Fuji Electric

Instruction Manual

ULTRASONIC FLOWMETER
FLOW TRANSMITTER
<ADVANCED TYPE>

TYPE: FSV-2

INF-TN2FSVLa-E Fuji Electric Co., Ltd.

PREFACE

We thank you very much for purchasing Fuji Electric's ultrasonic flow meter.
The instruction manual concerns the installation, operation, checkup, and maintenance of the Flow transmitter (FSV) of ultrasonic flow meter. Read it carefully before operation.

- 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

Note

Issued in September., 2013
Rev. 1st edition Jun., 2016

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.

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

Caution on mounting and piping

⚠ DANGER

- This unit is not explosion-proof type. Do not use it in a place with explosive gases. Otherwise, it may result in serious accidents such as explosion, fire, etc.

⚠ CAUTION

- The unit should be installed in a place conforming to the installation requirements noted in this instruction manual. Otherwise, it may cause electric shocks, fire, or malfunction of the unit.
- 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.

Cautions in wiring

⚠ CAUTION

- When performing wiring termination to prevent output trouble caused by moisture, dew condensation, or water leak, follow “Section 3.3. 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.
- The signal cable and analog output signal cable should be wired as far away as possible from high-voltage lines to prevent entry of noise signals as it will cause malfunction of the unit.
- To prevent malfunction of the unit, the analog output signal cable and power cable should be wired using separate 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 6.2.3. How to measure the insulation resistance” described in this manual.
- If the fuse is blown, detect and eliminate the cause, and then replace the fuse with a spare. If there are no spares, replace the fuse with the one specified in this manual “Section 6.3. How to replace the fuse ” (that must be acquired separately). Use of a fuse other than specified or its short-circuit may cause an electric shock or fire. The fuse should be replaced according to “Section 6.3. How to replace the fuse” described in this manual.

CAUTION ON INSTALLATION LOCATION

⚠ CAUTION

(1) A place that provides enough space for periodic inspection and wiring work.
(2) A place not exposed to direct sunshine nor inclement weather.
(3) A place free from excessive vibration, dust, dirt, and moisture.
(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 remote from electrical devices (motor, transformer, etc.) which generate electromagnetic induction noise, electrostatic noise, etc.
(8) A place not subjected to excessive fluid pulsation such as pump discharge side.
(9) A place that provides enough place for the length of the straight pipe.
(10) A place where ambient temperature and humidity are -20 to +55°C and 95% RH or less for flow transmitter (FSV).

Contents

1. PRODUCT OUTLINE

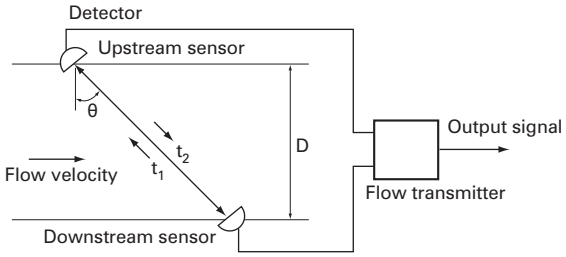
1.1. Overview

This flowmeter is a clamp-on type ultrasonic flow meter based on transit-time measuring method. Making full use of the latest electronics and digital signal processing technologies, the flowmeter is designed for 2-path system capable of simultaneously measuring 2 pipes, and energy calculation by connecting with temperature sensor, while keeping with the resistance to air bubbles. It is an effective solution for measurement and management of the energy used in energy-saving systems such as heating and air conditioning applications.

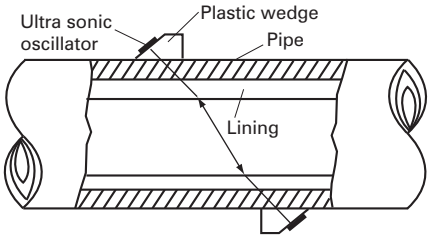
1.1.1. Measuring principle

Measuring principle

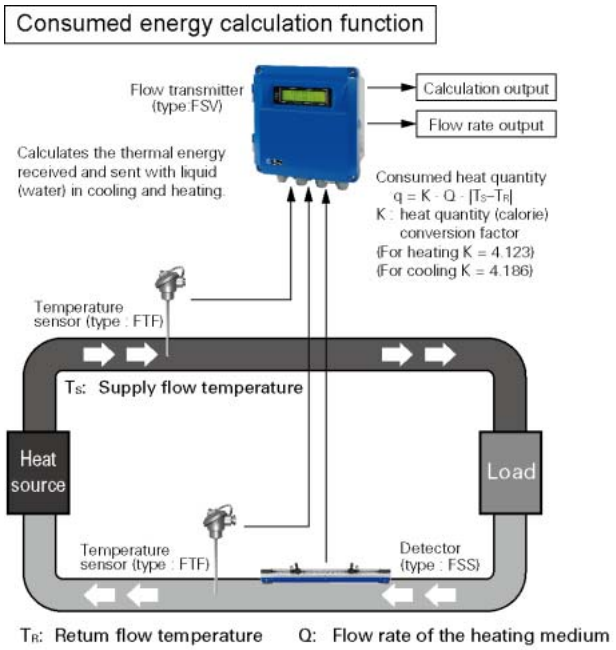
Ultrasonic flowmeter measures a flow rate by detecting the time difference of ultrasonic pulses propagating diagonally from the upstream side and downstream side.

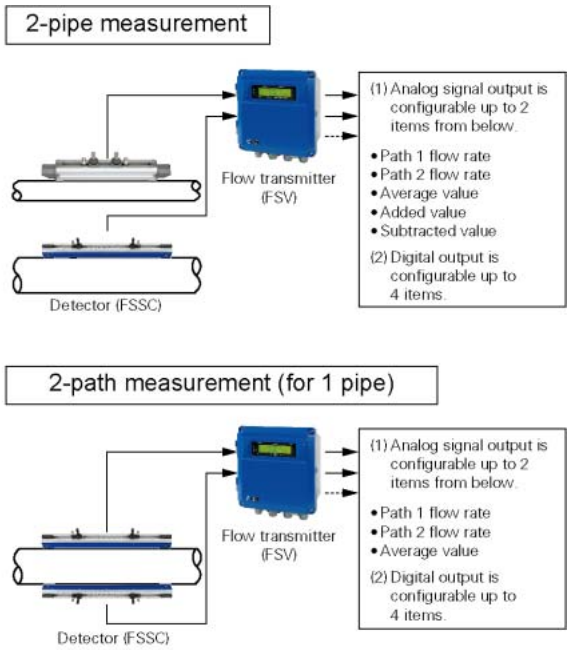


Mounting of detector



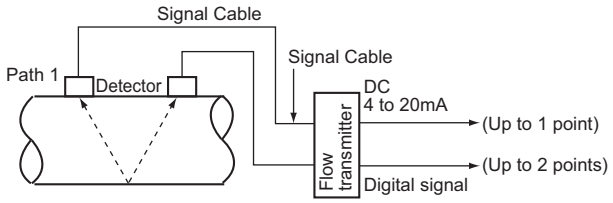
Function diagram



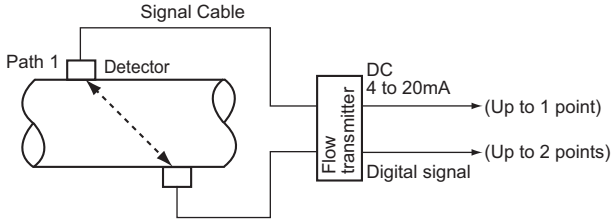


Configuration diagram

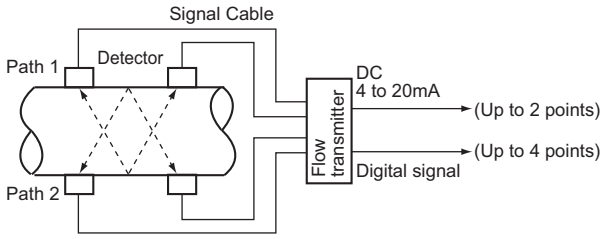
(1) Single path system (V method)



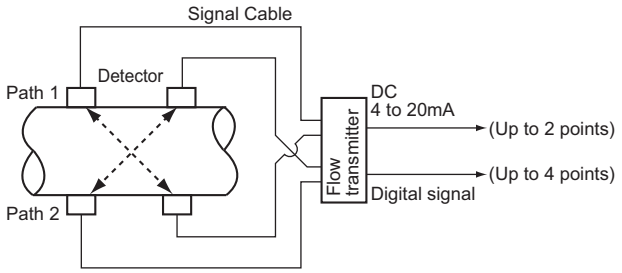
(2) Single path system (Z method)



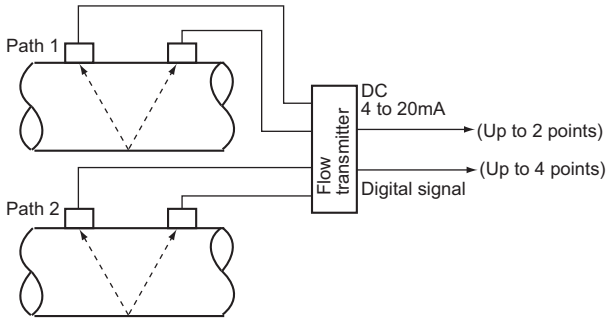
(3) 2-path system (V method)



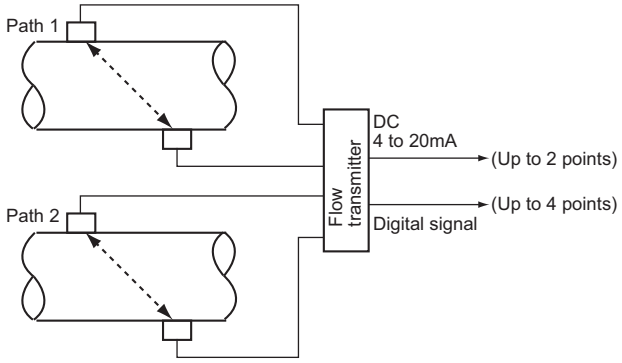
(4) 2-path system (Z method)



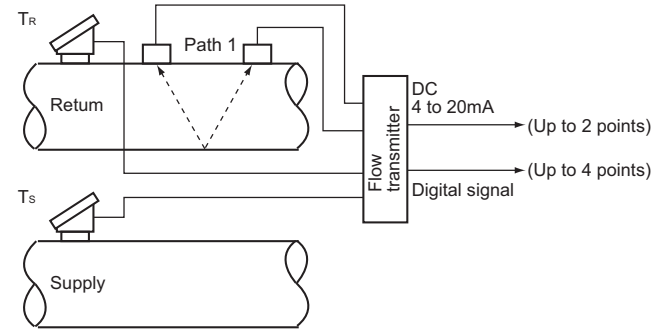
(5) 2-pipe system (V method)



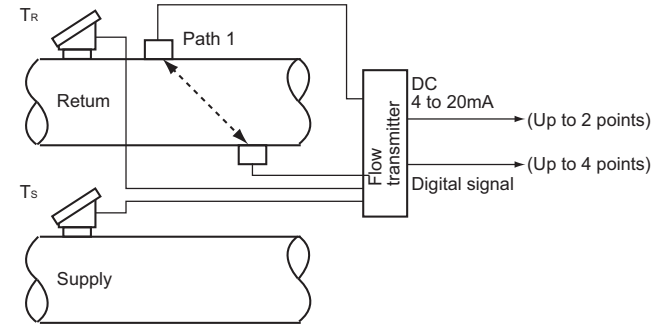
(6) 2-pipe system (Z method)



(7) Energy measurement (V method)



(8) Energy measurement (Z method)



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 (FSV)
- 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)
  (U bolt, nut 2 pieces, spring washer 2 pieces,
  plain washer 2 pieces) ····· 2 sets
- Ferrite core·····2 pieces (only for energy mesurement)

Detector (FSS) and signal cable (FLY)
- ■2-path version ·····2 sets
- ■2-pipe version·····2 sets
- ■1-path/ energy measurement version ·····1 set

Provided with acoustic coupler and set of the mounting belt according to specified code of symbol
For FSSE, a signal cable (15cm) is provided additionally.
For details on delivered items of detector, refer to the instruction manual for ultrasonic flowmeter detector.

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

Out of delivery
- Power cable
- Output signal cable
- RS-485 communication cable
- Resistance bulb (Pt100, 3-wire)

Flow transmitter (FSV)

FSV···L（IP67）

Pipe mounting bracket (option)

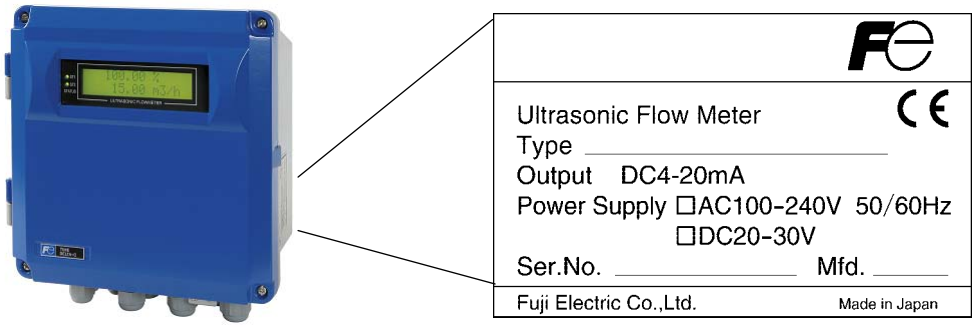
1.3. Check on type and specifications

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.

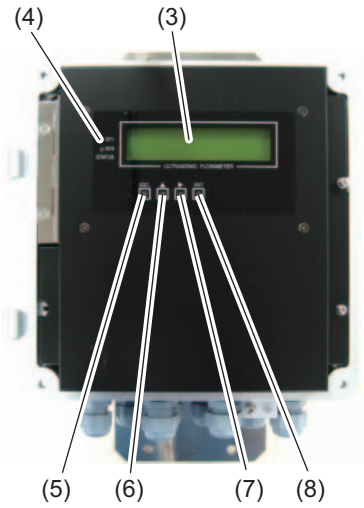
<Flow transmitter (FSV)>

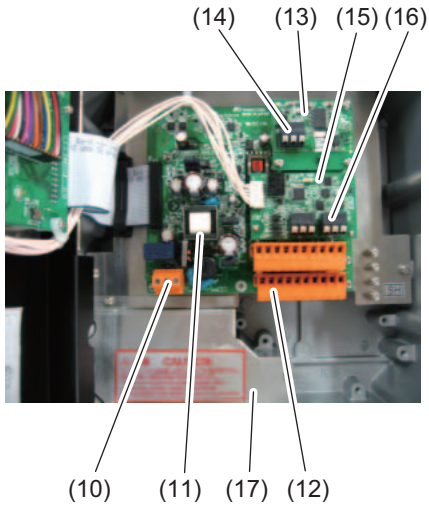
1 2 3 4 5 6 7 8	9 10 11 12 13	Description
F S V	– L	
S		(Destination) (4th digit) Standard (Japanese)
E		Standard (English)
Y		(Communication) (5th digit) None
D		RS485
A		(Use) (6th digit) 2-path/2-pipe
B		Single path/energy
1		(Power supply) (7th digit) AC100 to 240V 50/60Hz
	L	(Case structure) (9th digit) IP67
	Y	(Wire connection port) (10th digit) Weatherproof gland provided
	A	Union (for pilica) with gland
	Y	(Dampproofing) (11th digit) *1 None
	A	Provided
	Y	(Parameter setting) (12th digit) None
	A	Setting provided
	B	Setting provided + tag
	C	Tag
	B	(Mounting method) (13th digit) Wall mount
	C	Pipe mount

