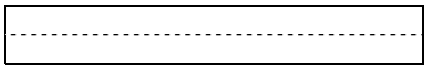
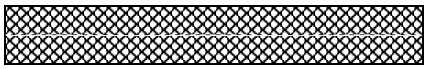
⚠ CAUTION

Be sure to turn OFF the power before opening the flow transmitter cover.
The power terminals are equipped with a varistor as standard, and the analog outputs are equipped with an arrester as standard.
When measuring the insulation resistance between each input/output and the grounding terminal, remove the screw on the upper right of the input/output terminal block as shown in the figure below.
Measurement locations
Between power terminal and ground terminal
Between each input/output and ground terminal
The insulation resistance performance is 100 MΩ/ 500 V DC.
Return the screw on the upper right of the input/output terminal block after testing.



6.3. Error and remedy

6.3.1. Display error

State	Probable cause
 Nothing is displayed.	● Power supply is not turned on. ● Low power supply voltage ● Fuse is blown out. ● Reverse polarity of DC power supply ● Turn the power OFF and then back ON again. → Proceed to "6.3.8.Remedying a hardware fault" if the problem is not resolved.
 Upper side appears black.	● Low power supply voltage ● Reverse polarity of DC power supply ● Turn the power OFF and then back ON again. → Proceed to "6.3.8.Remedying a hardware fault" if the problem is not resolved.
 Irrational display	● Turn the power OFF and then back ON again. → Proceed to "6.3.8.Remedying a hardware fault" if the problem is not resolved.
 Pale display	● Ambient temperature is 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 high (50°C or higher) ⇒ Decrease temperature.
LCD characters are skipped. LED does not come on	● Refer to "6.3.1.1.Checking the LCD/LED" for LCD/LED. The dots on the LCD are missing or the LED does not come on. → Proceed to "6.3.8.Remedying a hardware fault"
LED is displayed in red.	● Check at "6.3.1.2 Checking the LED lit in red".
"SNR ALARM" is displayed.	● Measurement is performed, however, the wave receipt status is poor. → Check at "6.3.5 When "SNR ALARM" is displayed".

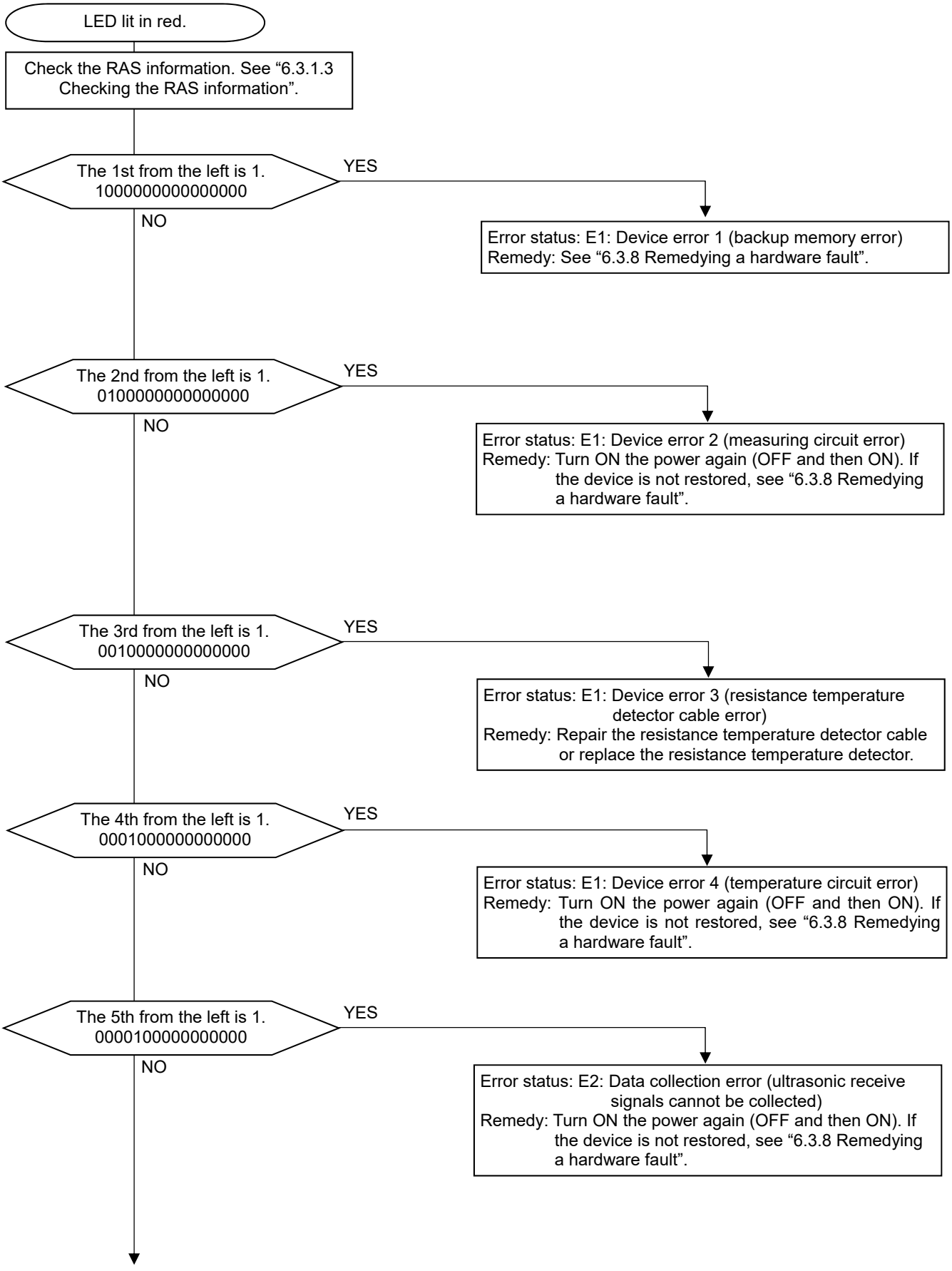
6.3.1.1. Checking the LCD/LED

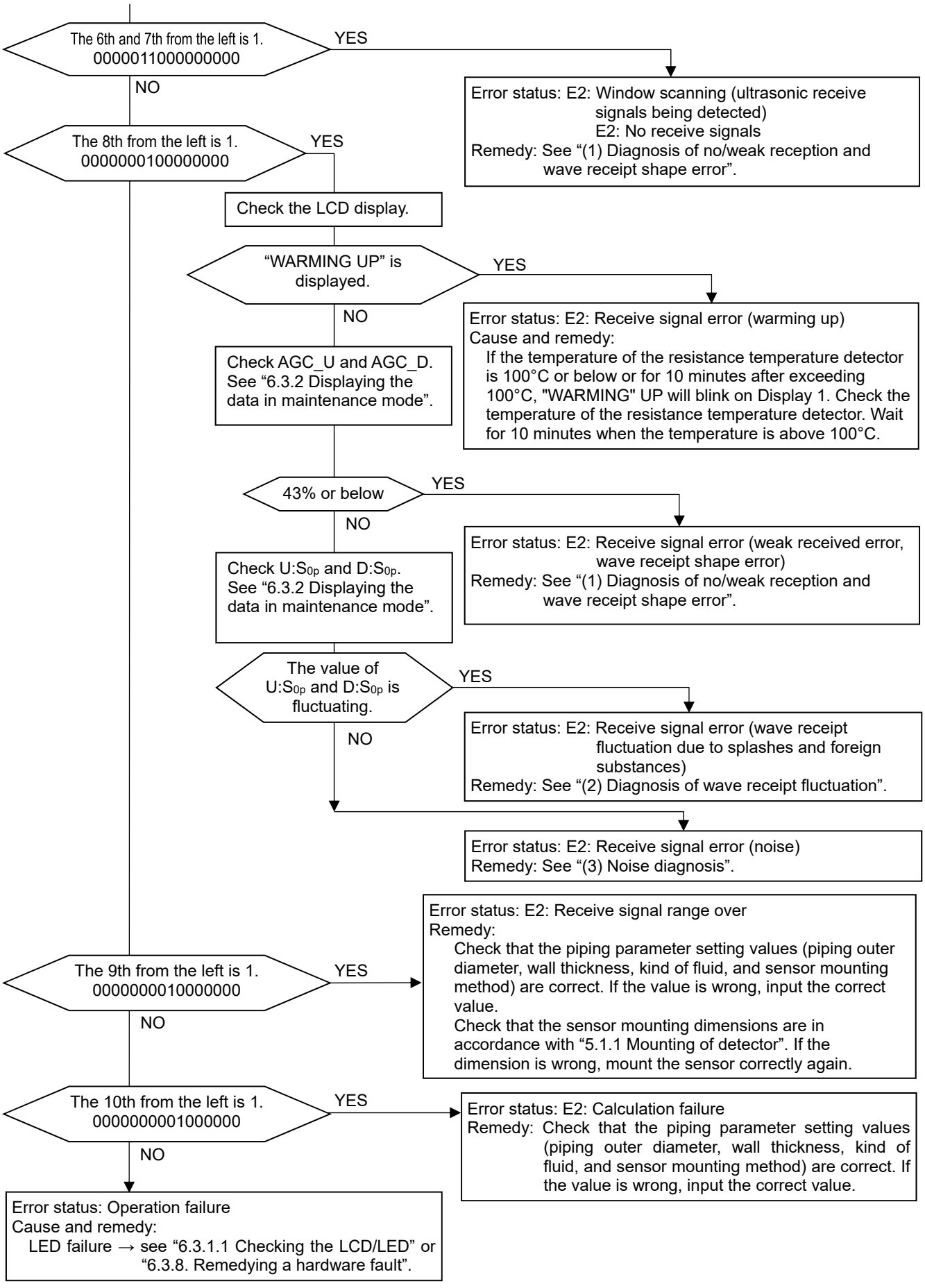
Follow the procedure shown below to check possible display errors.