Note 1: HumiSeal coated PCB



1.4. Name and function of each part



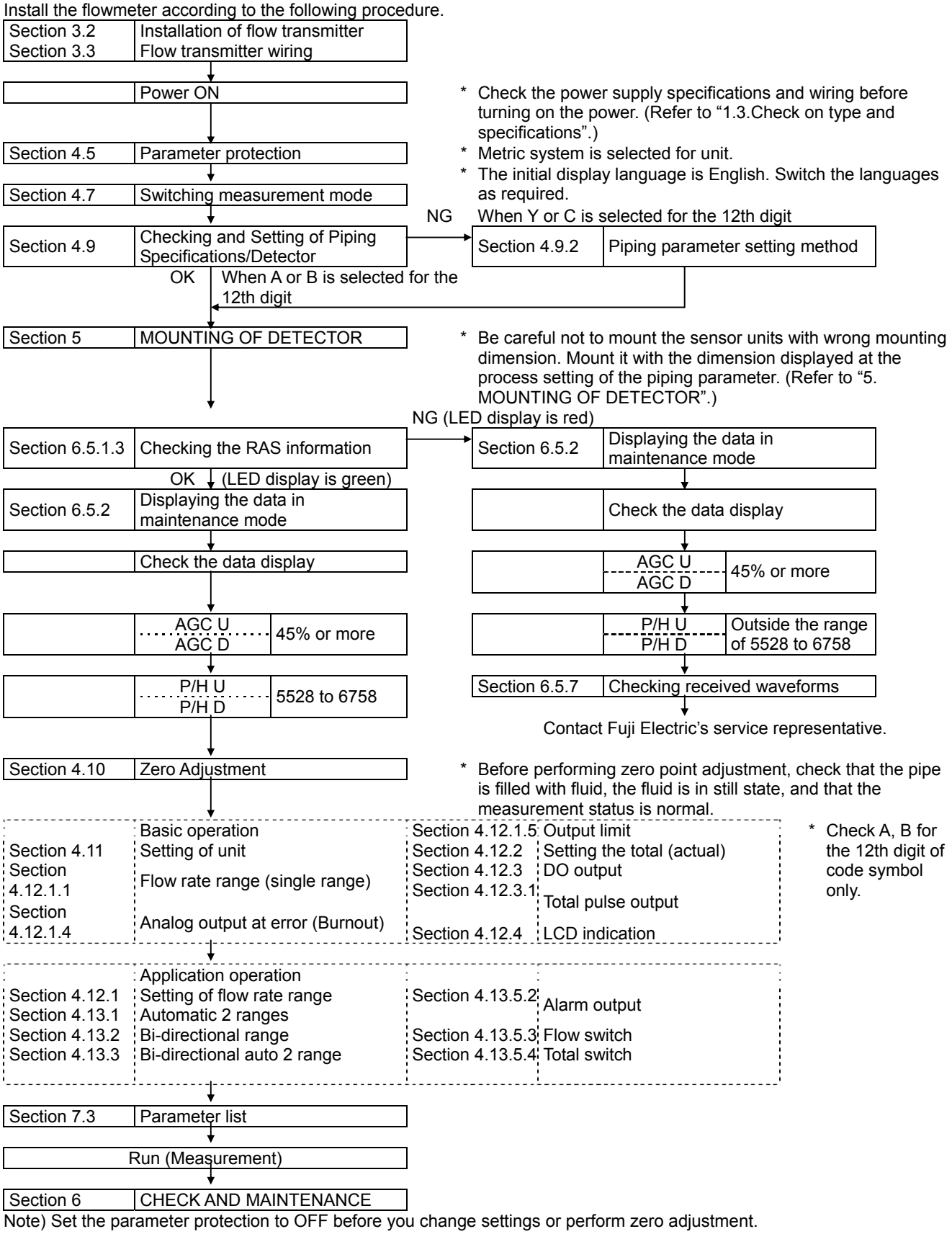


No.	Name	Key	Description
(1)	Wiring connection port, large		Wiring connection port for power cable and input/output cable, communication cable.
(2)	Wiring connection port, small		Wiring connection port for signal cable only.
(3)	Indication and setting unit		Indicates and sets the flow rate, etc.
(4)	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)	Signal terminal		Connects signal cable, analog output, DO output cable.
(13)	Communication board		Mounted if communication is optionally designated.
(14)	Communication board terminal		Connects communication cable. (A communication board is optional)
(15)	Temperature input board		Mounted if energy measurement is selected.
(16)	Temperature input board terminal		Connects the cable from resistance bulb.
(17)	Shield plate		Shields the signal cable.

2. OPERATION PREPARATION

2.1. Outline of installation procedure

Install the flowmeter according to the following procedure.



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

3. INSTALLATION

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

⚠ CAUTION

(1) A place where ambient temperature and humidity are -20 to +55°C and 95% RH or less for flow transmitter (FSV)
(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.

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.

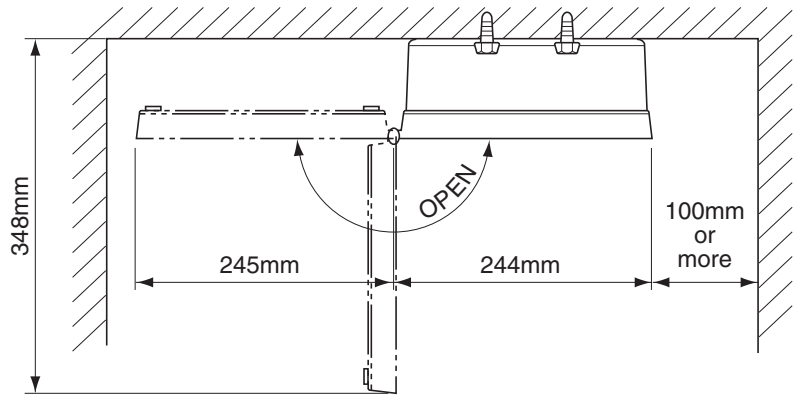


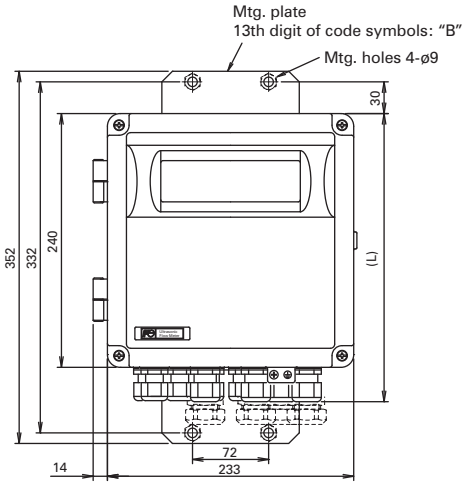
Fig. 3.1 Top view of mounting

3.2. Installation of flow transmitter

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

3.2.1. 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.



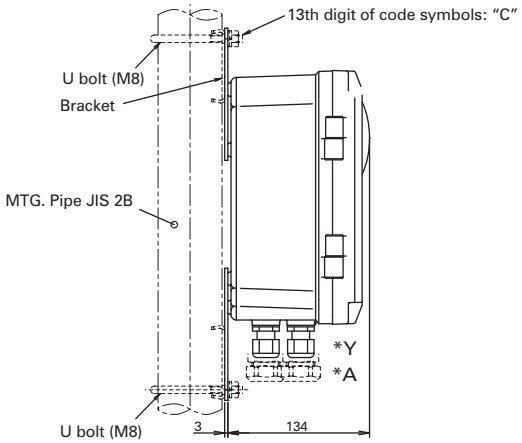
Nominal	Standard tightening torque
M8	12.5 [N·m]

3.2.2. 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.



10th digit of the code symbols	Conduit connection	L	Applicable cable	
			PF1/2	PF3/8
*Y	Waterproof gland	273	ø6 to 12	ø5 to 10
*A	Waterproof gland with union plug (for plica tube PV-5#17)	294	max. ø14	

3.3. Flow transmitter wiring

3.3.1. Cautions in wiring

⚠ CAUTION

(1) Use a special coaxial cable (FLYD) as a signal cable between the detector and flow transmitter (FSV). Do not provide a junction or splice of the signal cable midway.
(2) The signal cable between the detector or flow transmitter should be run in metallic conduits. Upstream and downstream signal cables may be put in the same conduit but, to avoid interference, do not put the power cable together.
(3) For output signal, use a shielded cable, where possible.
(4) To avoid noise interference, do not put the cables together with heavy duty line or the like into the same duct.
(5) If a ground wire is included in the power cable, connect it to ground as it is.
(6) A power switch is not provided on the instrument and must be mounted separately.
(7) Seal unused wiring ports by furnished caps.
(8) Be sure to connect a resistance bulb for each of T_S and T_R on the temperature input board terminal.

3.3.2. Applicable wires

Use the following cables.

- Power cable : 3-wire or 2-wire cabtyre cable
  Nominal sectional area 0.75mm^2 or more
  Outside diameter Φ11mm
- Output signal cable : 2-wire or multi-wire cabtyre cable as required
  Outside diameter Φ11mm
- Signal cable : Signal cable between detector and flow transmitter by type designation
  High-frequency coaxial double shield cable with
  characteristic impedance of 50Ω
  With one-side waterproof BNC connector
  Outside diameter Φ7.3mm
- Extension cable for resistance bulb: 3-wire or multi-wire cabtyre cable as required
  Nominal sectional area 0.75mm^2 or more
  Outside diameter Φ5 to 10mm
- Communication cable : Twisted pair cable with shield (for RS-485)
  Outside diameter Φ6 to 10mm

3.3.3. Treatment of wiring port

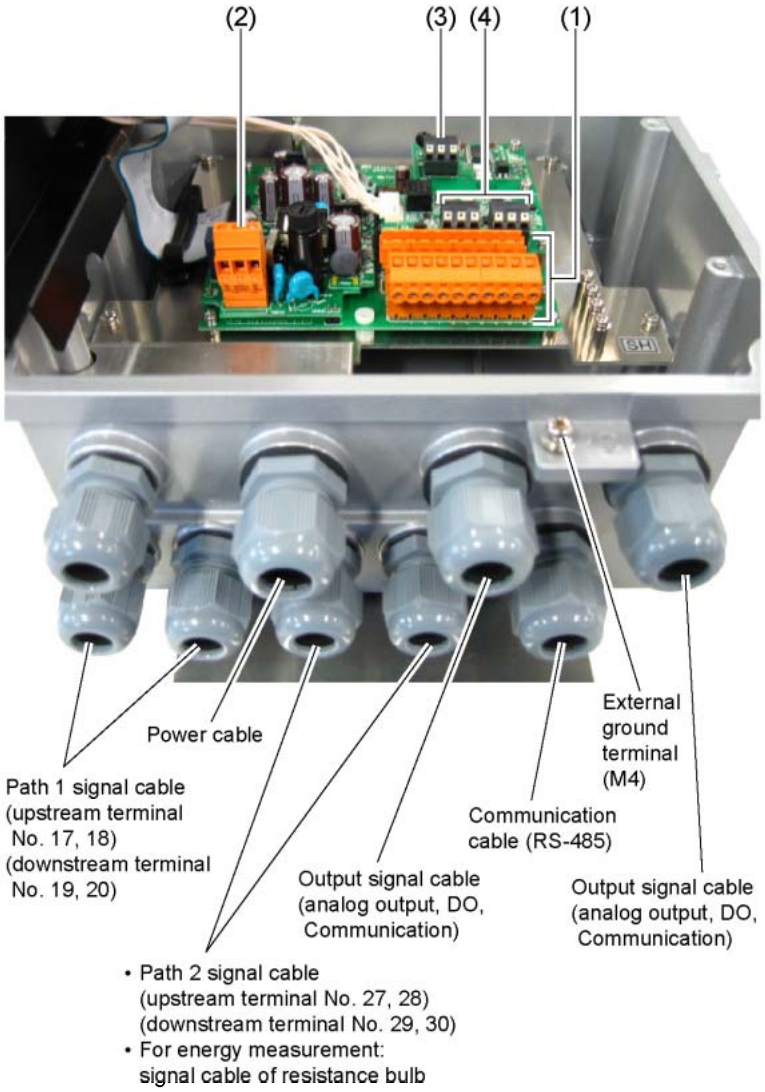
The casing of the flow transmitter is IP67. However, if installed in a humid place, the wiring ports must be made airtight to avoid ingress of moisture, condensation, etc. Be sure to use the waterproof glands furnished with the instrument in order to ensure the waterproof means. A gland, which is not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

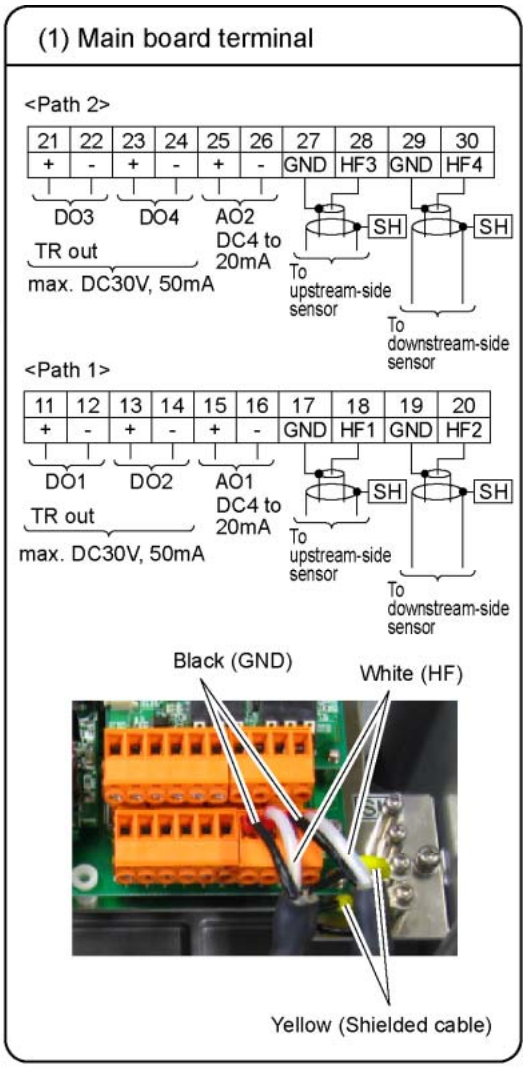
⚠ CAUTION

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

Wiring to each terminal

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





(2) Power terminal	(3) Commuication board terminal	(4) Temperature input board terminal
AC power supply AC100 ~ 240V 50/60Hz 1 2 3 L N FG	RS-485 1 2 3 SG A- B+ ⊖ ⊕	Resistance bulb Pt100 T_S (SUPPLY) 31 32 33 B B A T_R (RETURN) 41 42 43 B B A

Note 1) Terminal block is insertion type to connect a cable. Use bar terminal as crimp-style terminals.
Note 2) Be sure to connect ground terminal to external ground terminal. (Class D grounding)
Note 3) For output signal, use multiple core cable as required.
Note 4) Differential signal line of RS-485 consists of two pins.
⊕ means B+, and ⊖ means A-.

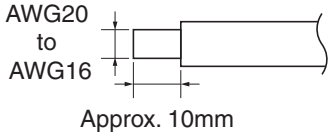
3.3.4. How to connect to terminal block

3.3.4.1. Cable treatment

Although the cables can be connected to the terminals with bare wire, we recommend using bar terminal (ferrule) for connecting cables.
When you cut and use the signal cable, make sure to cut the cable in same length of upstream and downstream.
Note) if cable lengths are different, it may adversely affect the output.

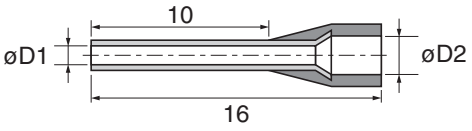
Usable wiring materials

• Wire
Gauge: AWG20 (0.5mm^2) to AWG16 (1.5mm^2)
Strip-off length: approx. 10mm



Approx. 10mm

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



Wire size (mm^2)	AWG	øD1 (mm)	øD2 (mm)	Type
0.5	20	1	2.6	H0.5/16
0.75	18	1.2	2.8	H0.75/16
1	17	1.4	3	H1/16
1.5	16	1.7	3.5	H1.5/16

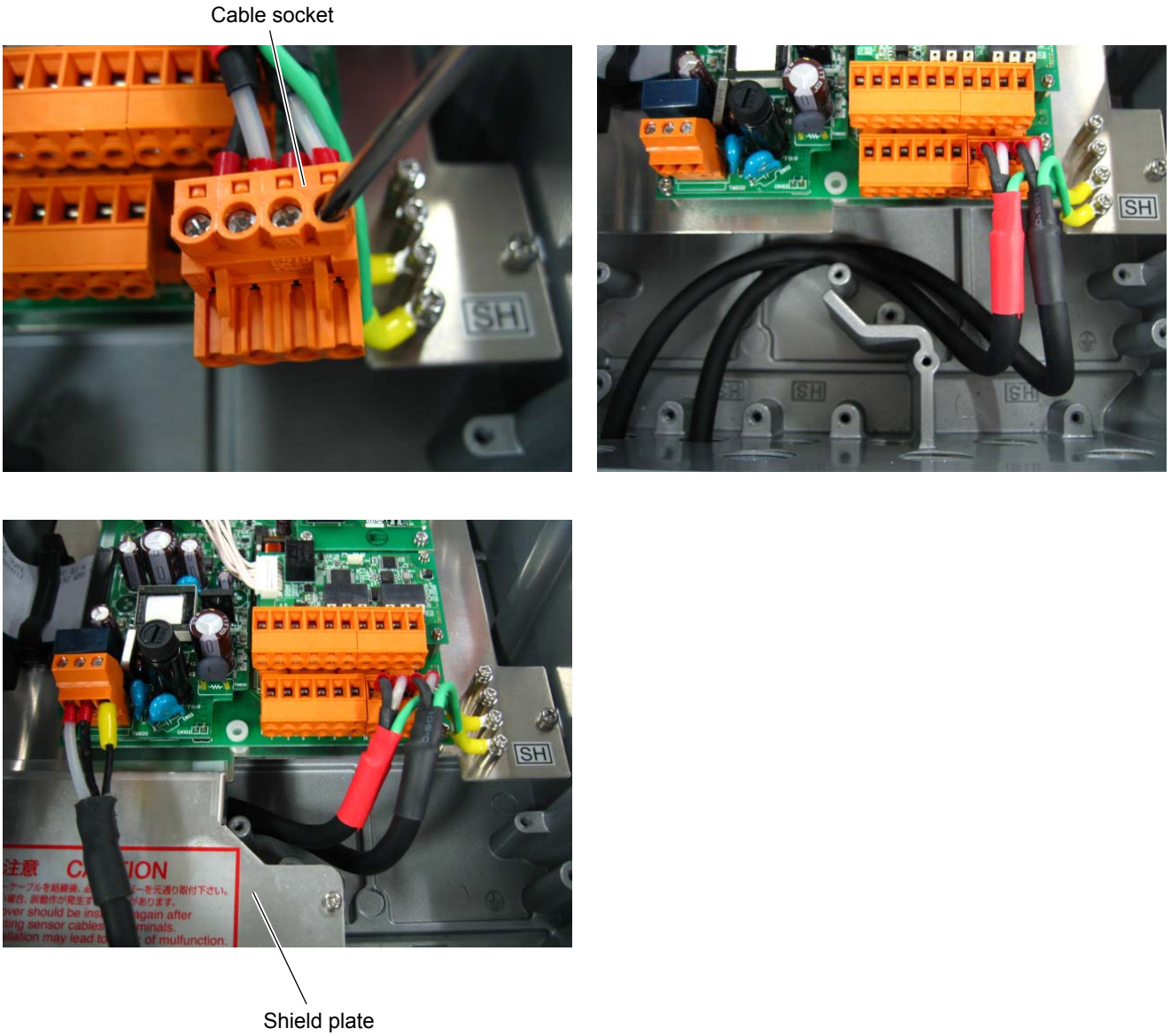
Note1) Make sure to use PZ6/5(H0.25 to H6 for sleeve) as a crimp tool for caulking.
Note2) Applicable sleeve is required for electric wire.
Note3) Insert the electric wire to the end of ferrule so as to crimp.
Note4) Length of stripped wire is 12mm.

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

Remove the shield plate and connect the signal cable of path 1 and either of path 2 or the signal cable of resistance bulb to signal terminal.
Re-attach the shield plate, and then connect the power cable to the power terminal.

Please prepare a flathead screwdriver (head size: 0.6 x 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.
(5) Fix the shield cable (green) of signal cable to the shield terminal.



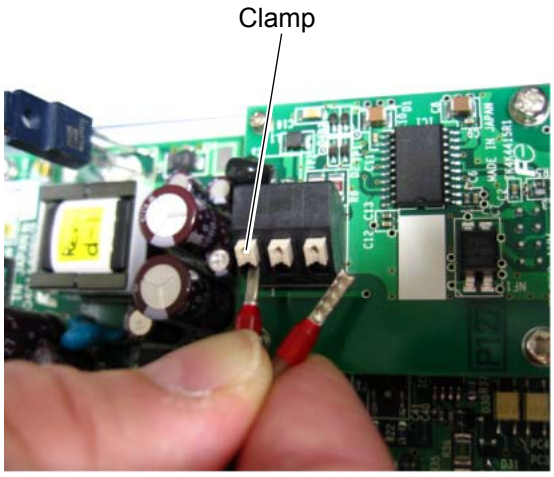
Note) Make sure to conduct the procedure not to damage the printed-circuit board when you remove and install the cable socket.

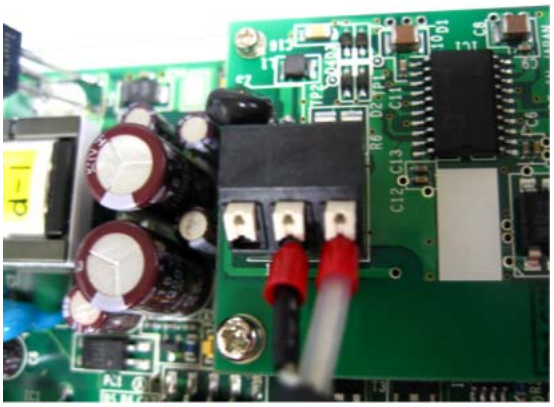
3.3.4.3. How to connect to communication board and temperature input board terminal

Prepare a tool such as a screwdriver to push a clamp when connecting bare wires.

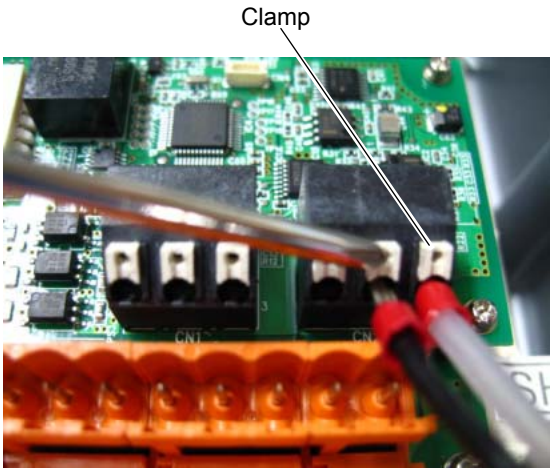
1. Push the clamp so as to open the connector.
2. Insert the cable to the connector and release the clamp to fix the cable.

(1)Communication board

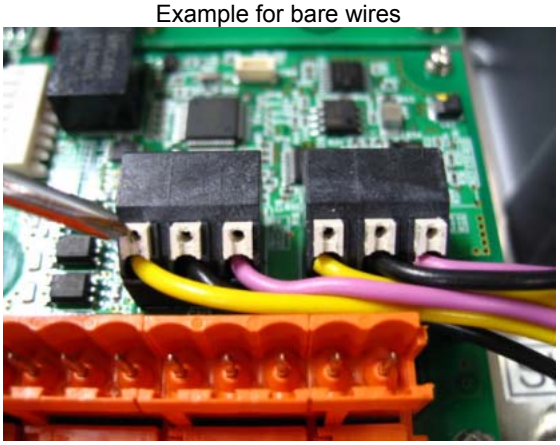




(2)Temperature input board



Example for bare wires



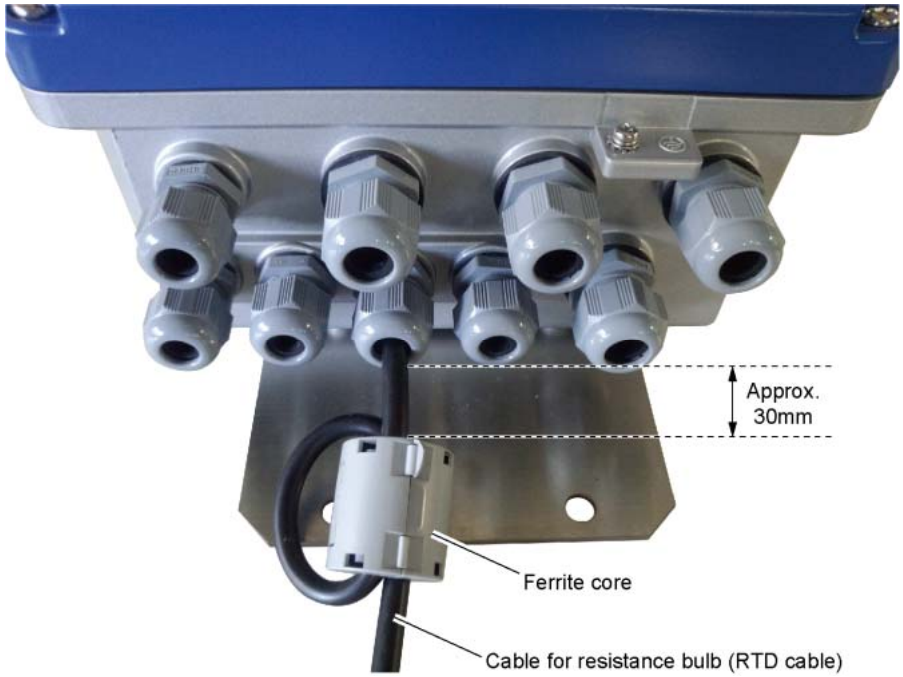
Note) Be sure to remove Path 2 connector when wiring cable from resistance bulb to temperature input board.

3.3.5. How to attach ferrite cores

A ferrite core should be attached on each side of the cable for resistance bulb (Ts and Tr) outside of the case.

1. Unlock the stopper on both side of the ferrite core to open it.
2. Wind the cable for resistance bulb around the ferrite core once.
3. Fit the stoppers of the ferrite core and press it together until it click shut.

Note1) Be careful not to pinch your fingers when attaching ferrite cores.
Note2) Do not damage the cable by pinching it excessively with the ferrite core when locking the ferrite core.



4. PARAMETERS

4.1. Description of display/setting unit

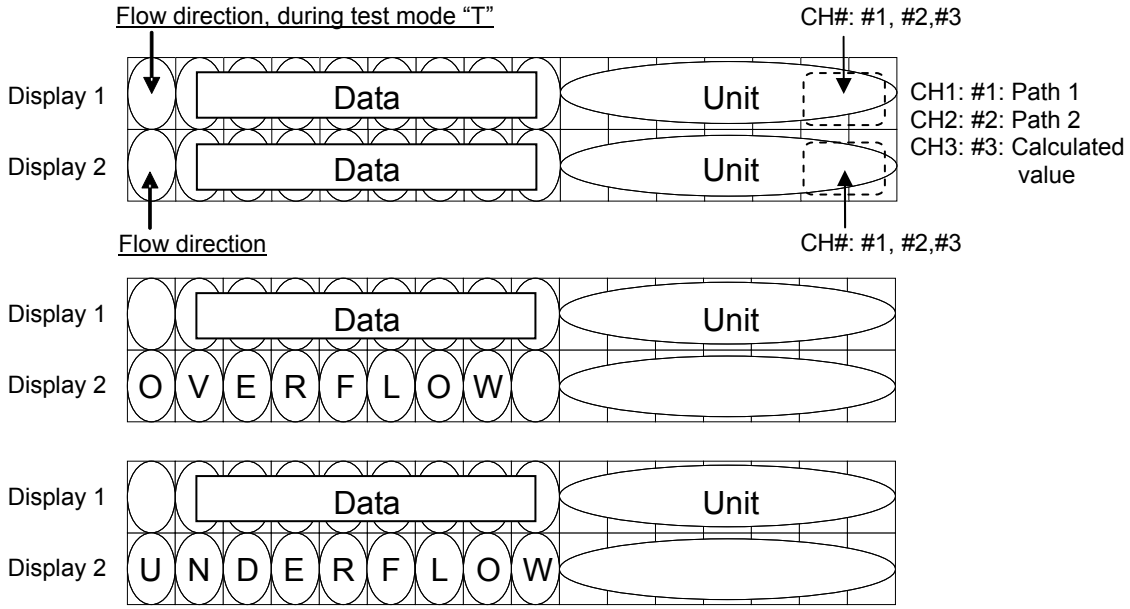
Display unit and setting unit are as shown below.

4.1.1. Display/setting unit

4.1.2. Description of display/setting unit

○ LCD display: Displays the measurement and setting (indication in 16 digits, 2-line).
"Measurement display"

Up to 8 digits including the decimal point are displayed in the data field. When the displayed digits exceed, "<" is displayed at the first digit. When overrange including the temperature overrange occurs or a cable break occurs, "OVERFLOW" or "UNDERFLOW" is displayed blinking on the Display 2. In the cases of 2-path and 2-pipe measurement mode, channel numbers are displayed blinking on display 1 and 2.



○ LED display: ST1: Indicates whether the received wave of path 1 is normal or not.
ST2: Indicates whether the received wave of path 2 is normal or not. (2-path and 2-pipe measurement modes)
ST2: Indicates whether the temperature is normal or not. (1-path/ energy measurement mode)
(Green) : Received wave is normal.
(Red) : Received wave 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.

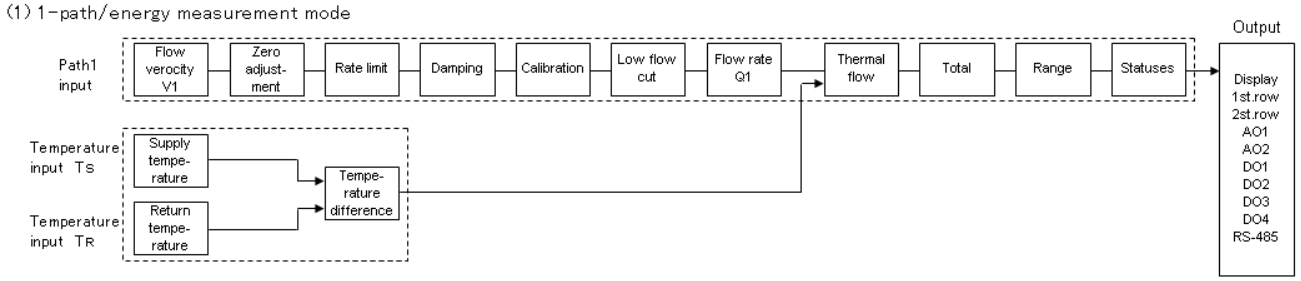
4.2. Measurement modes

The measurement mode can be switched among 2-path, 2-pipe, and 1-path/energy measurement, by changing the parameter. Refer to “4.7.1 Setting measurement mode and CH3 (calculation output)”.

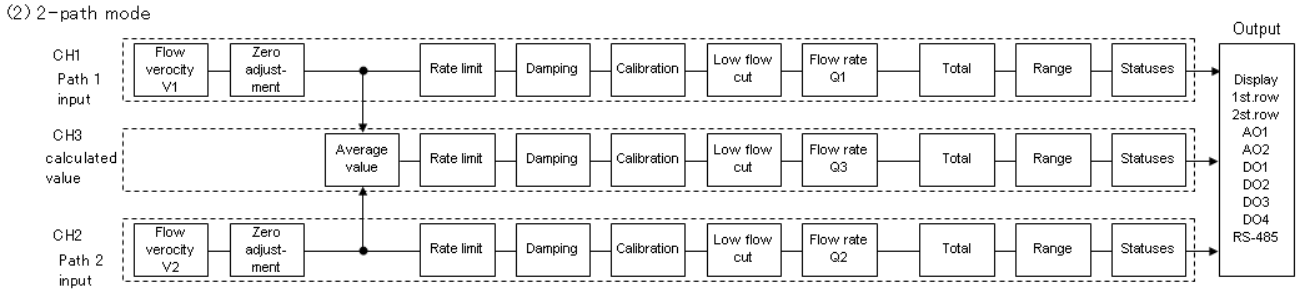
4.2.1. Function block diagram

The configuration from signal input to output varies depending on the measurement mode.

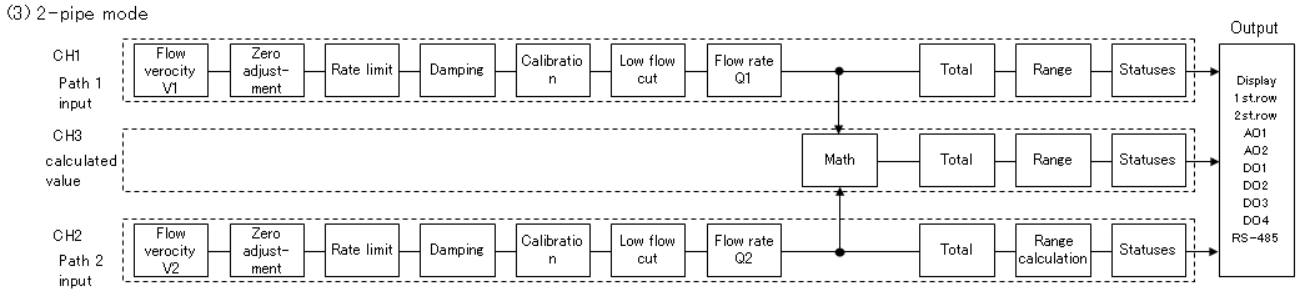
(1) 1-path/energy measurement mode



(2) 2-path mode



(3) 2-pipe mode



Math: average, addition, subtraction (CH1-CH2), subtraction (CH2-CH1)

4.2.2. Definition of the channels

In 2-path mode and 2-pipe mode, computation path from signal input to output is divided into three paths. Each computation path can be defined by channel. In some parameter setting, you need to specify which channel you are going to set.