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".	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 15 times to display "LCD/LED CHECK".	LCD/LED CHECK
ENT ▼	Press the ENT key once.	● ← Lit in red
▷ ▼	Every time the ▷ key is pressed, the display is switched in the order shown below. LCD: OFF completely LED: Lit in green LCD: Darkened LED: Lit in red If dots on the LCD are missing or the LED does not come on, the LCD/LED may have failed.	● ← Lit in green
ESC △	Obtain a measurement-mode display using the ESC key and the △ key.	0.000 m/s 0.000 m3/h

6.3.1.2. Checking the LED lit in red

When the LED is lit in red, follow the check procedure below.




The 6th and 7th from the left is 1.
0000011000000000
YES
NO
Error status: E2: Window scanning (ultrasonic receive signals being detected)
E2: No receive signals
Remedy: See “(1) Diagnosis of no/weak reception and wave receipt shape error”.
The 8th from the left is 1.
0000000100000000
YES
Check the LCD display.
“WARMING UP” is displayed.
YES
NO
Error status: E2: Receive signal error (warming up)
Cause and remedy:
If the temperature of the resistance temperature detector is 100°C or below or for 10 minutes after exceeding 100°C, "WARMING" UP will blink on Display 1. Check the temperature of the resistance temperature detector. Wait for 10 minutes when the temperature is above 100°C.
Check AGC_U and AGC_D.
See “6.3.2 Displaying the data in maintenance mode”.
43% or below
YES
NO
Error status: E2: Receive signal error (weak received error, wave receipt shape error)
Remedy: See “(1) Diagnosis of no/weak reception and wave receipt shape error”.
Check U:S0p and D:S0p.
See “6.3.2 Displaying the data in maintenance mode”.
The value of U:S0p and D:S0p is fluctuating.
YES
NO
Error status: E2: Receive signal error (wave receipt fluctuation due to splashes and foreign substances)
Remedy: See “(2) Diagnosis of wave receipt fluctuation”.
Error status: E2: Receive signal error (noise)
Remedy: See “(3) Noise diagnosis”.
The 9th from the left is 1.
0000000010000000
YES
NO
Error status: E2: Receive signal range over
Remedy:
Check that the piping parameter setting values (piping outer diameter, wall thickness, kind of fluid, and sensor mounting method) are correct. If the value is wrong, input the correct value.
Check that the sensor mounting dimensions are in accordance with “5.1.1 Mounting of detector”. If the dimension is wrong, mount the sensor correctly again.
The 10th from the left is 1.
0000000001000000
YES
NO
Error status: E2: Calculation failure
Remedy: Check that the piping parameter setting values (piping outer diameter, wall thickness, kind of fluid, and sensor mounting method) are correct. If the value is wrong, input the correct value.
Error status: Operation failure
Cause and remedy:
LED failure → see “6.3.1.1 Checking the LCD/LED” or “6.3.8. Remedying a hardware fault”.

(1) Diagnosis of no/weak reception and wave receipt shape error

In the case of no/weak reception or wave receipt shape error, the cause is considered to be a wrong piping parameter setting value, improper installation, problem of fluid/piping, or flowmeter failure. Check the following in order.

Wrong piping parameter setting value

Cause	Remedy
The outer diameter setting value is wrong.	Input the correct value (see “4.6 Checking and Setting of Piping Specifications/Detector”).
The wall thickness setting value is wrong.	
The kind of fluid is not set to steam.	
The sensor mounting method is not set to N method.	
The serviceman parameter has been changed from the factory setting (if the device has been installed by our serviceman).	Ask our serviceman to input the correct value or initialize the memory.

Improper installation

Cause	Remedy
The straight pipe length is below “3.2.1 Conditions on straight pipe”.	Install the device again to a place where the straight pipe length is satisfied.
For horizontal piping, the sensor is not mounted horizontally or within ±45° from the horizontal surface (for vertical pipes, the sensor may be attached to an arbitrary position on the outer perimeter).	Mount the sensor again on a horizontal place or a place within ±45° from the horizontal surface (see “5.2 Selecting the mounting location”).
The sensor is mounted on the welded part of the piping.	Mount it again avoiding the welded part (see “5.2 Selecting the mounting location”).
The sensor is not closely attached to the piping.	Mount the sensor correctly again (see “5.5 Sensor mounting bracket mounting”).
The sensor mounting direction is wrong.	Mount the sensor correctly again (see “5.6 Sensor mounting bracket mounting”).
The sensor mounting dimension is wrong (50, 65, and 80 A are 70 mm, and 100 A is 90 mm).	Mount the sensor correctly again (see “5.1.2 Mounting dimensions diagram”).
The holder pin is not fit to the V-groove of the sensor.	Mount the sensor correctly again (see “5.6 Sensor mounting bracket mounting”).
The bracket of the mounted sensor is tilted.	Mount the sensor mounting bracket again.
Acoustic coupler is not applied to the sensor (and the noise elimination frame), or the acoustic coupler is insufficient.	Mount the sensor correctly again (see “5.6 Sensor mounting bracket mounting”).
The sensor cable is not connected to the pre-amplifier.	Connect the sensor cable to the pre-amplifier again.
The connection of the dedicated signal cable is poor.	Connect the dedicated signal cable again. Insert the dedicated signal cable all the way in, and then tighten the screw (see “5.8 Wiring connection”).
The sensor is not covered with a thermal insulating material. The sensor may be affected by the external environmental temperature, causing measurement failure in some cases.	Keep the temperature of the sensor with a thermal insulating material.

Problem of fluid/piping

Cause	Remedy
Steam temperature out of the specification range Specification range: +120 to 180°C (50 A), +134 to 180°C (65, 80, 100 A)	Install the device again to a place where the temperature specification is satisfied.
Steam pressure out of the specification range Specification range: +0.1 to 0.9 MPa (G) (50 A), +0.2 to 0.9 MPa (G) (65, 80, 100 A)	Install the device again to a place where the pressure specification is satisfied.
Rapid pressure change (0.1 MPa or above in 10 seconds)	Install the device again to a place where there is no rapid pressure change.
Wall thickness not between 2.8 to 4.5 mm For SUS pipes and STPG pipes, the thickness may be out of the specification scope depending on the schedule (see “7.4 Piping data”).	Install the device again to a place where the wall thickness specification is satisfied.
Flow velocity out of the specification range Specification range: 0 to ±50 m/s (50, 65, 80 A), 0 to ±30 m/s (100 A)	Install the device again to a place where the flow velocity specification is satisfied.
Accumulation of drainage When the drainage level in the piping is higher than the sensor mounting position, the sensor does not work.	Discharge the drainage, or mount the detector to a place where there is no drainage accumulation.
Mixing of steam splashes	- Install the device again to a place where there are no splashes. - Cover the upstream piping of the detector and the detector with a thermal insulating material. - Install a steam trap or a separator on the upper side of the detector.
Dew condensation inside piping	Cover the piping and the detector with a thermal insulating material.
Piping material besides SGP, SUS, or STPG	Use SGP, SUS, or STPG pipes.
Uneven piping inner/outer surface due to rust, foreign substances, or accumulated substances	Polish the uneven outer surface of the piping (“5.3 Treatment of detector mounting surface”) with a sandpaper. If the piping inner surface has a possibility of rust, install the device again to a place without a possibility of rust.
Lining piping	Install the device again to piping that is not the lining piping.