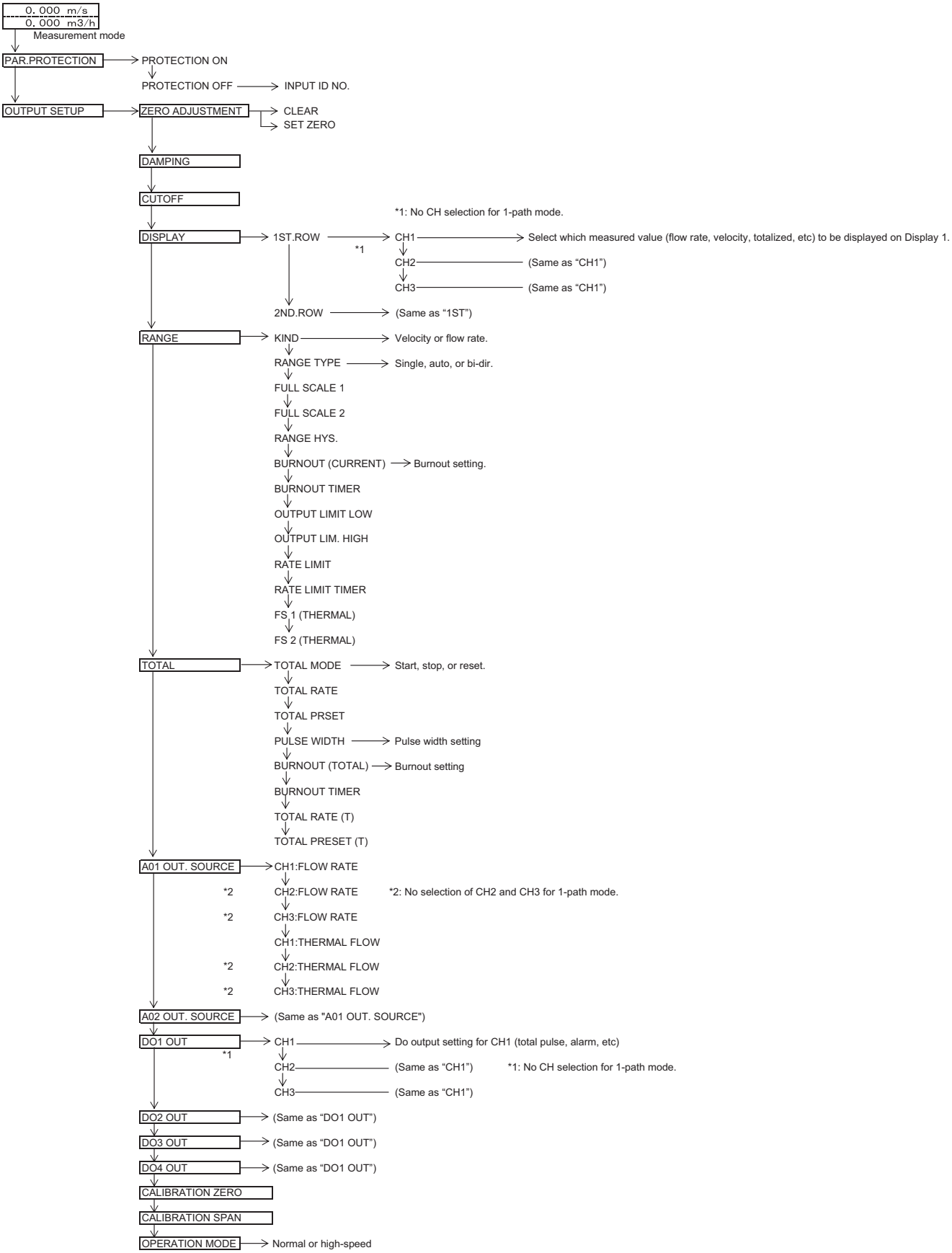
CH1 is assigned to the path 1 computation path from signal input to output.
CH2 is assigned to the path 2 computation path from signal input to output.
CH3 is assigned to the path of calculation.

4.3. Composition of key operation

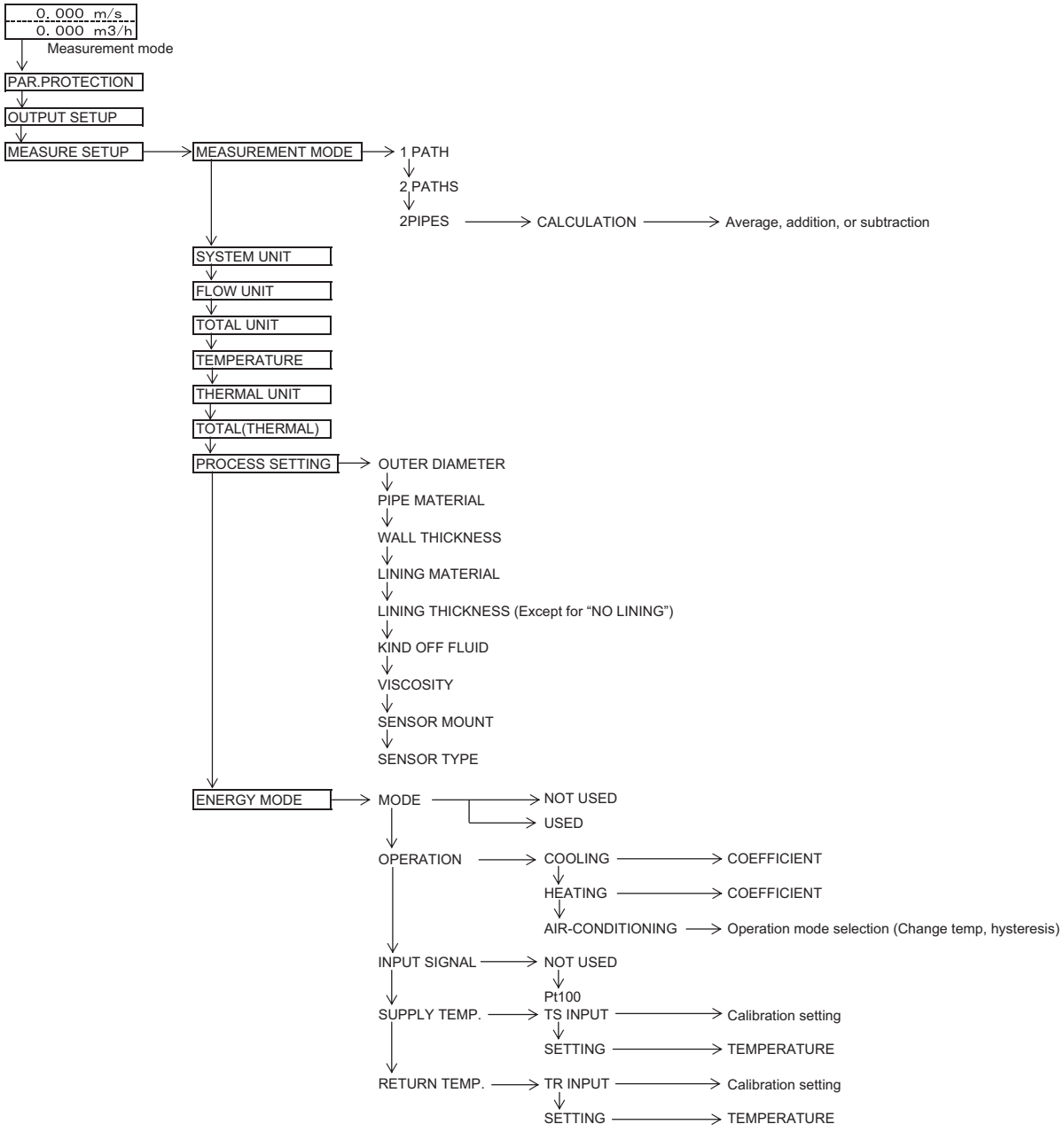
The composition of key operation is shown below.

4.3.1. 1-path/energy measurement mode and 2-path mode

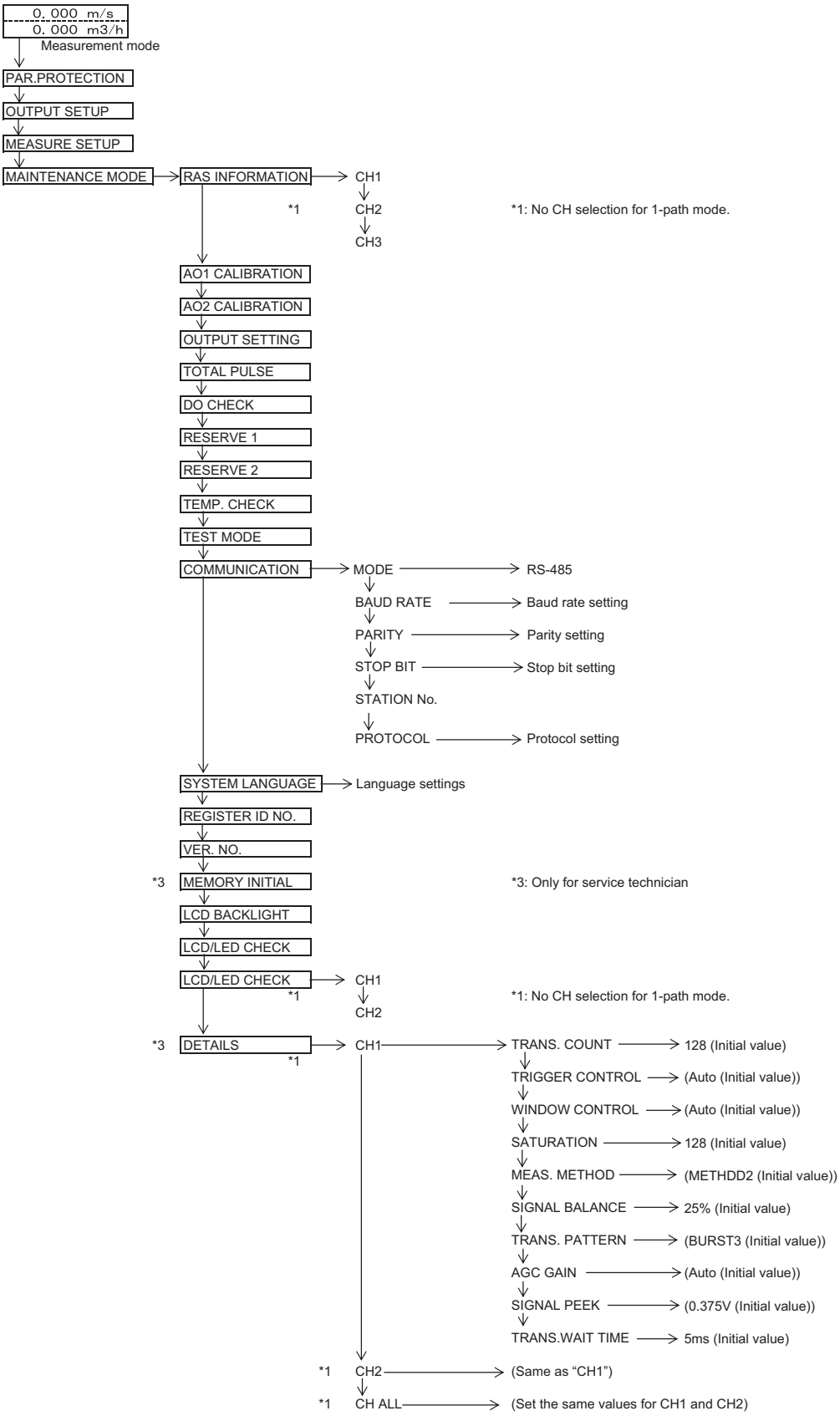
1-path and 2-path mode – parameter protection and output setup