Flowmeter failure

Cause	Remedy
Converter circuit failure or detector failure	See “6.3.8 Remedying a hardware fault”.

(2) Diagnosis of wave receipt fluctuation

Splash (foreign material) contamination → If measurement is normal after stopping flow, there is a high possibility of splash (foreign material) contamination, and this must be eliminated.

- Cover the pipe at detector mounting locations, and the detector with thermal insulating material.
- If there are any parts of the upstream pipe with no thermal insulating material, cover those parts with thermal insulating material.
- Relocate the detector to drainage discharge locations (steam traps) and the separator downstream.
- Install drainage discharge locations (steam traps) and a separator at the detector upstream side to eliminate splashes.

(3) Noise diagnosis

Cause	Remedy
Mounting failure of noise elimination frame	Follow the procedure in “5.4 Mounting the noise elimination frame” again.
Connector contact defect	5.8 Carry out Wiring connection over again.
The double-sided tape on the noise elimination frame is peeled off, or the heat-resisting rubber is damaged.	Replace the double-sided tape or prepare/replace the heat-resisting rubber in accordance with “5.10 Precautions for removing the noise elimination frame”.
Noise in power line	Install a noise-cut transformer.
The detector is not grounded, or grounding is insufficient.	Check the external grounding terminal (M4) grounding (Class D) condition described in section 3.4.4 Wiring to each terminal.
If there is noise in the ground line (panel grounding, etc.)	Try disconnecting the ground wire.
The dedicated signal cable is picking up inductive noise.	Separate the dedicated signal cable from the power cable. Use a short, dedicated cable.
The piping outer diameter differs from the specification and the noise elimination frame is not closely attached to the piping. Specification: ø 60.5 mm (50 A), ø 76.3 mm (65 A), ø 89.1 mm (80 A), ø 114.3 mm (100 A)	Check the piping outer diameter. Install the device again to a place where the outer diameter specification is satisfied.

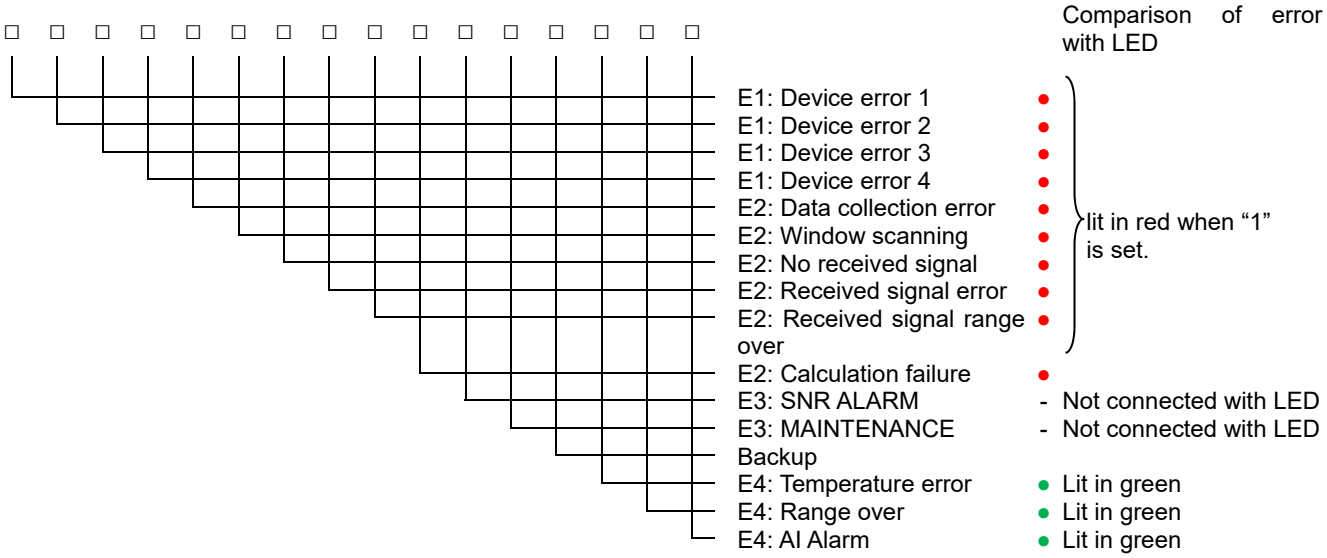
6.3.1.3. Checking the RAS information

When the red LED lights up, check the error contents according to the RAS information.

Key operation	Description	表示
△ ▼ ENT	Press the △ key for 4 times to display “MAINTENANCE MODE”. Press the ENT key once to display “RAS”. 1st ROW displayed in hexadecimal. 2nd ROW displayed in binary.	MAINTENANCE MODE RAS 0000H 0000000000000000

If the display is abnormal, 1 is set.
Move the cursor to 1 by the ▷ key, and press the ENT key to display the status contents. Pressing the ENT key again displays the troubleshooting.

Configuration of the RAS information



RAS information	Status	Troubleshooting
E1, E2	See “6.3.1.2 Checking the LED lit in red”.	
E3: Maintenance	Elapse of maintenance period	Periodic inspection Maintenance resetting
E3: SNR reduction	Reduced sensitivity of ultrasonic waves	Check noise absorption Check for splashes and foreign objects Check pipe data Check detector mounting and cable connection ⇒ Detector mounting position relocation, detector remounting
E4: Temperature error	The fluid temperature is outside the measuring range.	Check that the fluid temperature is not exceeding the measurement range (-45 to 205°C).
E4: Range over	Analog output and total output exceed the range.	Check the range data and the totalize setting.
E4: AI Alarm	The analog input exceeds the range.	Check the analog input and the connection.

Correspondence between DO output and Alarm
“ALL”: An alarm is output if E1: Device error 1, E1: Device error 2, E1: Device error 3, E1: Device error 4, or E2 occurs. “BURNOUT TIMER ENABLE”
“DEVICE ERROR”: An alarm is output if E1: Device error 1, E1: Device error 2, E1: Device error 3, or E1: Device error 4 occurs. “BURNOUT TIMER DISABLE”
“Process error” : Alarm is issued at occurrence of E2. [Burnout timer is enabled]
Burnout timer is to set a time between error occurrence and contact output.

6.3.2. Displaying the data in maintenance mode

Follow the procedure shown below to check possible display errors.

Key operation	Description	表示
△ ▼	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS”.	RAS 0000H 0000000000000000
△ ▼	Press the △ key for 17 times to display “DATA DISPLAY”.	DATA DISPLAY
ENT ▼	Press the ENT key. ● Displays the transit time and the window value calculated from the piping setting.	T0 C: 89 usec WinC: 80 usec
△ ▼	Press the △ key once. ● Displays the measurement value of transit time, T1 (forward time), and T2 (reverse time) from the piping setting.	T1: 0.000 usec T2: 0.000 usec
△ ▼	Press the △ key once. ● Displays the measurement value of average transit time, T0, and transit time difference, DT.	T0: 0.000 usec DT: 0.00 nsec
△ ▼	Press the △ key once. ● Displays the calculated value of pass time of the substances other than fluid, Ta, and angle of incidence of the fluid, θ.	Ta: 0.0000 usec θf: 0.000°
△ ▼	Press the △ key once. ● Displays the calculation value of sound velocity in fluid, Cf, and Reynolds number, Re.	Cf: 0.0 m/s Re: 0
△ ▼	Press the △ key once. ● Displays the analog input pressure AIp and analog input temperature AIt. Displays the calculation value selected with the AI range. (See section 4.10.1)	AIp: 0.0 MPa(G) AIt: 0.0 °C
△ ▼	Press the △ key once. ● Displays the temperature input Pt and density ρ calculation values.	Pt: 0.0 °C ρ: 0.000 kg/m3
△ ▼	Press the △ key once. ● Displays the flow velocity distribution correction coefficient K and flow velocity V1.	K: 1.3333 V1: 0.000 m/s
△ ▼	Press the △ key once. ● Displays flow velocity V2 and flow velocity V3.	V2: 0.000 m/s V3: 0.000 m/s
△ ▼	Press the △ key once. ● Displays the intensity of received signals. The larger the value, the larger the intensity of received signals. Normal measurement values fall in 43% or more. If the display appears as 0%, no signals are being received. It is likely that ultrasonic propagation is not possible due to reasons such as pipe rust.	AGC U: 0.00 % AGC D: 0.00 %
△ ▼	Press the △ key once. Displays receipt signal and noise SNR.	SNR U: 0. 000 dB SNR D: 0. 000 dB
△ ▼	Press the △ key once. Displays the noise peak value.	Nop U: 000 Nop D: 000

△ ▼	Press the △ key once. Displays the receipt signal waveform peak value. During normal measurement, the value is stable in the 5528 to 6758 range. If it fluctuates significantly, or if it gets smaller, there is a possibility that the fluid is contaminated with something such as splashes or foreign material which may cause ultrasonic propagation trouble.	Sop U: 6143 Sop D: 6143
△ ▼	Press the △ key once. ● Displays the detection level value of received signal waveform.	TRG U: 25.00% TRG D: 25.00%
△ ▼	Press the △ key once. Displays the received signal saturation count and measurement model.	OVER: 0 MODEL: LAMB WAVES
△ ▼	Press the △ key once. Displays the measurement value of the window.	Win U: 266 usec Win D: 266 usec
△ ▼	Press the △ key once. Displays transmission frequency fpulse and sampling frequency fsampl.	fpulse: 1000 kHz fsampl: 8000 kHz
▷ △	Use the ▷ key and △ key to display the measurement mode.	

6.3.3. Key error

State	Probable cause
No response is made to key input.	● Hard failure ⇒ Refer to “6.3.8 Remedying a hardware fault”.
Certain key is not responded. Action is not as defined.	

6.3.4. Error in measured value

State	Probable cause	Troubleshooting
The reading appears with "-" (minus).	● Pre-amplifier and sensor cable connection (+ and - are reversed.)	→ Connect properly.
	● Flow of fluid is reversed.	
Measured value fluctuates though flow rate is constant.	● Straight pipe length is inadequate.	→ Move to a location that can secure "3.2.1 Conditions on straight pipe".
	● Pump, valve, or others which disturb the flow are located nearby.	→ Mount the instrument with a clearance of 80D or more.
	● Pulsation exists in flow.	→ Set the damping to increase the response time.
Measured value remains the same though flow rate is changing. (LED lit in red)	See "6.3.1.2 Checking the LED lit in red".	
Error in measured value	● Input piping specifications differ from the actual ones.	→ A difference of 1% in inner diameter causes an error of about 3%. Input the correct specifications. ● Input scale as lining.
	● Insufficient linear pipe length (Refer to "3.2.1 Conditions on straight pipe")	→ Find another mounting place (upstream of disturbing objects). No disturbing objects in flow within 80D upstream without pump, valve, combined pipe, etc. ● Mount the sensor at different angles with respect to the cross section of pipe to fine the location where mean value is obtainable. The mount the sensor at that location.
	● There is a build-up of drainage or solid matter, etc. inside the pipe.	→ There tends to be much build-up at locations with small cross-sectional area. ● Remove the drainage or solid matter, etc., or relocate the sensor to a location with no drainage or solid matter, etc.
	● The detector has not been thermally insulated.	→ The detector will be exposed to the effects of external environmental temperatures, resulting in measurement errors. ● Thermally insulate the pipe to which the detector is mounted, and the detector with thermal insulating material.

6.3.5. When "SNR ALARM" is displayed

Measurement is performed, however, the wave receipt status is poor.

- Monitor the measurement status, and check "6.3.1.2 Checking the LED lit in red" if there are times when the LED turns red.
- Even if the LED does not turn red, it is recommended that you refer to "(1) Diagnosis of no/weak reception and wave receipt shape error in 6.3.1.2 Checking the LED lit in red", and check the flowmeter status.

6.3.6. Error in analog output

State	Probable cause	Troubleshooting
Current output is not matched.	Range setting is wrong.	● Set the range correctly.
Not 4mA when measurement value is 0.	Analog output is misadjusted.	● Perform analog output calibration.
Output is 0mA.	Break of wiring	
Output rises beyond 20mA.	“OVER RANGE” appears on the LCD.	Range over ● Recommence setting of range data of analog output.
The output becomes lower than 4mA.	“UNDER RANGE” appears on the LCD.	Back flow ● Set upper/lower stream properly.
Indication is changed 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.	Hard failure	● Contact manufacturer or service.

6.3.7. Error in input temperature

State	Probable cause	Troubleshooting
“UNDER RANGE” is indicated on LCD display.	Fluid temperature is below -45°C.	Overrange ● Check fluid temperature.
“OVER RANGE” is indicated on LCD display.	Fluid temperature is above 205°C.	Overrange ● Check fluid temperature.
“UNDER RANGE” and “-210°C” are indicated.	Break of resistance bulb	● Repair the cable of resistance bulb. ● Replace resistance bulb.
“OVER RANGE” and “892.5°C” are indicated.		
Measured value won’t change in spite of actual temperature change	Hardware failure	● Contact manufacturer or service.

6.3.8. Remedying a hardware fault

If the hardware is found faulty as a result of Section 6.3.1 to section 6.3.8 above, provide specific details to Fuji Electric.

7. APPENDIX

7.1. Specifications

1. General specifications

Measurement principle:
Ultrasonic transit-time difference method

System configuration:
Measurement with flow transmitter (type: FSJ) and detector (type: FSX)
Conversion to mass flow rate with flow transmitter, detector, pressure gauge/thermometer (analog input)

Power supply:
100 to 240 V AC (+10%/-15%), 50/60 Hz

Power consumption:
20 VA or less

Grounding:
Class D grounding with ground resistance of 100 Ω or less

Varistor:
Provided as standard for power supply

Arrester:
Provided as standard for analog output

Signal cable:
2 m (between detector and pre-amplifier)
5 to 30 m (between pre-amplifier and flow transmitter)

Enclosure:
IP67 (with connectors fitting)

Ambient temperature:
-20 to +60°C (when in use)
-20 to +65°C (when stored)
Note) Refer to the 10 pages for "Usage precautions".

Ambient humidity:
95% RH or less

Vibration resistance:
0.5 G, 5 to 200 Hz

Installation environment:
Non-explosion-proof area with no direct sunlight, corrosive gas, or radiant heat

Material:
Flow transmitter: Aluminum alloy
Detector (sensor): Plastic, stainless steel
Detector (sensor mounting bracket): Aluminum alloy, stainless steel
Noise elimination frame: Heat-resistant rubber, stainless steel
Pre-amplifier: Aluminum alloy

Coating:
Flow transmitter: Urethane resin coating
Pre-amplifier: Polyester powder paint

Finish color:
Flow transmitter (front cover): Silver
Flow transmitter (case): Dark silver
Pre-amplifier: Light gray

Weight:
Flow transmitter: 5.5 kg
Detector (excluding preamp): 6.5 kg (50A), 7.5 kg (65A), 8.0 kg (80A), 8.5 kg (100A)
Dedicated cable (10 m): 2.1 kg
Pre-amplifier: 1.5 kg

2. Measurement fluid specifications

Applicable fluid:
Saturated steam

Flow profile:
Fully-developed turbulent or laminar flow in round pipe

Splashing, wetness fraction:
Wetness fraction: 0%, there should be no splashing

Flow rate/flow amount:
Lower limit of measurable range: 0 m/s
Upper limit of measurable range: Refer to Table 1

Pressure:
0.1 MPa (G) to 0.9 MPa (G) (50A)
0.2 MPa (G) to 0.9 MPa (G) (65A, 80A, 100A)
Note) When the pressure changes by 0.1 MPaG or bigger within 10 seconds, it may not be measured.