1-path and 2-path mode – measurement setup

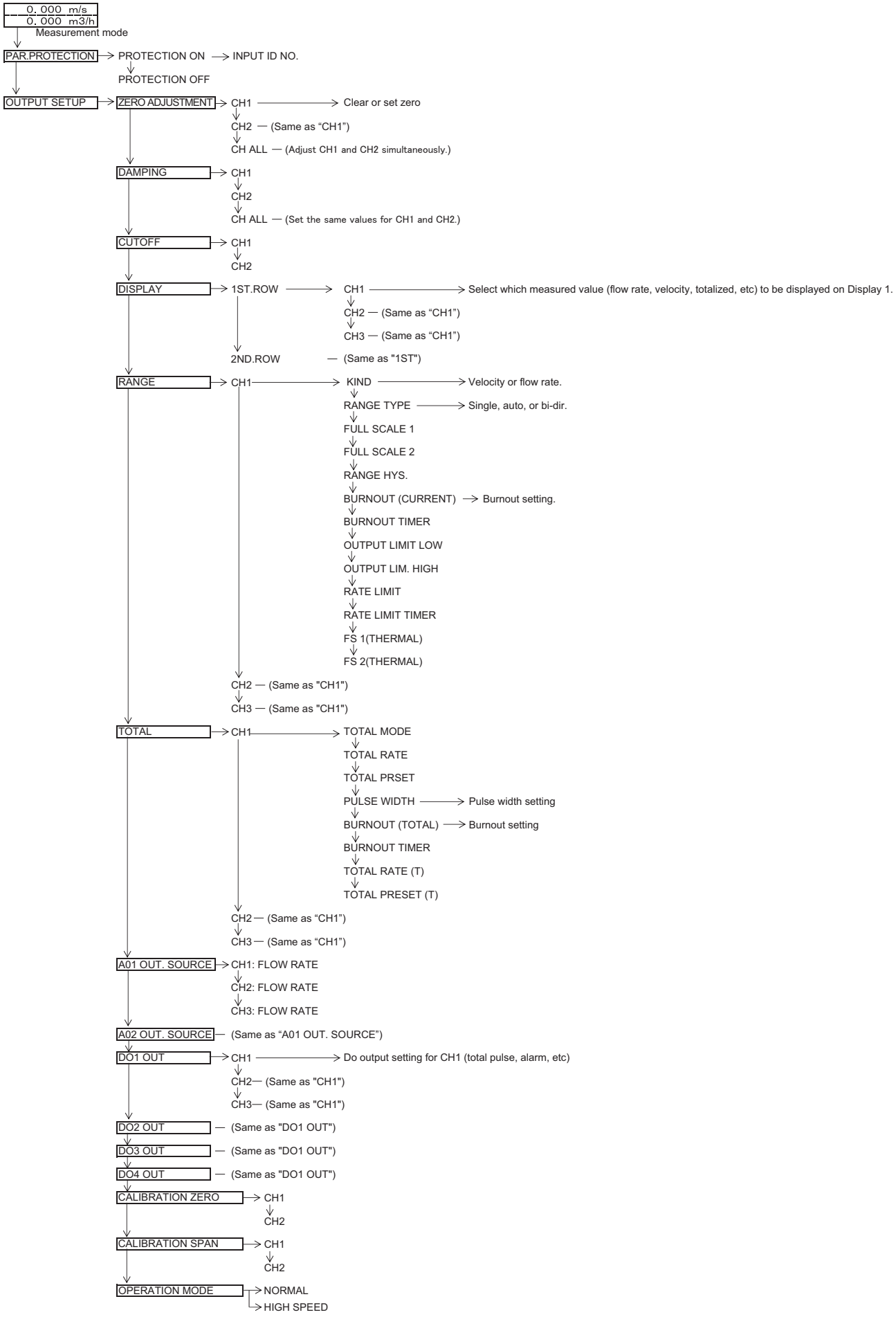


1-path and 2-path mode – maintenance mode

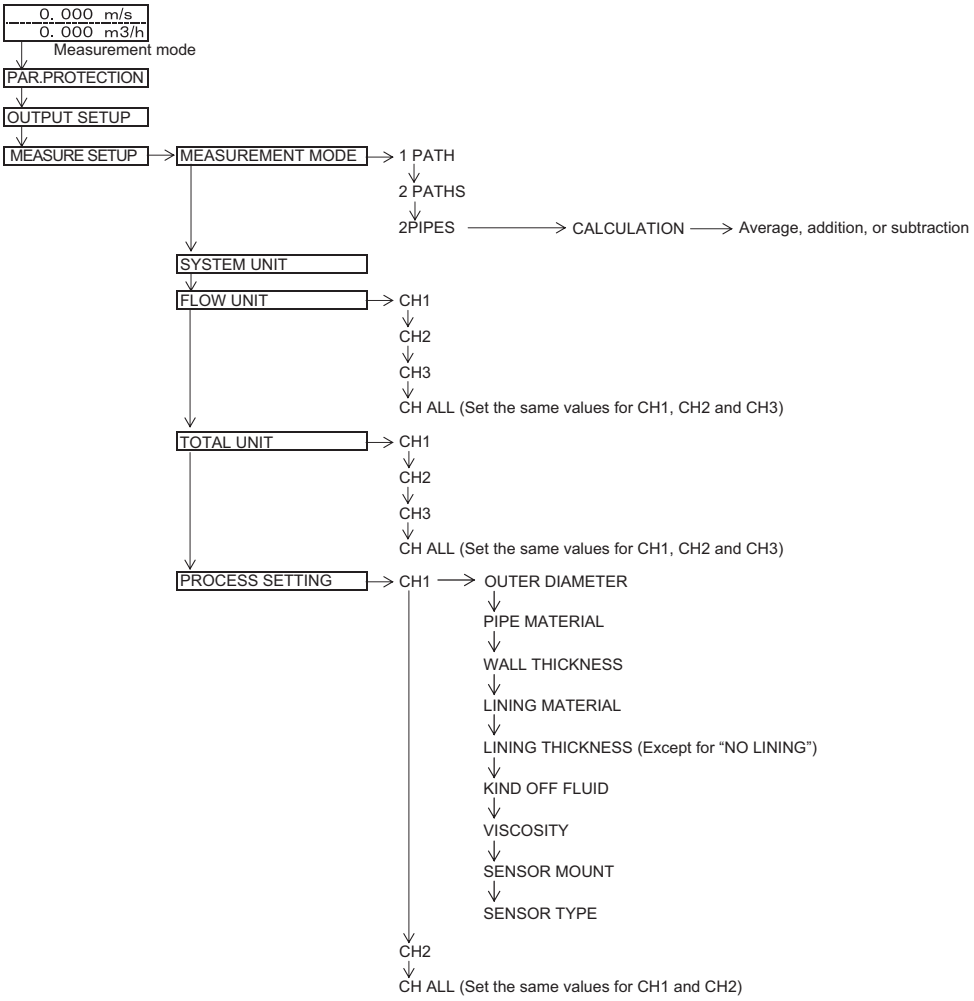


4.3.2. 2-pipe mode

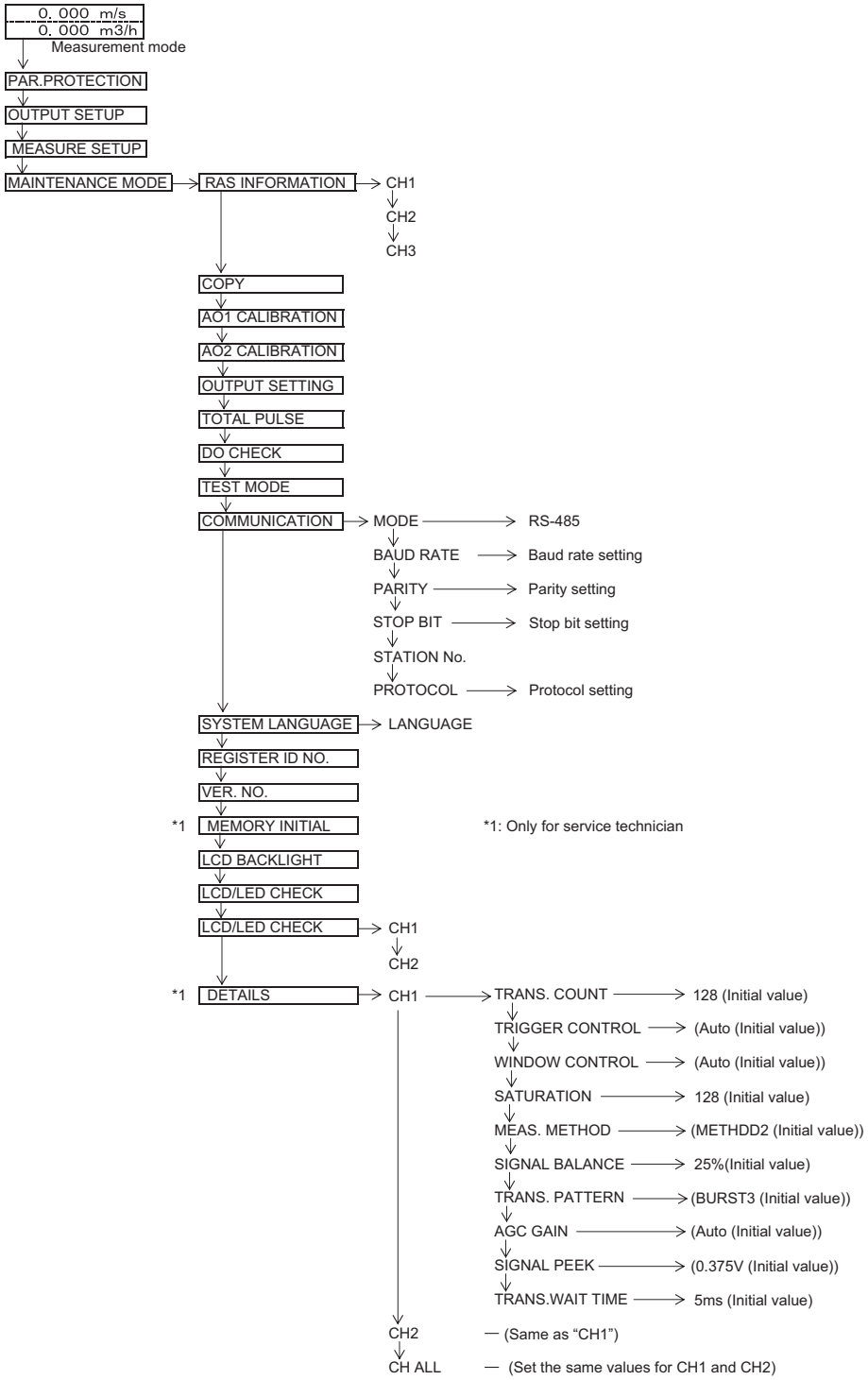
2-pipe mode – parameter protection and output setup



2-pipe mode – measurement setup



2-pipe mode – maintenance mode



4.4. Parameter initial value list

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

	Setting unit		Settable range	Initial value	Setting value
1	Parameter protection		No. of menu: 2	PROTECTION ON	PROTECTION ON, PROTECTION OFF
2	ID No		0000 to 9999	0000	ID No. is invalid when 0000 is selected.
3	Language		No. of menu: 5	English *1	English, Japanese, German, French and Spanish
4	Measuring condition	Measurement mode	No. of menu: 3	1 path	1 path, 2 paths, 2 pipes
5		CH3 calculation output (2 pipe)	No. of menu: 4	Average	Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1)
6		System unit	No. of menu: 2	Metric	Metric or inch
7		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
8		Total unit	No. of menu: 8	m^3	mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
9		Outer diameter	6.00 to 6200.00mm	60.00mm	[mm, in]
10		Pipe material	No. of menu: 13 Sound velocity: 1000 to 3700m/s	PVC	Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP Pipe sound velocity (Sound velocity: [m/s, ft/s])
11		Wall thickness	0.10 to 100.00mm	4.00mm	[mm, in]
12		Lining material	No. of menu: 8 Sound velocity: 1000 to 3700m/s	No lining	No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC Lining S.V. (Sound velocity: [m/s, ft/s])
13		Lining thickness	0.01 to 100.00mm	–	[mm, in]
14		Kind of fluid	No. of menu: 18 Sound velocity: 300 to 2500m/s	Water	Seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410 Fluid S.V. (Sound velocity: [m/s, ft/s])
15		Dynamic viscosity coefficient	0.001 to 999.999 $\times10^{-6}m^2/s$	1.0038 $\times10^{-6}m^2/s$	[$\times10^{-6}m^2/s$, ft^2/s]
16		Sensor mounting method	No. of menu: 2	V method	V method, Z method
17		Sensor type	No. of menu: 10	FSSA/FSSG	FSSA/FSSG, FLS_12,/FLS_22,FSSC, FSG_32, FSG_31/FSG_41, FSSE/FSG_50,FSSF/FSG_51, FSD12, FSSD/FSD22,FSSH/FSD32
18	Energy measurement	Temperature unit	No. of menu: 3	℃	℃, K, F
19		Thermal unit	No. of menu: 7	MJ/h	MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kWh, MWh
20		Total unit (Thermal)	No. of menu: 7	MJ	MJ, GJ, BTU, kBTU, MBTU, kW, MW
21		Energy mode	No. of menu: 2	Used	Not used, Used
22		Operation mode	No. of menu: 3 Thermal coefficient: 1.000 to 9.999 Temperature: -40 to 200℃	Cooling 4.186 4.123 30℃ 25℃	☐ Cooling (Thermal coefficient for cooling:) ☐ Heating (Thermal coefficient for Heating:) ☐ Air-conditionning (Changing temperature [(18) unit]) (Hysteresis [(18) unit])
23		Input signal	No. of menu: 2	Pt100	Not used, Pt100
24		Supply temperature	No. of menu: 2 Zero: -40 to 40℃ Span: 50 to 150% Damping: 0 to 120sec Temperature: -40 to 200℃	T_S input 0.0℃ 100% 5sec 25.0℃	☐T_S input (Calibration zero [(18) unit]) (Calibration span %) (Damping sec) ☐Setting (Temperature [(18) unit])
25		Return temperature	No. of menu: 2 Zero: -40 to 40℃ Span: 50 to 150% Damping: 0 to 120sec Temperature: -40 to 200℃	0.0℃ 100% 5sec 25.0℃	☐T_R input (Calibration zero [(18) unit]) (Calibration span %) (Damping sec) ☐Setting (Temperature [(18) unit])
26	Output condition	Zero adjustment	No. of menu: 2	Clear (unadjusted)	Clear, adjustment (Clear has been factory-set.)
27		Damping	0.0 to 100.0sec	5.0sec	sec
28		Low flow cut	0 to 5m/s in terms of flow velocity	$0.150m^3/h$	[(7) unit]

	Setting unit			Settable range	Initial value	Setting value
29		Display	Source channel of display 1st line	(2-path /2-pipe) (Energy measurement)	CH1 CH1	CH1, CH2, CH3
30			Content of display 1st line	No. of menu: 7 (2-pipe) No. of menu: 16 (Energy measurement)	Flow rate (m^3/h) Thermal flow(MJ/h)	Flow velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual) and -Total pulse H: Total (Thermal), H: Total pulse (Thermal), C: Total (Thermal), C: Total pulse (Thermal), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference
31			Decimal point position of display 1st line		****.***	□□□□□□□□ (Fill in the specified digit)
32			Source channel of display 2nd line	(2-path /2-pipe) (Energy measurement)	CH2 CH1	CH1, CH2, CH3
33			Content of display 2nd line	No. of menu: 7 (2-pipe) No. of menu: 16 (Energy measurement)	Flow rate (m^3/h) Flow rate (m^3/h)	Flow velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual) and -Total pulse H: Total (Thermal), H: Total pulse (Thermal), C: Total (Thermal), C: Total pulse (Thermal), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference
34			Decimal point position of display 2nd line		****.***	□□□□□□□□ (Fill in the specified digit)
35		Analog output	Analog output 1 source channel	(2-path /2-pipe) (Energy measurement)	CH1: Flow rate CH1: Thermal flow	CH1: Flow rate, CH2: Flow rate, CH3: Flow rate CH1: Thermal flow, CH2: Thermal flow, CH3: Thermal flow
36			Analog output 2 source channel	(2-path /2-pipe) (Energy measurement)	CH2: Flow rate CH1: Flow rate	CH1: Flow rate, CH2: Flow rate, CH3: Flow rate CH1: Thermal flow, CH2: Thermal flow, CH3: Thermal flow
37			Kind	No. of menu: 2	Flow rate	Flow velocity, Flow rate
38			Range type	No. of menu: 4	Single range	Single range, Auto 2 range, Bi-dir range and Bi-dir Auto 2 range
39			Full scale 1	0, ±0.3 to ±32m/s in terms of flow velocity	15.000m^3/h	[(7) unit]
40			Full scale 2	0, ±0.3 to ±32m/s in terms of flow velocity	0.000m^3/h	[(7) unit]
41			Full scale 1 (Thermal)	±99999999	0.000 MJ/h	[(19) unit]
42			Full scale 2 (Thermal)	±99999999	0.000 MJ/h	[(19) unit]
43			Hysteresis	0.00 to 20.00	10.00%	%
44			Burnout (current)	No. of menu: 5	Hold	Not used, Hold, Lower, Upper and Zero
45			Burnout timer	10 to 900sec	10sec	sec
46			Output limit low	-20 to 0%	-20%	%
47			Output limit high	100 to 120%	120%	%
48			Rate limit	0 to 5m/s in terms of flow velocity	0.000m^3/h	[(7) unit]
49			Rate limit timer	0 to 900sec	0sec	sec
50		Total output	Total mode	No. of menu: 3	Stop	Start, Stop and Reset
51			Total rate	0.000000 to 99999999	0m^3	[(8) unit]
52			Total preset	0.000000 to 99999999	0m^3	[(8) unit]
53			Total rate (Thermal)	0.000000 to 99999999	0 MJ	[(20) unit]
54			Total preset (Thermal)	0.000000 to 99999999	0 MJ	[(20) unit]
55			Pulse width	No. of menu: 7	50.0msec	5.0msec, 10.0msec, 50.0msec, 100.0msec, 200.0msec, 500.0sec,1000msec.
56			Burnout (total)	No. of menu: 2	Hold	Not used, hold
57			Burnout timer	10 to 900sec	10sec	sec

	Setting unit		Settable range	Initial value	Setting value
58		DO1 source channel		CH1	CH1, CH2, CH3
59		DO1 output type	No. of output content menu: 10 (2 pipe) No. of output content menu: 19 (energy measurement) No. of alarm menu: 3 Flow switch: 0 to 32m/s in terms of flow velocity Total switch: 0.000000 to 99999999 Flow switch (Thermal): 0.000000 to 99999999 Total switch (Thermal): 0.000000 to 99999999	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch ☐Flow SW high [[(7) unit]] ☐Flow SW low [[(7) unit]] ☐Total switch [[(8) unit]] ☐Range over ☐Pulse range over ☐–Flow direction ☐ H: Total pulse (Thermal) ☐ C: Total pulse (Thermal) ☐ Full scale 2 (Thermal), ☐ Flow switch (Thermal) ☐ Flow SW high [[(19) unit]] ☐ Flow SW low [[(19) unit]] ☐ Total switch (Thermal) [[(20) unit]] ☐ AO range over (Thermal) ☐ P: range over (Thermal) ☐ Air-conditioning, ☐ Temp. alarm
60		DO1 Output operation	No. of menu: 2	Active ON	Active ON, Active OFF
61		DO2 source channel		CH1	CH1, CH2, CH3
62	Output condition	DO2 Output type	No. of output content menu: 10 (2 pipe) No. of output content menu: 19 (energy measurement) No. of alarm menu: 3 Flow switch: 0 to 32m/s in terms of flow velocity Total switch: 0.000000 to 99999999 Flow switch (Thermal): 0.000000 to 99999999 Total switch (Thermal): 0.000000 to 99999999	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch ☐Flow SW high [[(7) unit]] ☐Flow SW low [[(7) unit]] ☐Total switch [[(8) unit]] ☐Range over ☐Pulse range over ☐–Flow direction ☐ H: Total pulse (Thermal) ☐ C: Total pulse (Thermal) ☐ Full scale 2 (Thermal), ☐ Flow switch (Thermal) ☐ Flow SW high [[(19) unit]] ☐ Flow SW low [[(19) unit]] ☐ Total switch (Thermal) [[(20) unit]] ☐ AO range over (Thermal) ☐ P: range over (Thermal) ☐ Air-conditioning, ☐ Temp. alarm
63		DO2 Output operation	No. of menu: 2	Active ON	Active ON, Active OFF
64		DO3 source channel		CH1	CH1, CH2, CH3
65		DO3 Output type	No. of output content menu: 10 (2 pipe) No. of output content menu: 19 (energy measurement) No. of alarm menu: 3 Flow switch: 0 to 32m/s in terms of flow velocity Total switch: 0.000000 to 99999999 Flow switch (Thermal): 0.000000 to 99999999 Total switch (Thermal): 0.000000 to 99999999	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch ☐Flow SW high [[(7) unit]] ☐Flow SW low [[(7) unit]] ☐Total switch [[(8) unit]] ☐Range over ☐Pulse range over ☐–Flow direction ☐ H: Total pulse (Thermal) ☐ C: Total pulse (Thermal) ☐ Full scale 2 (Thermal), ☐ Flow switch (Thermal) ☐ Flow SW high [[(19) unit]] ☐ Flow SW low [[(19) unit]] ☐ Total switch (Thermal) [[(20) unit]] ☐ AO range over (Thermal) ☐ P: range over (Thermal) ☐ Air-conditioning, ☐ Temp. alarm
66		DO3 Output operation	No. of menu: 2	Active ON	Active ON, Active OFF
67		DO4 source channel		CH1	CH1, CH2, CH3
68		DO4 Output type	No. of output content menu: 10 (2 pipe) No. of output content menu: 19 (energy measurement) No. of alarm menu: 3	Not used	☐Not used ☐+Total pulse ☐-Total pulse ☐Range full scale 2 ☐Alarm [All, Device error, Process error] ☐Flow rate switch

	Setting unit		Settable range	Initial value	Setting value
			Flow switch: 0 to 32m/s in terms of flow velocity Total switch: 0.000000 to 99999999 Flow switch (Thermal): 0.000000 to 99999999 Total switch (Thermal): 0.000000 to 99999999		☐Flow SW high [[(7) unit]] ☐Flow SW low [[(7) unit]] ☐Total switch [[(8) unit]] ☐Range over ☐Pulse range over ☐–Flow direction ☐ H: Total pulse (Thermal) ☐ C: Total pulse (Thermal) ☐ Full scale 2 (Thermal), ☐ Flow switch (Thermal) ☐ Flow SW high [[(19) unit]] ☐ Flow SW low [[(19) unit]] ☐ Total switch (Thermal) [[(20) unit]] ☐ AO range over (Thermal) ☐ P: range over (Thermal) ☐ Air-conditioning, ☐ Temp. alarm
69		DO4 Output operation	No. of menu: 2	Active ON	Active ON, Active OFF
70		Zero calibration	-5 to 5m/s in terms of flow velocity	0.000m^3/h	[(5) unit]
71		Span calibration	-200.00 to 200.00%	100.00%	%
72		Operation mode	No. of menu: 2	Standard	Standard, High speed
73	Communication	Communication mode	No. of menu: 1	RS-485	RS-485
74		Baud rate	No. of menu: 3	9600bps	9600bps, 19200bps, 38400bps
75		Parity	No. of menu: 3	Odd	None, Odd, Even
76		Stop bit	No. of menu: 2	1 bit	1 bit, 2 bits
77		Station No.	1 to 31	1	(In case of RS-485)
78		Communication protocol	No. of menu: 2	MODBUS	MODBUS, M-Flow
79	LCD	LCD BACKLIGHT	No. of menu: 2	ON	ON, OFF
80		LIGHTS OUT TIME	0 to 99 min	5 min	min

*1) English is set when 4th digit of the type is “E”.

FSV [S] : Japanese

FSV [E] : English

4.5. Parameter protection

4.5.1. 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 4.15.9.)

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 ENT key once to blink the 2nd line.	PAR.PROTECTION PROTECTION ON
△ ▼	Press the △ key once to display "PROTECTION OFF".	PAR.PROTECTION PROTECTION OFF
ENT ▼ ▼ ▼ ▼	Press the ENT key once to display “PAR.PROTECTION”.	PAR.PROTECTION ** COMPLETE ** ↓ INPUT ID NO. ****
ENT ▼ ▼	Press the ENT key once to indicate "0000" and blink the cursor. Note) If ID No. is "0000" (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.

4.6. Display language

4.6.1. 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 4.5.1.)

Operation (example)	Select English for the display language. Below is an example for 1-path/energy measurement mode and 2-path mode.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼ ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼ △	Press the △ key for 13 times (9 times for 2-pipe mode) 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. Below is an example for 1-path/energy measurement mode and 2-path mode.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼ ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMAITION 0000000000000000
▼ △	Press the △ key for 13 times (9 times for 2-pipe mode) 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 ** ﾄｳﾛｸ **
▼ ▼ ▼ ▼	——— Japanese has been registered. ———	↓ ｹﾞﾝｺﾞ (LANGUAGE) ﾆﾎﾝｺﾞ (JAPANESE)
ESC △	Press the ESC key or the △ key to display the measurement mode.	0.000 m/s 0.000 m3/h

4.7. Switching measurement mode

4.7.1. Setting measurement mode and CH3 (calculation output)

Description
- Measurement mode can be selected.
- When 2-pipe measurement is selected, the calculation formula for CH3 can be configured.

Settable range

1. Measurement mode : 1-path, 2-path, 2-pipe
   - ・1 PATH : Measure flow rate and thermal energy in 1 pipe using 1 set of detector
   - ・2 PATHS : Measure flow rate in 1 pipe using 2 sets of detector
   - ・2 PIPES : Measure flow rates in 2 separate pipes using 1 set of detector for each pipe.

2. CH3 calculation output : average, addition, subtraction (CH1-CH2), subtraction (CH2-CH1)

   When selecting 2-pipe measurement mode:
   - ・AVERAGE ＝ (path 1 + path 2) / 2
   - ・ADDITION ＝ path 1 + path 2
   - ・SUB (CH1-CH2) ＝ path 1 - path 2
   - ・SUB (CH2-CH1) ＝ path 2 - path 1

   * When selecting 2-path measurement mode, average value is output for CH3.
   * When selecting 1-path or 2-path measurement mode, there is no setting items of CH3.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set measurement mode to 2-pipe and CH3 calculation output to subtraction (CH1-CH2).	
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 “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
▼		
ENT	Press the ENT key once to blink the second line.	MEASUREMENT MODE 1 PATH
▼		
△	Press the △ key twice to display “2 PIPES”.	MEASUREMENT MODE 2 PIPES
▼		
ENT	Press the ENT key once to save the change.	MEASUREMENT MODE ** COMPLETE **
▼		↓
▼	——— 2 PIPES has been registered. ———	CH3 CALCULATION AVERAGE
▼	“CH3 CALCULATION” is displayed.	
ENT	Press the ENT key once to blink the second line.	CH3 CALCULATION AVERAGE
▼		
△	Press the △ key twice to display “SUB (CH1-CH2).	CH3 CALCULATION SUB (CH1-CH2)
▼		
ENT	Press the ENT key once to save the change.	CH3 CALCULATION ** COMPLETE **
▼		↓
▼	——— SUB (CH1-CH2) has been registered. ——	CH3 CALCULATION SUB (CH1-CH2)
▼	“CH3 CALCULATION” is displayed.	
ESC △	Press the ESC key twice, and then the △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.8. Channel number

4.8.1. Channel designation

Description

- When selecting 2-path or 2-pipe measurement mode, you need to specify the channel number to set some parameters. In 1-path/energy measurement mode, there is no parameter need to be specified by channel number.

Channel number

- ・CH1 : Settings for path 1
- ・CH2 : Settings for path 2
- ・CH3 : Settings for calculation
- ・CH ALL : Simultaneous settings for path 1 and 2, or path 1 and the calculated value

Related parameters ○: applicable, ―:not applicable

Parameter		2-path			2-pipe		
		CH1	CH2	CH3	CH1	CH2	CH3
Output setup	Zero adjustment	―	―	―	○	○	―
	Damping	―	―	―	○	○	―
	Cutoff	―	―	―	○	○	―
	Display	○	○	○	○	○	○
	Range	―	―	―	○	○	○
	Total	―	―	―	○	○	○
	DO	○	○	○	○	○	○
	Calibration zero	―	―	―	○	○	―
	Calibration span	―	―	―	○	○	―
Measurement setup	Flow unit	―	―	―	○	○	○
	Total unit	―	―	―	○	○	○
	Process setting	―	―	―	○	○	―
Maintenance mode	RAS information	○	○	○	○	○	○
	Data display	○	○	―	○	○	―
	Details	○	○	―	○	○	―

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Check the damping time of CH2. Below is an example for 2-pipe measurement mode.	
Key operation	Description	Display
		0.000 m/s 0.000 m3/h
△	Press the △ key once to display “OUTPUT SETUP”.	OUTPUT SETUP
▼		
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT CH1
▼		
△	Press the △ key once to display “DAMPING”.	DAMPING CH1
▼		
ENT	Press the ENT key once to blink the second line.	DAMPING CH1
▼		
△	Press the △ key once to display “CH2” on second line.	DAMPING CH2
▼		
ENT	Press the ENT key once to display damping time.	DAMPING #2 5.0 sec
▼	The channel number will blink on the right side of the first line.	
ESC △	Press the ESC key twice, and then the △ key 3 times to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.9. Checking and Setting of Piping Specifications/Detector

4.9.1. Checking piping parameter

4.9.1.1. 1-path/energy measurement mode and 2-path mode

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 “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key for 7 times to display “PROCESS SETTING”.	PROCESS SETTING S= 16(48mm)
ENT ▼	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER 60.00 mm
△ ▼	Press the △ key once to display “PIPE MATERIAL”.	PIPE MATERIAL PVC
△ ▼	Press the △ key once to display “WALL THICKNESS”.	WALL THICKNESS 4.00 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 WATER
△ ▼	Press the △ key once to display “VISCOSITY”.	VISCOSITY 1.003800 E-6m2/s
△ ▼	Press the △ key once to display “SENSOR MOUNT”.	SENSOR MOUNT V METHOD
△ ▼	Press the △ key once to display “SENSOR TYPE”.	SENSOR TYPE FSSA/FSSG
ESC △	Press the ESC key twice, and the △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.9.1.2. 2-pipe mode

(Example) check the piping parameters for path 2.

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 4 times to display “PROCESS SETIING ”	PROCESS SETIING ＣＨ１
▼		
ENT	Press the ENT key once to blink the cursor.	PROCESS SETTING CH1
▼		
△	Press the △ key once to display “CH2” on the second line.	PROCESS SETTING CH2
▼		
ENT	Press the ENT key once to display “PROCESS SETTING”.	PROCESS SETTING ＃２ Ｓ＝ １６（ ４８mm）
▼	The channel number will blink on the right side of the first line.	
ENT	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER ６０．００ mm
▼		
△	Press the △ key once to display “PIPE MATERIAL”.	PIPE MATERIAL PVC
▼		
△	Press the △ key once to display “WALL THICKNESS ”.	WALL THICKNESS ４．００ 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 WATER
▼		
△	Press the △ key once to display “VISCOSITY”.	VISCOSITY １．００３８００ Ｅ－６m２／ｓ
▼		
△	Press the △ key once to display “SENSOR MOUNT”.	SENSOR MOUNT V method
▼		
△	Press the △ key once to display “SENSOR TYPE”.	SENSOR TYPE ＦＳＳＡ／ＦＳＳＧ
▼		
ESC △	Press the ESC key twice, and then the △ key twice to return to the measurement mode.	0．000 m／s 0．000 m3／h

4.9.2. Piping parameter setting method

Description
- Set the parameters of piping and fluid to be measured to determine the sensor mounting spacing.
- The mounting dimension of the sensor is automatically calculated. Refer to “5.1.1 Mounting of detector”.

⚠ CAUTION

Be sure to set the following parameters before mounting the sensor on the pipe. Mount the sensor to match the sensor mounting length.
- Unless the sensor units are spaced accurately, the measurement error will be excessive or the received wave may be abnormal.

Setting items
1. Channel designation : CH1, CH2, CH ALL
   * When using 2-pipe measurement, set both CH1 and CH2. CH1 and CH2 can be set simultaneously by selecting CH ALL.
   * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.
2. Pipe outer diameter : 6.00 to 6200.00 [mm] (factory set at 60.00 [mm]).
3. Piping material : CARBON STEEL, STAINLESS STEEL, PVC (factory set), COPPER, CAST IRON, ALUMINIUM, FRP, DUCTILE IRON, PEEK, PVDF, ACRYLIC, PP, Others (Sound velocity: 1000 to 3700[m/s])
4. Wall thickness : 0.10 to 100.00 [mm] (factory set at 4.00 [mm]).
5. Lining material : NO LINING (factory set), TAR EPOXY, MORTAR, RUBBER, TEFLON, PYREX GLASS, PVC, Others (Sound velocity: 1000 to 3700[m/s])
6. Lining thickness : 0.10 to 100.00 [mm]
7. Measuring fluid : WATER, SEAWATER, DIST.WATER, AMMONIA, ALCOHOL, BENZENE, ETHANOL, GLYCOL, KEROSENE, MILK, METHANOL, TOLUOL, LUBE OIL, FUEL OIL, PETROL, REFRIGERANT R410, Others (Sound velocity: 300 to 2500[m/s])
8. Dynamic viscosity coefficient : 0.0010 to 999.999 × 10^{-6} [m^2/s] (factory set at 1.0038 x 10^{-6} [m^2/s])
9. Detector mounting method : V method (factory set), Z method. Refer to “5.2.Selection of mounting method”
10. Detector type : FSSA/FSSG (factory set), FLS_12/FLS_22, FSSC,FSG_32, FSG_31/FSG-41, FSSE/FSG_50, FSSF/FSG_51, FSD12, FSSD/FSD22,FSSH/FSD32

Note) If the sensor type is previous type, make a setting change for current type.

Previous type	Current type	Previous type	Current type
FLD22	FSD22	FLW41	FSG_41
FLD32	FSD32	FLW50	FSG_50
FLW11	FSG_31	FLW51	FSG_51
FLW12	FSG_32		

For concrete keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

(1) Setting method when sensor type is “FSSA”.

Operation (example)	Carry out setting for measuring the flow rate of water flowing through PVC pipe (for tap water) using FSSA detector. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.9.1.2 for channel designation of 2-pipe measurement.	
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= 16 (48mm)
ENT ▼	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER 60.00 mm
ENT ▼	Press the ENT key once to blink the cursor.	OUTER DIAMETER 0160.00 mm
		0160.00 mm
		0160.00 mm
		0110.00 mm
		0110.00 mm

△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by △ the key. Operated to compose "114" because, from Piping data in Section 7.4., the outer diameter of polyvinyl chloride pipe (tap water size) is 114 mm.	OUTER DIAMETER 0114.00 mm
ENT ▼	Press the ENT key once to register the outer diameter.	OUTER DIAMETER ** COMPLETE **
▼ ▼ ▼	——— Outer diameter has been registered. ———	↓ OUTER DIAMETER 114.00 mm
△ ▼	Press the △ key once to display “PIPE MATERIAL”. Because PVC (factory set) is already registered, go to the next step. Note) If the pipe is made of another material, press ENT key, and select a corresponding menu by the △ key.	PIPE MATERIAL PVC
△ ▼	Press the △ key once to display “WALL THICKNESS”.	WALL THICKNESS 4.00 mm
ENT ▼	Press the ENT key once to blink the cursor.	WALL THICKNESS 004.00 mm 004.00 mm
△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key. Operated to compose "7" because, from Piping data in Section 7.4, the wall thickness of polyvinyl chloride pipe (tap water size) is 7.0mm.	WALL THICKNESS 007.00 mm
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register the wall thickness. ——— Wall thickness has been registered. ———	WALL THICKNESS ** COMPLETE ** ↓ WALL THICKNESS 7.00 mm
△ ▼	Press the △ key once to display “LINING MATERIAL”. "NO LINING" (factory set) is already registered. Because there is no lining, go to the next step. Note) If lining is provided, press the ENT key and △ key to select the material or enter the sound velocity. Further, go to "LINING THICKNESS", and input a lining thickness. Nothing is indicated in case of "NO LINING".	LINING MATERIAL NO LINING
△ ▼	Press the △ key once to display "KIND OF FLUID". Because, also, "WATER" (factory set) is already registered, go to the next step. Note) If fluid to be measured is other than water, press the ENT key, and select the menu or enter the sound velocity.	KIND OF FLUID WATER
△ ▼	Press the △ key once to display "VISCOSITY". Input the kinematic viscosity of the fluid to be measured. Because the kinematic viscosity 1.0038E^{-6} [m^2/s] of water at 20°C is already registered, go to the next step. In case of fluid other than water, input the kinematic viscosity at a measurement status of fluid to be measured referring to data in Section 7.4., etc.	VISCOSITY 1.0038 E-6m2/s
ESC ▼	Press the ESC key once to display “PROCESS SETTING”. “S=31” is indicated on the 2nd line. After mounting the frames on piping, insert into it 2 sensor units spaced at 31 divisions.	PROCESS SETTING S= 31 (93mm)
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

(2) Setting method when sensor type is other than “FSSA” or “FSSG”

Operation (example)	Carry out setting for measuring the flow rate of water flowing through PVC pipe (for tap water) having 100 mm of nominal diameter, using FSSC detector. * Settings of piping and fluid to be measured are omitted, since it is same as “(1) Setting method when sensor type is “FSSA” * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.9.1.2 for channel designation of 2-pipe measurement.	
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 for 7 times to display “PROCESS SETTING”.	PROCESS SETTING S= 31 (93mm)
ENT ▼	Press the ENT key once to display “OUTER DIAMETER”.	OUTER DIAMETER 114.00 mm
△ ▼	Press the △ key for 7 times to blink the cursor.	SENSOR TYPE FSSA/FSSG
ENT ▼	Press the ENT key once to blink the cursor.	SENSOR TYPE FSSA/FSSG
△ ▼	Press the △ key for 2 times to display “FSSC” on the 2nd line.	SENSOR TYPE FSSC
ENT ▼	Press the ENT key once to register “FSSC”.	SENSOR TYPE ** COMPLETE ** ↓
▼ ▼ ▼	——— “FSSC” has been registered. ———	SENSOR TYPE FSSC
ESC ▼	Press the ESC key once to display “PROCESS SETTING”. “S=58.43mm” is displayed on the 2nd line. Align the sensor mounting spacing to 58.43mm, and attach the sensor to the pipe.	PROCESS SETTING S= 58.43mm
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 m/s 0.000 m3/h

4.10. Zero Adjustment

Description
- Zero point can be calibrated.

Settable range:
Channel designation : CH1, CH2, CH ALL
* When using 2-pipe measurement, calibrate both CH1 and CH2. CH1 and CH2 can be calibrated simultaneously by selecting CH ALL.
* No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

CLEAR : Clears the zero point calibration value to "0".
Used in case the flow cannot be stopped when calibrating the zero point.
Note 1) Where possible, stop the flow and carry out "SET ZERO" stated below.
Otherwise, an error may occur in the zero point.