Temperature:
+120°C to + 180°C (50A)
+134°C to + 180°C (65A, 80A, 100A)

3. Performance

Accuracy:

<Table 2>

Flow rate	50A	65, 80, 100A
10 to 30 m/s	±3.0% of rate	±4.0% of rate
30 to 50 m/s	±5.0% of rate	±5.0% of rate
0 to 10 m/s	±0.3 m/s	±0.4 m/s

Note) They are guaranteed values obtained with our inspection equipment.
Accuracy may be lower, depending on the condition of steam and piping, and the length of straight pipes.
Please refer to "Check Items before Purchase" on Page 10.

Note) Flow rate of 30 to 50 m/s at 100A is out of the measurement range.

Note) The above accuracies are for displayed values and pulse output.
For analog output, ± 0.04mA is to be added to those values (at ambient temperature of 25°C).

Response time:
0.2 s (standard)

Warm-up time:
Starting at the normal temperature, it takes about 10 minutes until the temperature of the detector stabilize after steam begins to flow (this depends on the facilities).
During warm-up, the measurement accuracy might not be satisfied or there may happen output holding.

<Table 1>

Nominal diameter	Inner diameter of SGP [mm]	Upper limit of measurable range										
		Flow rate [m/s]	Mass flow rate [kg/h]									
			Volumetric flow rate [m³/h]	0.1 at [MPa]	0.2 at [MPa]	0.3 at [MPa]	0.4 at [MPa]	0.5 at [MPa]	0.6 at [MPa]	0.7 at [MPa]	0.8 at [MPa]	0.9 at [MPa]
50A	52.9	±50	±396	±450	±656	±858	±1058	±1256	±1453	±1648	±1843	±2037
65A	67.9	±50	±652	–	±1081	±1414	±1743	±2069	±2393	±2715	±3036	±3357
80A	80.7	±50	±921	–	±1526	±1997	±2462	±2923	±3381	±3836	±4289	±4741
100A	105.3	±30	±941	–	±1559	±2040	±2515	±2986	±3453	±3918	±4382	±4844

Note) Values in Table 1 are for SGP. The measurable range of the flow rate varies depending on the inner diameter of pipes.

4. Detector specifications (FSX)

Detector mounting method:
Clamp-on type (mounted externally on pipe)

Pipe size:
50A (outer diameter: ø60.5 mm)
65A (outer diameter: ø76.3 mm)
80A (outer diameter: ø89.1 mm)
100A (outer diameter: ø114.3 mm)

Pipe thickness:
2.8 to 4.5 mm

Pipe material:
Steel, stainless steel
Note) Not applicable to lining pipes

Sensor heat-resistant temperature:
Max. 180°C

5. Flow transmitter specifications (FSJ)

Analog output signals:
4 to 20 mA DC (insulated), 1 point
Allowable load resistance: 600 Ω or less

Analog input signals:
4 to 20 mA DC (insulated), 1 point
Input signals: Saturated steam pressure or saturated steam temperature

Temperature input function:
Pt100: 1 point (for saturated steam temperature or pipe surface temperature)
Measurement range: 100 to 180°C
*Temperature sensor should be prepared separately.

Contact output signals:
Forward total, reverse total, alarms, working range, flow switch, or total switch can be allocated as required.
- Type: Transistor output, open collector output (insulated)
- Load rating: 30 V DC, 50 mA
- Number of output points: 2 points
- Max. output frequency: 100 pulses per second

Communication function:
- RS-485 (Modbus specification, insulated)
  No. of connectable modules: Up to 31
  Baud rate: 9600, 19200, 38400 bps
  Parity: None/odd/even, selectable
  Stop bit: 1 or 2 bits, selectable
  Cable length: Up to 1 km
  Data: Instantaneous flow velocity, instantaneous flow rate, total value, etc.

Display device:
LCD with 2 lines of 16 characters and back light
2-color LED (Normal: green, Extraordinary: red)

Indication language:
Japanese (Katakana)/English/French/German/Spanish (changeable)

Flow velocity/flow rate indication:
Numerals: 8 digits (incl. decimal point)
Instantaneous flow velocity, flow rate (volumetric flow rate)
Instantaneous flow velocity indication (minus indication for reverse flow)
Unit:

<Table 3>

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

Instantaneous flow rate (mass flow rate):

<Table 4>

Flow rate	g/s, g/min, g/h, g/d, kg/s, kg/min, kg/h, kg/d, t/s, t/min, t/h, t/d

Mass flow rate conversion:
Conversion from density and volumetric flow rate measurement value to mass flow rate
Density is calculated with either one of the below input
- Density fixed value input
- Saturated steam pressure AI input value
- Saturated steam temperature AI input value
- Temperature input

Total value indication:
Numerals: 9 digits

<Table 5>

Volumetric flow rate	mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
Mass flow rate	g, kg, t

Pipe connection:
Refer to ordering code in the page 5.

6. Functionality

Self-diagnostic function:
Receiving wave diagnosis, S/N diagnosis, device diagnosis, etc.

Damping:
0 to 100s (every 0.1s) for analog output and flow velocity/flow rate indication

Low flow rate cutoff:
0 to 5m/s in terms of flow velocity

Alarm:
Digital output available for Hardware fault or Process fault

Bi-directional flow measurement:
Bi-directional flow measurement and flow rate summation

Range switching and range setting range:
Single range, automatic 2 ranges, bi-directional range, bi-directional automatic 2 ranges

Troubleshooting function:
Dialog style troubleshooting display

Maintenance function:
Analog output/analog input adjustment and verification
Digital output verification

Burnout:
Analog output: Hold/Overscale/Underscale/Zero selectable
Flow rate total: Hold/Count selectable
Burnout timer: 10 to 900s (every 1s)

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:
2 forward ranges configurable independently
Hysteresis: 0 to 20% of working range
Working range applicable to digital output

Flow switch:
Lower limit, upper limit configurable independently
Digital output available for status at actuated point

Total switch:
Forward total switching point configurable
Digital output available when actuated

Total preset:
Total flow returns to the user-defined preset value every time a user resets the total.

Backup of power failure:
backup by non-volatile memory

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

Physical specifications

Acoustic coupler:

Acoustic coupler is a filling between detector and pipe.
Type of acoustic coupler:

<Table 6>

Type	High-temperature grease (for short-term installation) Name: KS-62M	High-temperature grease (for long-term installation) Name: Moly High Temp Grease
Fluid temperature	-30 to 250°C	-15 to +250°C
Expected lifetime	6 months	2 years

Note) Please contact us when using high-temperature grease (long-term type) outside of Japan.

Signal cable: (between detector and Pre-amplifier):

Structure: Heat-resisting high-frequency coaxial cable
Sheath: Flame-resisting PVC
Outer diameter: ø11.5 mm
Terminal treatment:

<Table 7>

Cable type	FLYE
Terminal to transmited	dedicated
Terminal to detector side	dedicated

External terminal of flow transmitter:

plug terminal (Screw type euro terminal)

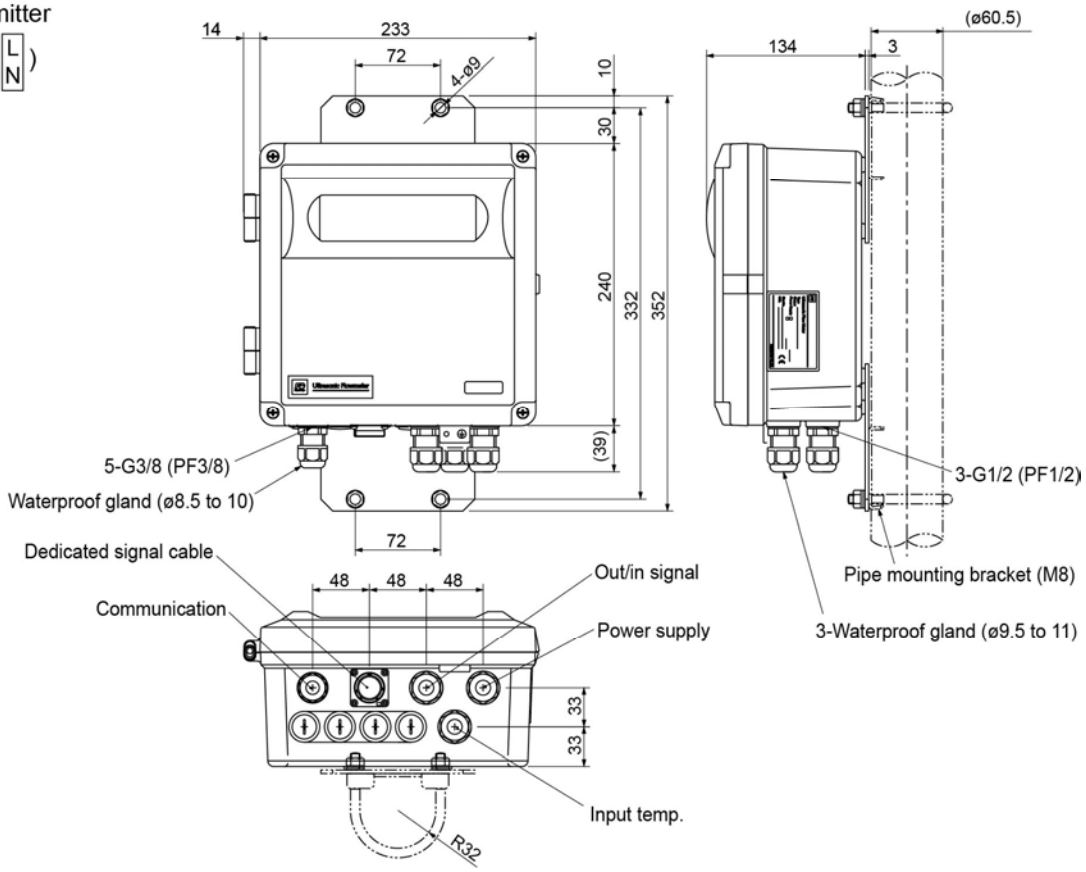
■PC loader software

Provided as standard
• PC/AT compatible computer
• Main functions: Software for displaying and making changes to parameters, for gathering measurement data Instantaneous flow rate, instantaneous flow velocity, total values, and error information, etc. can be imported.
• OS: Windows 8.1 (Professional)/Windows 10 (Enterprise)
Editions in parentheses ( ) indicate versions for which operation has been verified.
• Required memory: 125 MB or more
• Disk drive: Windows 8.1/10 compatible CD-ROM drive
• Hard disk drive capacity: Min. available capacity of 52 MB
Note: Communication converter
For the PC that supports RS-232C serial interface, RS-232C - RS-485 converter is needed for connecting the PC and main unit.
For the PC that does not support RS-232C serial interface, additionally, USB - RS232C converter is also needed.
<Recommendation>
[RS-232C - RS-485 converter]
RC-770X(manufactured by SYSMEX RA)
[USB - RS-232C converter]
USB-CVRS9 (manufactured by SANWA SUPPLY)

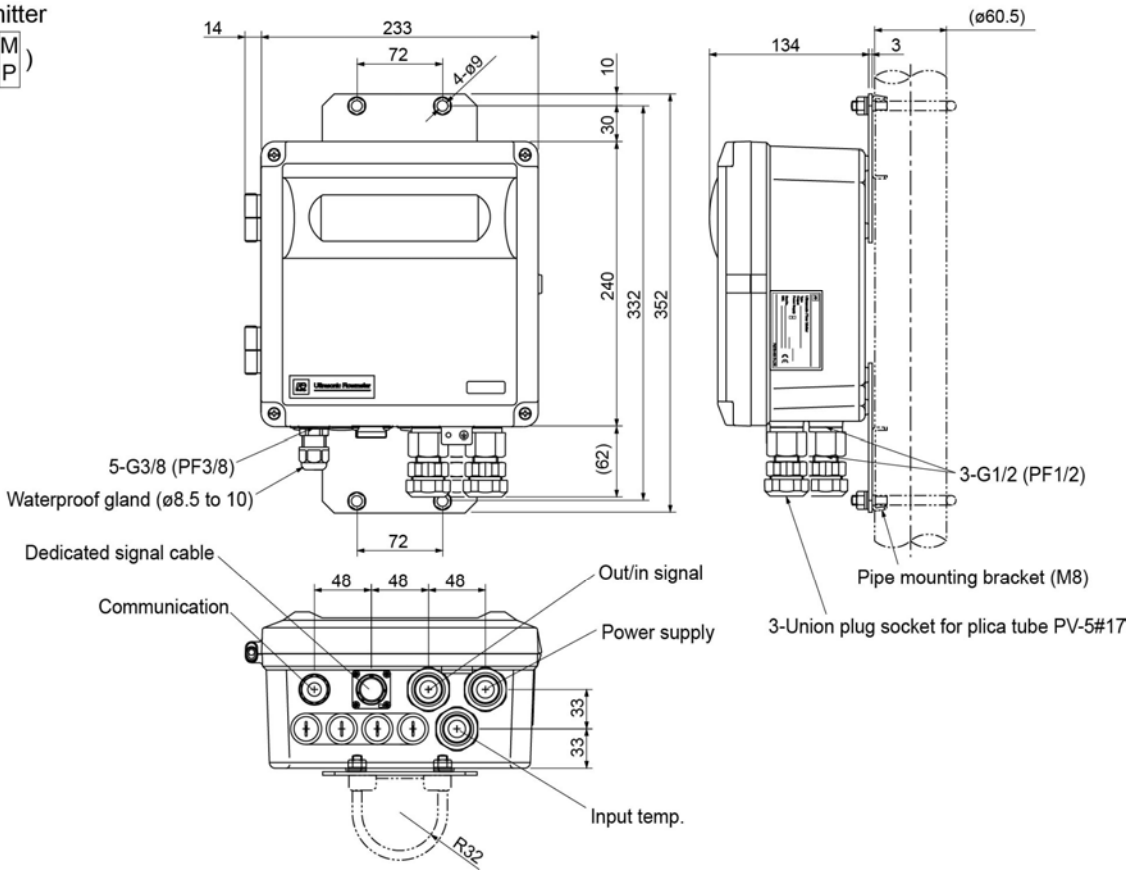
7.2. Outline diagram

OUTLINE DIAGRAM (Unit: mm)

Flow transmitter
(Type: FSJ [L/N])



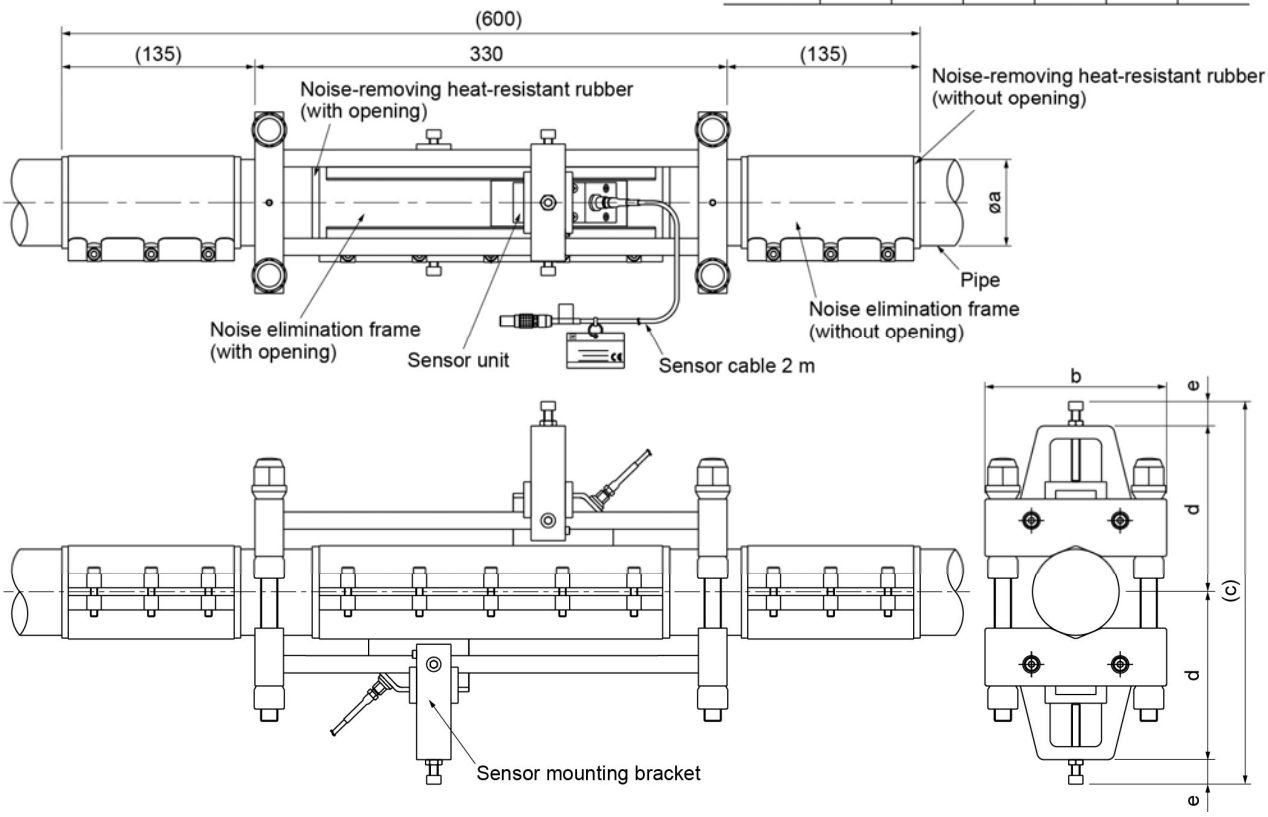
Flow transmitter
(Type: FSJ [M/P])