SET ZERO : A point where "SET ZERO" is carried out is regarded as zero. Used for zero calibration with flow stopped.
Note 2) The flow must completely be stopped.
Otherwise, the flowing status is regarded as zero, thereby causing an error.

It takes ten seconds to several tens of seconds to complete adjustment, depending on pipe diameter.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Completely fill the piping, close the upstream and downstream valves, and proceed to zero point calibration. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1. for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
▼		
ENT	Press the ENT key twice to display “ZERO ADJUSTMENT” and blink the cursor.	ZERO ADJUSTMENT CLEAR
▼		
△	Press the △ key once, and select “SET ZERO”.	ZERO ADJUSTMENT SET ZERO
▼		
ENT	Press the ENT key once to carry out “SET ZERO”.	ZERO ADJUSTMENT ** COMPLETE **
▼	* Be sure to completely stop the flow beforehand.	↓
▼	——— Zero adjustment has been completed. ———	ZERO ADJUSTMENT SET ZERO
▼		
ESC △	Press the ESC key once, and the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.11. Setting of unit

4.11.1. Unit system

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

Length····· mm
Flow velocity····· m/s
Flow rate····· L/s, L/min, L/h, L/d, kL/d, ML/d, m^3/s, m^3/min, m^3/h, m^3/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d
Total unit ····· mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
Kinematic viscosity coefficient ····· $E^{-6}m^2/s$
Temperature unit····· ℃, K, F
Thermal unit····· MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kWh, MWh
Total unit (Thermal)····· MJ, GJ, BTU, kBTU, MBTU, kW, MW

<Note> Set the total mode to “STOP” before setting this parameter. (See Section 4.12.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Change the unit system from inch system to metric system.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ 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

4.11.2. Flow rate unit

Description
- Select the unit of flow rate.
- Metric system

Channel designation : CH1, CH2,CH3
* When using 2-pipe measurement, set all of CH1, CH2, and CH3.
* No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

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 4.11.1.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set a flow rate unit to “L/min”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△	Press the △ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
▼		
ENT	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
▼		
△	Press the △ key twice to display “FLOW UNIT”.	FLOW UNIT m3/h
▼		
ENT	Press the ENT key once to blink the cursor.	FLOW UNIT m3/h
▼		
△	Press the △ key several times to display “L/min”.	FLOW UNIT L/min
▼		
ENT	Press the ENT key once to register.	FLOW UNIT ** COMPLETE ** ↓
▼		
▼	——— “L/min” has been registered. ———	FLOW UNIT L/min
▼		
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 m/s 0.000 L/min

4.11.3. Flow total unit

Description
- Select the unit of total volume.
- Metric system

Channel designation : CH1, CH2, CH3
* When using 2-pipe measurement, set all of CH1, CH2, and CH3.
* No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

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 4.11.1.
Set the total mode to “STOP” before setting this parameter. (See Section 4.12.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set a flow total unit to “L”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key 3 times to display “TOTAL UNIT”.	TOTAL UNIT m3
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL UNIT m3
△ ▼	Press the △ key twice to display “L”.	TOTAL UNIT L
ENT ▼	Press the ENT key once to register.	TOTAL UNIT ** COMPLETE ** ↓
▼ ▼ ▼	——— “L” has been registered. ———	TOTAL UNIT L
ESC △	Press the ESC key once and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.11.4. Temperature unit

Description
- Select the temperature unit for 1-path/energy measurement.
- Metric system
  Temperature unit ···· ℃ (factory set), K, F

<Note> First, set the unit system (metric) according to Section 4.11.1.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set a temperature unit to "℃".	
Key operation	Description	Display
△	Press the △ key 3 times to display "MEASURE SETUP".	MEASURE SETUP
▼		
ENT	Press the ENT key once to display "MEASUREMENT MODE".	MEASUREMENT MODE 1 PATH
▼		
△	Press the △ key 4 times to display "TEMPERATURE".	TEMPERATURE ℃
▼	℃ (factory setting) has been registered.	
▼	Use ENT key and △ key to change the unit.	
▼		
ESC △	Press the ESC key once, and the △ key twice to return to the measurement mode.	0.000 L 0.000 L/min

4.11.5. Thermal unit

Description
- Select the unit of instantaneous thermal energy to be measured in 1-path/energy measurement mode.
- Metric system
  Thermal unit ···· MJ/h (factory set), GJ/h, BTU/h, kBTU/h, MBTU/h, kWh, MWh

<Note> First, set the unit system (metric) according to Section 4.11.1.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set a thermal unit to “GJ/h”.	
Key operation	Description	Display
△ ▼	Press the △ key 3 times to display “MEASURE SETUP”.	MEASURE SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key 5 times to display “THERMAL UNIT”.	THERMAL UNIT ＭＪ／ｈ
ENT ▼	Press the ENT key once to blink the cursor.	THERMAL UNIT ＭＪ／ｈ
△ ▼	Press the △ key once to display “GJ/h”.	THERMAL UNIT ＧＪ／ｈ
ENT ▼ ▼ ▼ ▼	Press the ENT key once to save the change. ——— “GJ/h” has been registered. ———	THERMAL UNIT ＊＊ COMPLETE ＊＊ ↓ THERMAL UNIT ＧＪ／ｈ
ESC △	Press the ESC key once, and the △ key twice to return to the measurement mode.	０．０００ ｍ／ｓ ０．０００ Ｌ／ｍｉｎ

4.11.6. Thermal total unit

Description
- Select the unit of totalized thermal energy to be measured in 1-path/energy measurement mode.
- Metric system
  Total unit (Thermal) ‥ MJ (factory set), GJ, BTU, kBTU, MBTU, kW, MW

<Note> First, set the unit system (metric) according to Section 4.11.1.
When setting, stop status should be set at total mode. (See Section 4.12.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set a thermal total unit to "GJ".	
Key operation	Description	Display
△ ▼	Press the △ key 3 times to display "MEASURE SETUP".	MEASURE SETUP
ENT ▼	Press the ENT key once to display "MEASUREMENT MODE".	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key 6 times to display "TOTAL(THERMAL)".	TOTAL(THERMAL) M J
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL(THERMAL) M J
△ ▼	Press the △ key once to display "GJ".	TOTAL(THERMAL) G J
ENT ▼ ▼ ▼ ▼	Press the ENT key once to save the change. ——— GJ has been registered. ———	TOTAL(THERMAL) ＊＊ COMPLETE ＊＊ ↓ TOTAL(THERMAL) G J
ESC △	Press the ESC key once, and the △ key twice to return to the measurement mode.	0.000 L 0.000 L／min

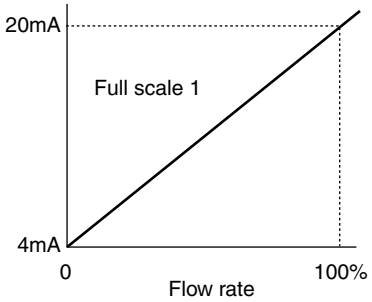
4.12. Output Setting

4.12.1. Setting of flow rate range

4.12.1.1. Flow rate 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 32 [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 "FLOW UNIT" in the "MEASURE SETUP" mode. (Refer to Section 4.11.2.)



・ 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 ～ 32 [m/s] <Table1>

Int. dia. of pipes [mm]	Flow rate unit	
	[m^3/h]	[L/min]
25	0.530 to 56.5	8.84 to 942
50	2.12 to 226	35.3 to 3770
80	5.43 to 579	90.5 to 9651
100	8.48 to 905	141 to 15080
150	19.1 to 2036	318 to 33929
200	33.9 to 3619	565 to 60319
300	76.3 to 8143	1272 to 135717

- Channel designation : CH1, CH2,CH3
  * When using 2-pipe measurement, set CH1, CH2 and CH3.
  * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

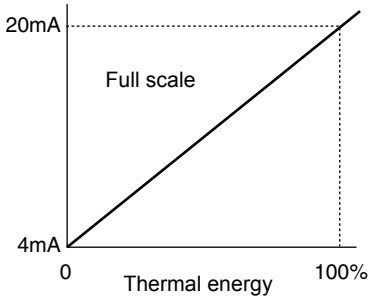
Operation (example)	Set the range type to single range and “FULL SCALE1” to flow rate of 60m^3/h. * Set the piping parameters and "FLOW UNIT" beforehand. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to enter the “ZERO ADJUSTMENT” mode.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND FLOW RATE
▼	Because flow rate (factory set) is already registered, go to the next step.	
△ ▼	Press the △ key to display “RANGE TYPE”	RANGE TYPE SINGLE
	Because single range (factory set) is already registered, go to the next step.	
△ ▼	Press the △ key once to display “FULL SCALE1”.	FULL SCALE1 15.000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE1 00015.000 m3/h
△ ▷ ▼	Move the cursor by the ▷ key, and change the numeric value by the	00015.000 m3/h
▼	△ key.	00065.000 m3/h
▼		00065.000 m3/h
▼		

▼ ▼ ▼ ▼	Change the full scale1 to “60”. Note) To change the decimal point position, align the cursor with a place to change to and press the △ key likewise.	FULL SCALE1 000006**0**.0 m3/h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— FULL SCALE1 has been registered. ———	FULL SCALE1 ** COMPLETE ** ↓ FULL SCALE1 60.000 m3/h
ESC △	Press the ESC key for 2 times and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.12.1.2. Thermal range (single range)

Description
- The range (full scale) of thermal energy to be measured is set. (for 1-path/energy measurement)
  * The analog output (4-20mA) corresponds to the range setting.
- Settable range: 0.000000 to 99999999.
  * THERMAL UNIT must be set beforehand.

<Note> The thermal unit is as selected by "THERMAL UNIT" in the "MEASURE SETUP" mode. (Refer to Section 4.11.2)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1)

Operation (example)	Set the range type to single range and “FS 1(THERMAL)” to thermal flow of 2000MJ/h. * Set the piping parameters and "THERMAL UNIT" beforehand. * Below is an example for 1-path/energy measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to enter the “ZERO ADJUSTMENT” mode.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND FLOW RATE
△ ▼	Press the △ key once to display “RANGE TYPE”	RANGE TYPE SINGLE
	Because single range (factory set) is already registered, go to the next step.	
△ ▼	Press the △ key 10 times to display “FS 1(THERMAL)”.	FS 1(THERMAL) 0 MJ／h
ENT ▼	Press the ENT key once to blink the cursor.	FS 1(THERMAL) 0 0 0 0 0 0 0 0 0 MJ／h
△ ▷ ▼ ▼ ▼ ▼	Move the cursor by the ▷ key, and change the numeric value by the △ key. Change the value of FS 1(THERMAL) to “20000.” Note) To change the decimal point position, align the cursor with a place to change to and press the △ key likewise.	0 0 0 0 0 0 0 0 0 0 MJ／h 0 0 0 0 2 0 0 0 0 MJ／h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to save the change. ——— FS 1(THERMAL) has been registered. ———	FS 1(THERMAL) ＊＊ COMPLETE ＊＊ ↓ FS 1(THERMAL) 20000 MJ／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

4.12.1.3. The source of analog output

Description

- Specify of which channel (path 1, path 2, or calculated value) flow rate and/or thermal energy are to be output to AO1 and AO2. The contents of output vary depending on the setting of measurement mode.

1-path/energy measurement mode:
Settable range
1. Source channel of AO1: CH1 flow rate, CH1 thermal flow
2. Source channel of AO2: CH1 flow rate, CH1 thermal flow

2-path mode and 2-pipe mode:
Settable range
1. Source channel of AO1: CH1 flow rate, CH2 flow rate, CH3 flow rate
2. Source channel of AO2: CH1 flow rate, CH2 flow rate, CH3 flow rate

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set analog output AO1 to CH3 flow rate. * Below is an example for 2-path measurement mode.	
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 6 times to display “AO1 OUT. SOURCE”.	AO1 OUT. SOURCE CH1: FLOW RATE
ENT ▼	Press the ENT key to blink the cursor.	AO1 OUT. SOURCE CH1: FLOW RATE
△ ▼	Press the △ key twice to display “CH3: FLOW RATE”.	AO1 OUT. SOURCE CH3: FLOW RATE
ENT ▼	Press the ENT key once to save the change.	AO1 OUT. SOURCE ＊＊ COMPLETE ＊＊
▼ ▼ ▼	———AO1 OUT. SOURCE has been registered.———	↓ AO1 OUT. SOURCE CH3: FLOW RATE
ESC △	Press the ESC key once and the △ key 3 times to return to the measurement mode.	0. 000 m／s 0. 000 m3／h

4.12.1.4. Analog output at error (Burnout)

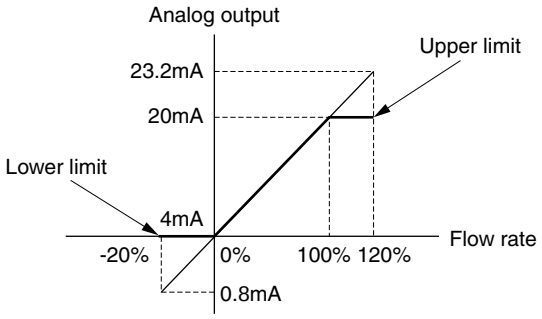
Description
- Determine how to set the analog output when received wave error, etc. due to device error, accidental drain of piping or entry of bubbles.
- Settable range
  (1) Analog output (4-20mA) at error
  HOLD : Outputs a current value preceding the error (factory set).
  UPPER : Sets analog output 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 4.5.1.)

Operation (example)	Set “UPPER” to BURNOUT. Set “20sec” to BURNOUT TIMER. * Set the piping parameters and "FLOW UNIT" beforehand. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETTUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”.	KIND FLOW RATE
△ ▼	Press the △ key for 5 times to display “BURNOUT” (CURRENT).	BURNOUT (CURRENT) HOLD
ENT ▼	Press the ENT key once to blink on the 2nd line.	BURNOUT (CURRENT) HOLD
△ ▼	Press the △ key once to display “UPPER”.	BURNOUT (CURRENT) UPPER
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— UPPER has been registered. ———	BURNOUT (CURRENT) ** COMPLETE ** ↓ BURNOUT (CURRENT) UPPER
△ ▼	Press the △ key once to display “BURNOUT TIMER”.	BURNOUT TIMER 10 sec
ENT ▼	Press the ENT key once to blink the cursor.	BURNOUT TIMER 010 sec
▷ ▼	Press the ▷ key once to align the cursor to “1”.	BURNOUT TIMER 010 sec
△ ▼	Press the △ key once to set “2”.	BURNOUT TIMER 020 sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— BURNOUT TIMER has been registered. ———	BURNOUT TIMER ** COMPLETE ** ↓ BURNOUT TIMER 20 sec
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.12.1.5. 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)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set “-10% (2.4mA)” to lower limit, and “110% (21.6mA)” to upper limit. * Set the piping parameters and "FLOW UNIT" beforehand. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
▼		
ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▼		
△	Press the △ key for 4 times to display “RANGE”.	RANGE
▼		
ENT	Press the ENT key once to display “KIND”.	KIND FLOW RATE
▼		
△	Press the △ key for 7 times to display “OUTPUT LIMIT LOW”.	OUTPUT LIMIT LOW -20 %
▼		
ENT	Press the ENT key once to blink the cursor.	OUTPUT LIMIT LOW -20 %
▼		
▷	Press the ▷ key once to align the cursor to “2”.	OUTPUT LIMIT LOW -20 %
▼		
△	Press the △ key several times to set “1”.	OUTPUT LIMIT LOW -10 %
▼		
ENT	Press the ENT key once to register.	OUTPUT LIMIT LOW ** COMPLETE ** ↓
▼		
▼	——— OUTPUT LIMIT LOW has been registered. ———	OUTPUT LIMIT LOW -10 %
▼		
△	Press the △ key once to display “OUTPUT LIM. HIGH”.	OUTPUT LIM. HIGH 120 %
▼		
ENT	Press the ENT key once to blink the cursor.	OUTPUT LIM. HIGH 120 %
▼		
▷	Press the ▷ key once to align the cursor to “2”.	OUTPUT LIM. HIGH 120 %
▼		
△	Press the △ key several times to set “1”.	OUTPUT LIM. HIGH 110 %
▼		
ENT	Press the ENT key once to register.	OUTPUT LIM. HIGH ** COMPLETE ** ↓
▼		
▼	——— OUTPUT LIM. HIGH has been registered. ———	OUTPUT LIM. HIGH 110 %
▼		
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.12.2. Setting the total (actual)

4.12.2.1. Total flow pulse (total 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 4.11.3.)
- 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, DO2, DO3 and DO4).

DO output port	Frequency range of pulse output (at full scale flow rate)	Pulse width
DO1, DO2, DO3, DO4 : Transistor, open collector	100 pulse/sec	5ms, 10ms, 50ms, 100ms, 200ms

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:

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

Condition 2:

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

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

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

$$= \underline{0.0001\ [\text{m}^3]} = \underline{0.1\ [\text{L}]}$$

As above:

$$\underline{0.1\ [\text{L}] \leq \text{TOTAL RATE}} \quad \cdots\cdots \text{A}$$

Condition 2

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

$$= \underline{0.001\ [\text{m}^3]} = \underline{1\ [\text{L}]} \quad \cdots\cdots \text{B}$$

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.