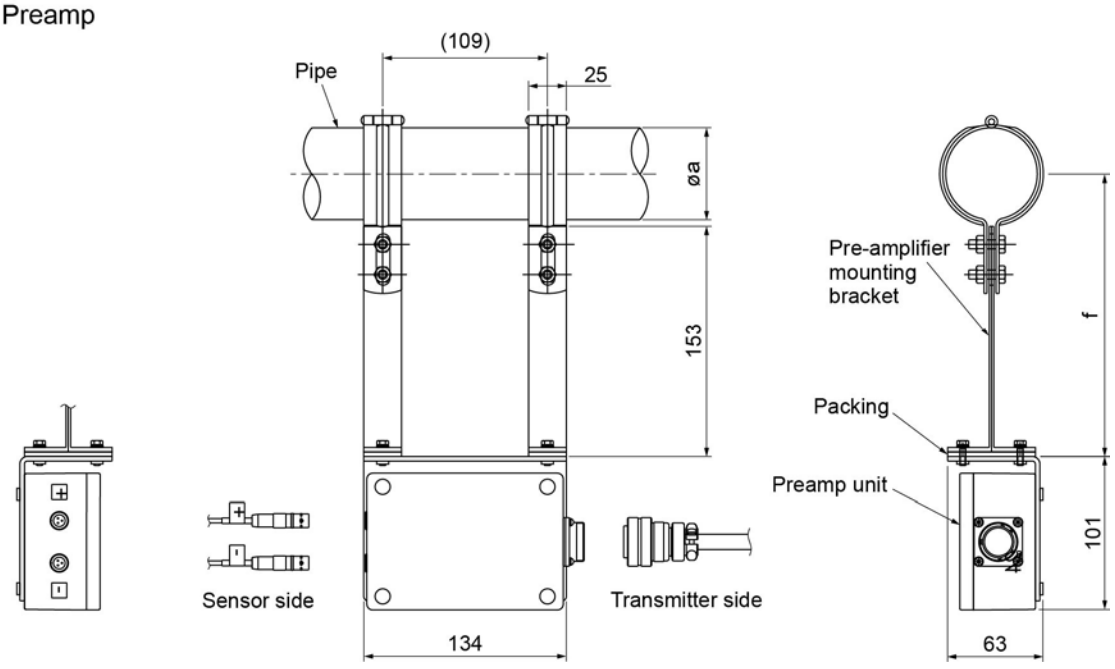
OUTLINE DIAGRAM (Unit: mm)

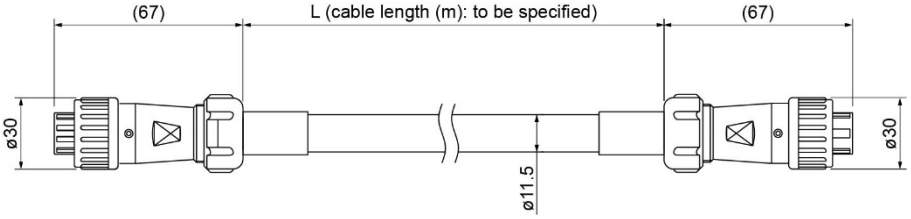
Detector (Type: FSX)

Pipe size	øa	b	c	d	e	f
50A	60.5	127	267	116	17	188
65A	76.3	175	282	124	17	196
80A	89.1	175	295	131	16	202
100A	114.3	175	320	145	16	215



Preamp





7.3. Parameter list

1. Type of detector
2. Type of flow transmitter
3. Type of signal cable
4. Tag No. (When tag plate is specified)
5. Parameter setting list (When parameter setting is specified)

Company name: _____ Branch: _____

Name of the contact person: _____ TEL: _____

Measuring fluid: _____ _____

＜Parameter specification table＞

	Setting unit	Initial value	Setting value	Setting range
1	ID №	0000		
2	LANGUAGE	English		English, Japanese, German, French, Spanish
3	SYSTEM UNIT	Metric		Metric or Inch
4	VOLUME FLOW UNIT	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
5	VOL.TOTAL UNIT	m^3		m^3 mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBB
6	MASS FLOW UNIT	kg/h		g/s, g/min, g/h, g/d, kg/s, kg/min, kg/h, kg/d, t/s, t/min, t/h, t/dL
7	MASS TOTAL UNIT	kg		g, kg, t
8	PRESSURE UNIT	MPa(G)		MPa(G), bar(G) (G:gauge pressure)
9	TEMPERATURE UNIT	°C		°C, K, °F
10	OUTER DIAMETER	60.50 mm		[mm]
11	PIPE MATERIAL	Carbon steel		Carbon steel, Stainless
12	WALL THICKNESS	3.80 mm		[mm]
13	DENSITY	Fixed value 2.667378 kg/m^3		AI Current, Pt TEMPERATURE, Fixed value (DENSITY: [kg/m3])
14	DAMPING	5.0 sec		[sec]
15	LOW FLOW CUT	2.40 m^3/h		[4.UNIT]
16	1ST.ROW	VELOCITY (m/s)		VELOCITY, VOLUME FLOW RATE, VOLUME FLOW (%), MASS FLOW RATE, MASS FLOW (%), +TOTAL (VOLUME), +TOTAL PULSE (V), -TOTAL (VOLUME), -TOTAL PULSE (V), +TOTAL (MASS), +TOTAL PULSE (M), -TOTAL(MASS), -TOTAL PULSE (M), PRESSURE, TEMPERATURE, Pt TEMPERATURE, SNR, AGC
17	DECIMAL POINT POSITION	****.***		□□□□□□□□ (Specified digit check)
18	2ND.ROW	FLOW RATE (m^3/h)		VELOCITY, VOLUME FLOW RATE, VOLUME FLOW (%), MASS FLOW RATE, MASS FLOW (%), +TOTAL (VOLUME), +TOTAL PULSE (V), -TOTAL (VOLUME), -TOTAL PULSE (V), +TOTAL (MASS), +TOTAL PULSE (M), -TOTAL (MASS), -TOTAL PULSE (M), PRESSURE, TEMPERATURE, Pt TEMPERATURE, SNR, AGC
19	DECIMAL POINT POSITION	****.***		□□□□□□□□ (Specified digit check)
20	AO OUT.SOURCE	VOLUME FLOW RATE		VOLUME FLOW RATE, MASS FLOW RATE
21	RANGE TYPE	Single		Single, Auto 2, Bi-dir, Bi-dir Auto 2
22	KIND	Flow rate		Velocity, Flow rate
23	VOLUME FLOW FS1	80.000 m^3/h		[4.UNIT]
24	VOLUME FLOW FS2	0.000 m^3/h		[4.UNIT]
25	MASS FLOW FS1	0.000 kg/h		[6.UNIT]
26	MASS FLOW FS2	0.000 kg/h		[6.UNIT]
27	HYSTERESIS	10.00%		%
28	BURNOUT (CURRENT)	Hold		Not used, Hold, Lower, Upper and Zero
29	BURNOUT TIMER	10 sec		[sec]
30	OUTPUT LIMIT LOW	-20%		[%]
31	OUTPUT LIMIT HIGH	120%		[%]

	Setting unit	Initial value	Setting value	Setting range
32	RATE LIMIT	40.000 m^3/h		[4.UNIT]
33	RATE LIMIT TIMER	1 0 sec		[sec]
34	TOTAL MODE	STOP		START, STOP, TOTAL RESET
35	VolumeTOTAL RATE *Note1	0 m^3		[5.UNIT]
36	V:TOTAL PRESET	0 m^3		[5.UNIT]
37	MASS TOTAL RATE *Note1	0 m^3		[7.UNIT]
38	M:TOTAL PRESET	0 kg		[7.UNIT]
39	PULSE WIDTH *Note1	50.0 msec		5.0 msec, 10.0 msec, 50.0 msec, 100.0 msec, 200.0 msec, 500.0 msec, 1000.0 msec
40	BURNOUT (TOTAL)	Hold		Not used, Hold
41	BURNOUT TIMER	10 sec		[sec]
42	DO1 OUTPUT TYPE	Not used		• +Vol.TOTAL PULSE • -Vol.TOTAL PULSE • +MassTOTAL PULSE • -MassTOTAL PULSE • FULL SCALE 2 (* Note1) • ALARM [ALL, HARDWARE FAULT, PROCESS ERROR] • Vol.FLOW SWITCH • Vol.FLOW SW HIGH [[4.UNIT]] • Vol.FLOW SW LOW [[4.UNIT]] • MassFLOW SWITCH • MassFLOW SW HIGH [[6.UNIT]] • MassFLOW SW LOW [[6.UNIT]] • Vol.TOTAL SWITCH [[5.UNIT]] • MassTOTAL SWITCH [[7.UNIT]] • AO RANGE OVER • PULSE RANGE OVER • -: FLOW DIRECTION • INPUT ALARM • MAINTENANCE
43	DO1 OUTPUT OPERATION	Active ON		Active ON, Active OFF
44	DO2 OUTPUT TYPE	Not used		• +Vol.TOTAL PULSE • -Vol.TOTAL PULSE • +MassTOTAL PULSE • -MassTOTAL PULSE • FULL SCALE 2 (* Note1) • ALARM [ALL, HARDWARE FAULT, PROCESS ERROR] • Vol.FLOW SWITCH • Vol.FLOW SW HIGH [[4.UNIT]] • Vol.FLOW SW LOW [[4.UNIT]] • MassFLOW SWITCH • MassFLOW SW HIGH [[6.UNIT]] • MassFLOW SW LOW [[6.UNIT]] • Vol.TOTAL SWITCH [[5.UNIT]] • MassTOTAL SWITCH [[7.UNIT]] • AO RANGE OVER • PULSE RANGE OVER • -: FLOW DIRECTION • INPUT ALARM • MAINTENANCE
45	DO2 OUTPUT OPERATION	Active ON		Active ON, Active OFF
46	AI RANGE KIND	NOT USED		NOT USED, PRESSURE, TEMPERATURE
47	AI BASE SCALE	0		[8. or 9.UNIT]
48	AI FULL SCALE	0		[8. or 9.UNIT]
49	COMMUNICATION BAUD RATE	38400 bps		9600 bps, 19200 bps, 38400 bps
50	COMMUNICATION PARITY	Odd		None, Odd, Even
51	COMMUNICATION STOP BIT	1 bit		1 bit, 2 bits
52	COMMUNICATION STATION NO.	1		
53	LIGHTS-OUT TIME	0		[min]

Note 1) When selecting "total pulse" for DO1 and DO2, specify the pulse width and total rate so that both of condition 1 and condition 2 indicated below are satisfied.

Condition 1:

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

Condition 2:

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

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

7.4. Piping data

Carbon steel pipes for ordinary piping SGP (JIS G3452-2014）

How to call pipe		Outer diameter	Thickness
(A)	(B)	(mm)	(mm)
15	1/2	21.7	2.8
20	3/4	27.2	2.8
25	1	34.0	3.2
32	1 1/4	42.7	3.5
40	1 1/2	48.6	3.5
50	2	60.5	3.8
65	2 1/2	76.3	4.2
80	3	89.1	4.2
90	3 1/2	101.6	4.2
100	4	114.3	4.5
125	5	139.8	4.5
150	6	165.2	5.0
175	7	190.7	5.3
200	8	216.3	5.8

Carbon steel pipes for pressure service STPG (JIS G3454-2017)

Nominal diameter		Outer diameter mm	Thickness					
			Schedule 10	Schedule 20	Schedule 30	Schedule 40	Schedule 60	Schedule 80
A	B		Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm
15	1/2	21.7	-	-	-	2.8	3.2	3.7
20	3/4	27.2	-	-	-	2.9	3.4	3.9
25	1	34.0	-	-	-	3.4	3.9	4.5
32	1 1/4	42.7	-	-	-	3.6	4.5	4.9
40	1 1/2	48.6	-	-	-	3.7	4.5	5.1
50	2	60.5	-	3.2	-	3.9	4.9	5.5
65	2 1/2	76.3	-	4.5	-	5.2	6.0	7.0
80	3	89.1	-	4.5	-	5.5	6.6	7.6
90	3 1/2	101.6	-	4.5	-	5.7	7.0	8.1
100	4	114.3	-	4.9	-	6.0	7.1	8.6
125	5	139.8	-	5.1	-	6.6	8.1	9.5
150	6	165.2	-	5.5	-	7.1	9.3	11.0
200	8	216.3	-	6.4	7.0	8.2	10.3	12.7

Stainless steel pipe for pipe arrangement SUS-TP (JIS G3459-2016)

Nominal diameter		Outer diameter mm	Thickness						
			Schedule 5S	Schedule 10S	Schedule 20S	Schedule 40	Schedule 80	Schedule 120	Schedule 160
A	B		Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm
15	1/2	21.7	1.65	2.1	2.5	2.8	3.7	-	4.7
20	3/4	27.2	1.65	2.1	2.5	2.9	3.9	-	5.5
25	1	34.0	1.65	2.8	3.0	3.4	4.5	-	6.4
32	1 1/4	42.7	1.65	2.8	3.0	3.6	4.9	-	6.4
40	1 1/2	48.6	1.65	2.8	3.0	3.7	5.1	-	7.1
50	2	60.5	1.65	2.8	3.5	3.9	5.5	-	8.7
65	2 1/2	76.3	2.1	3.0	3.5	5.2	7.0	-	9.5
80	3	89.1	2.1	3.0	4.0	5.5	7.6	-	11.1
90	3 1/2	101.6	2.1	3.0	4.0	5.7	8.1	-	12.7
100	4	114.3	2.1	3.0	4.0	6.0	8.6	11.1	13.5
125	5	139.8	2.8	3.4	5.0	6.6	9.5	12.7	15.9
150	6	165.2	2.8	3.4	5.0	7.1	11.0	14.3	18.2
200	8	216.3	2.8	4.0	6.5	8.2	12.7	18.2	23.0

Stainless steel pipe for pipe arrangement welded pipe (JIS G3459-2016)

Nominal diameter		Outer diameter mm	Thickness				
			Schedule 5S	Schedule 10S	Schedule 20S	Schedule 40	Schedule 80
A	B		Thickness mm	Thickness mm	Thickness mm	Thickness mm	Thickness mm
15	1/2	21.7	1.5	2.0	2.5	3.0	3.5
20	3/4	27.2	1.5	2.0	2.5	3.0	4.0
25	1	34.0	2.0	2.5	3.0	3.5	4.5
32	1 1/4	42.7	2.0	3.0	3.0	3.5	5.0
40	1 1/2	48.6	2.0	3.0	3.0	4.0	5.0
50	2	60.5	2.0	3.0	3.5	4.0	5.5
65	2 1/2	76.3	2.0	3.0	3.5	5.0	7.0
80	3	89.1	2.0	3.0	4.0	5.5	8.0
90	3 1/2	101.6	2.5	3.0	4.0	6.0	8.0
100	4	114.3	2.5	3.0	4.0	6.0	9.0
125	5	139.8	3.0	3.5	5.0	7.0	10.0
150	6	165.2	3.0	3.5	5.0	7.0	12.0
200	8	216.3	3.0	4.0	6.5	8.0	13.0

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