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

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

- Channel designation : CH1, CH2, CH3
  * When using 2-pipe measurement, set CH1, CH2 and CH3.
  * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

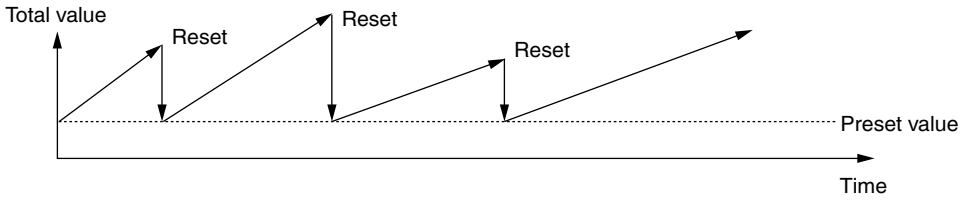
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set total rate to 0.1m^3/pulse, and pulse width to 100ms. * Set the flow total unit beforehand. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key once to display “ TOTAL RATE”	TOTAL RATE 0 m3
ENT ▼	Press the ENT key once to display the cursor.	TOTAL RATE 000000000 m3
▷ ▼	Press the ▷ key for 7 times to move the cursor.	TOTAL RATE 0000000 0 m3
△ ▼	Press the △ key several times to display a decimal point.	TOTAL RATE 0000000.0 m3
▷ ▼	Press the ▷ key once to move the cursor.	TOTAL RATE 0000000.0 m3
△ ▼	Press the △ key once to display “1”.	TOTAL RATE 0000000.1 m3
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “ TOTAL RATE” has been registered. ———	TOTAL RATE ** COMPLETE ** ↓ TOTAL RATE 0.1 m3
△ ▼	Press the △ key twice to display “PULSE WIDTH”.	PULSE WIDTH 50.0 msec
ENT ▼	Press the ENT key once to blink the cursor.	PULSE WIDTH 50.0 msec
△ ▼	Press the △ key twice, and select “100.0msec”.	PULSE WIDTH 100.0 msec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— PULSE WIDTH has been registered. ———	PULSE WIDTH ** COMPLETE ** ↓ 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 has been registered. ———	TOTAL MODE ** COMPLETE ** ↓ 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

4.12.2.2. 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 4.11.3.)
  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 4.5.1.)

Operation (example)	Set the preset value to 100m^3. * Set the flow total unit beforehand. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key twice to display “TOTAL PRESET”	TOTAL PRESET 0 m3
ENT ▼	Press the ENT key once to display the cursor.	TOTAL PRESET 0000000
▷ ▼	Press the ▷ key for 6 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	TOTAL PRESET 0000000 m3
△ ▼	Press the △ key once to display “1”.	TOTAL PRESET 0000010 0 m3
ENT ▼	Press the ENT key once to register.	TOTAL PRESET ** COMPLETE ** ↓
▼ ▼ ▼	——— “ TOTAL PRESET” has been registered. ———	TOTAL PRESET 100 m3
△ ▼	Press the △ key for 4 times to display “TOTAL MODE”.	TOTAL MODE STOP
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL MODE STOP
△ ▼	Press the △ key once, and select “TOTAL RESET”.	TOTAL MODE TOTAL RESET
ENT ▼	Press the ENT key once to register.	TOTAL MODE ** COMPLETE ** ↓
▼ ▼ ▼	——— “TOTAL MODE” has been registered. ———	TOTAL MODE TOTAL RESET
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 m/s 0.000 m3/h

4.12.2.3. Total energy pulse (total rate, pulse width)

Description
- Set to totalize a process variable (thermal energy) by total meter, etc. according to total pulse output. (for 1-path/energy measurement mode only).
  Energy totalization and flow totalization can be performed simultaneously.
- 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 thermal energy total unit before setting the total rate. (See Section 4.11.6)
- Regarding pulse width and setup restriction, refer to 4.12.2.1 “Setting the total flow pulse”.
  * Total pulse is not output when TOTAL RATE is set to “0”.
  * Minus-totalization of thermal energy is not available when the flow direction is reverse.
  * 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 4.5.1.)

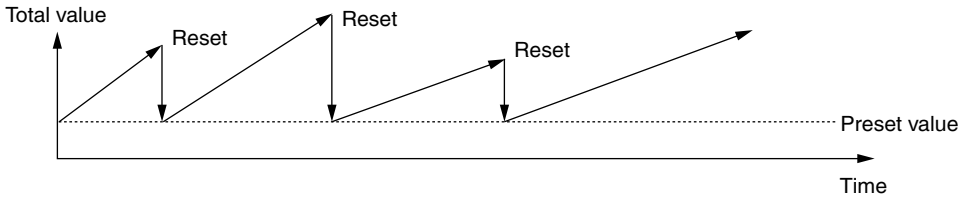
Operation (example)	Set the total rate to 1GJ per pulse. * Set the energy total unit before setting the total rate. * See 4.12.2.1 “Total flow pulse (total rate, pulse width)” for setting procedure of pulse width * Below is an example for 1-path/energy measurement mode.	
Key operation	Description	Display
△	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
▼ ENT	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
▼ △	Press the △ key for 5 times to display “TOTAL”.	TOTAL
▼ ENT	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
▼ △	Press the △ key 6 times to display TOTAL RATE (T)”.	TOTAL RATE(T) 0 GJ
▼ ENT	Press the ENT key once to display the cursor.	TOTAL RATE(T) 0 0 0 0 0 0 0 0 0 GJ
▼ ▷	Press the ▷ key 8 times to move the cursor.	TOTAL RATE(T) 0 0 0 0 0 0 0 0 0 GJ
▼ △	Press the △ key once to display “1”.	TOTAL RATE(T) 0 0 0 0 0 0 0 0 1 GJ
▼ ENT	Press the ENT key once to save the change.	TOTAL RATE(T) ＊＊ COMPLETE ＊＊
▼ ▼ ▼ ▼	——— TOTAL RATE(T) has been registered. ———	TOTAL RATE(T) 1 GJ
△	Press the △ key twice 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

4.12.2.4. Preset value for total energy

Description

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 heating total memory and cooling total memory.
  Set the total unit (thermal) beforehand in the MEASURE SETUP mode. (Refer to section 4.11.6.)
  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 4.5.1.)

Operation (example)	Set the preset value to 100GJ. * Set the total unit (thermal) beforehand * Below is an example for 1-path/energy measurement mode.	
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 ADJUTMENT SET ZERO
△ ▼	Press the △ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE STOP
△ ▼	Press the △ key twice to display “TOTAL PRESET(T)”	TOTAL PRESET(T) 0 GJ
ENT ▼	Press the ENT key once to display the cursor.	TOTAL PRESET(T) 0 0 0 0 0 0 0 0 0 GJ
▷ ▼	Press the ▷ key for 6 times to move the cursor. * Note that, it cannot be entered on the first digit (leftmost).	TOTAL PRESET(T) 0 0 0 0 0 0 0 0 0 GJ
△ ▼	Press the △ key once to display “1”.	TOTAL PRESET(T) 0 0 0 0 0 0 1 0 0 GJ
ENT ▼	Press the ENT key once to register.	TOTAL PRESET(T) ＊＊ COMPLETE ＊＊ ↓
▼ ▼ ▼	——— “ TOTAL PRESET(T)” has been registered. ———	TOTAL PRESET(T) 1 0 0 GJ
△ ▼	Press the △ key for 4 times to display “TOTAL MODE”.	TOTAL MODE STOP
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL MODE STOP
△ ▼	Press the △ key once, and select “TOTAL RESET”.	TOTAL MODE TOTAL RESET
ENT ▼	Press the ENT key once to register.	TOTAL MODE ＊＊ COMPLETE ＊＊ ↓
▼ ▼ ▼	——— “TOTAL MODE” has been registered. ———	TOTAL MODE TOTAL RESET
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0. 000 m／s 0. 000 m3／h

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

Description
- The total is started, stopped or reset.
- Channel designation : CH1, CH2,CH3
  * When using 2-pipe measurement, designate of which channel you want to start or stop calculation.
  * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.
- 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> A resetting action simultaneously resets both forward total memory and reverse total memory, and total thermal energy for cooling and total thermal energy for heating

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Reset the total value (reset value 0m^3), and restart a total. *Set the “TOTAL UNIT” beforehand. Refer to “4.12.4 LCD indication” * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
		0.00 m3/h + 127.26 m3
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE START
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL MODE START
△ ▼	Press the △ key twice to display “TOTAL RESET”.	TOTAL MODE TOTAL RESET
ENT ▼ ▼ ▼ ▼	Press the ENT key twice to execute “TOTAL RESET”. ——— The total operation is started. ———	TOTAL MODE ** COMPLETE ** ↓ TOTAL MODE TOTAL RESET
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.00 m3/h 0.00 m3

4.12.2.6. Totalization processing at error (Burnout)

Description
BURNOUT (TOTAL)
- Determines how to react such errors that the measurement status is abnormal on account of an empty pipe interior or bubbles mixed in fluid (common to total indication and 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.
  In energy measurement mode, totalization also stops at a hardware error such as a break in a resistance bulb (RTD).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Change the processing from "BURNOUT" to "HOLD", and change the burnout timer setting from 10 seconds to 15 seconds. *Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 5 times to display “TOTAL”.	TOTAL
ENT ▼	Press the ENT key once to display “TOTAL MODE”.	TOTAL MODE START
△ ▼ ▼ ▼ ▼	Press the △ key for 4 times to display “BURNOUT(TOTAL)”. Because HOLD (factory set) is already registered, go to the next step. Note) For setting “NOT USED”, press the //ENT key, and the /// key to select “NOT USED”.	BURNOUT(TOTAL) HOLD
△ ▼	Press the △ key once to display “BURNOUT TIMER”.	BURNOUT TIMER 10sec
ENT ▼	Press the ENT key once to blink the cursor.	BURNOUT TIMER 010sec
▷ ▼	Press the ▷ key twice to move the cursor.	BURNOUT TIMER 010sec
△ ▼	Press the △ key for 5 times to set “5”.	BURNOUT TIMER 015sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— BURNOUT TIMER has been registered. ———	BURNOUT TIMER ** COMPLETE ** ↓ BURNOUT TIMER 15sec
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.00 m3/h + 0.00 m3

4.12.3. DO output

Description

- Selects the output of total pulses and statuses (of alarm, flow switch, total switch, etc.).
- Selecting the source channel of DO output (DO1, DO2, DO3, and DO4)
  Specify of which channel (path 1, path 2, or calculated value) the data are to be output to DO output.
  Channel selection: CH1, CH2, CH3
  <Note> In 1-path/energy measurement, no parameters need to be specified by channel number.

- DO output types (common to DO1, DO2, DO3, and DO4):

Settable range

NOT USED	: Does not use the contact output.
+TOTAL PULSE	: Outputs the forward total flow pulses.
- TOTAL PULSE	: Outputs total flow pulse in reverse direction.
FULL SCALE 2	: Contact output is activated during FULL SCALE 2 measurement status. (forward automatic 2 ranges, forward and reverse range, forward/reverse automatic 2 ranges)
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.).
PROCESS ERROR	: Contact output is activated when no waves are received, or waves are unstable.
FLOW SWITCH	
FLOW SW HIGH	: Contact output is activated when flow rate is above the setting.
FLOW SW LOW	: Contact output is activated when flow rate is below the setting.
TOTAL SWITCH	: Contact output is activated when total flow value exceeds the setting.
AO RANGE OVER	: Contact output is activated when the lower and upper limits of flow range are above the setting.
PULSE RANGE OVER	: Contact output is activated when the total flow pulse output exceeds the maximum output frequency.
-FLOW DIRECTION	: Contact output is activated when the flow is in reverse direction.
* The following items are used only in 1-path/energy measurement.	
H: TOTAL PULSE(T)	: Outputs pulse for total heating energy
C: TOTAL PULSE(T)	: Outputs pulse for total cooling energy.
FULL SCALE 2(T)	: Contact output is activated during FULL SCALE 2(T) measurement status. (forward automatic 2 ranges, forward and reverse range, forward/reverse automatic 2 ranges)
FLOW SWITCH(T)	
FLOW SW HIGH(T)	: Contact output is activated when instantaneous thermal energy is above the setting.
FLOW SW LOW(T)	: Contact output is activated when instantaneous thermal energy is below the setting.
TOTAL SWITCH(T)	: Contact output is activated when total thermal energy exceeds the setting.
AO RANGE OVER(T)	: Contact output is activated when over-range occurs.
P:RANGE OVER(T)	: Contact output is activated when pulse overrange occurs.
AIR-CONDITIONING	: Contact output is activated when the operation mode switches between cooling and heating.
TEMP. ALARM	: Contact output is activated when an over-range (-40 to 200℃) temperature or an error such as a breakage of resistance bulb.
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 4.12.2.1)
100 pulses/s or less (at full scale flow rate)
Pulse width: 5, 10, 50, 100, 200,500 and 1000ms.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

4.12.3.1. Total pulse output

Description
- Sets the total pulse output for DO1 OUT, DO2 OUT, DO3 OUT, and/or DO4 OUT.
  + TOTAL PULSE: Outputs flow rate total pulse in forward direction.
  - TOTAL PULSE: Reverse flow rate total pulse output.
  H: TOTAL PULSE(T): Total pulse output of totalized heating energy.
  C: TOTAL PULSE(T): Total pulse output of totalized cooling energy.
  Note) Refer to Section 4.12.2.1.to set the flow total rate, pulse width, etc.
  Note) Refer to Section 4.12.2.3 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 4.5.1.)

Operation (example)	Set the DO1 output to "+ TOTAL PULSE". Also, set the contact to "ACTIVE ON". * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 6 times to display "DO1 OUT". * Press the △ key again to display "DO2 OUT". * Press the △ key again to display "DO3 OUT". * Press the △ key again to display "DO4 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 "+ TOTAL PULSE " on the 2nd line. * Use the △ key to select "- TOTAL PULSE", "H: TOTAL PULSE(T)", or "C: TOTAL PULSE(T)".	DO1 OUT +TOTAL PULSE
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register "+TOTAL PULSE". ——— "+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 m3/h 0.000 m3

4.12.4. LCD indication

Description
- Selecting the source channel
  Specify of which channel (path 1, path 2, or calculated value) values are to be displayed in the first and the second line.
  Channel selection: CH1, CH2,CH3
  <Note> In 1-path/energy measurement, no parameters need to be specified by channel number

- Flow velocity indication
  Selectable flow velocity units: m/s (if SYSTEM UNIT was set to METRIC) (See section 4.11.1)
  <Note> The decimal point position is fixed. (3 digits after a decimal point)
- Flow rate indication
  Selectable flow rate indications: Actual value reading, % reading.
  <Note> The indication unit is as selected by FLOW UNIT. (See section 4.11.2.)
- Total flow indication
  Selectable total indications: Actual total value reading (forward/reverse flow), total pulse count (forward/reverse flow).
  <Note> The indication unit is as selected by TOTAL UNIT. (See section 4.11.3.)

* The following items are used in 1-path/energy measurement.
- Instantaneous energy indication
  Selection: Actual value reading, % reading
  <Note> The indication unit is as selected by THERMAL UNIT. (See section 4.11.5)
- Total energy indication
  Selection: Actual total value reading (heating/cooling), energy total pulse count (heating/cooling).
  <Note> The indication unit is as selected by TOTAL(THERMAL). (See section 4.11.6)
- Temperature indication
  Selection: supply temperature, return temperature, temperature difference
  <Note> The indication unit is as selected by TEMPERATURE. (See section 4.11.4.)
  <Note> The decimal point position is fixed. (℃: 1 digit after a decimal point, K: 2 digits after a decimal point)

- How to set the indication
  Set the DISPLAY setting mode to 1st ROW (for indication on 1st line) or 2nd ROW (for indication on 2nd line), and further select indication contents.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Display the 1st line of LCD indication in percentages (%). * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 3 times to display “DISPLAY”.	DISPLAY 1ST.ROW
ENT ▼	Press the ENT key once to blink the cursor.	DISPLAY 1ST.ROW
ENT ▼	Press the ENT key again, and select “1ST. LOW”.	1ST. LOW VELOCITY
△ ▼	Press the △ key twice to display “FLOW RATE(%)”.	1ST. LOW FLOW RATE(%)
ENT ▼	Press the ENT key once, and select and fix “FLOW RATE(%)” to display “1:DECIMAL POINT”.	1:DECIMAL POINT ****.***
▷ ▼	Press the ▷ key once to shift the decimal point position to next place.	1:DECIMAL POINT *****.**
ENT ▼	Press the ENT key once to register.	1:DECIMAL POINT ** COMPLETE ** ↓
▼ ▼ ▼	——— FLOW RATE(%) indication has been set. ———	1:DECIMAL POINT *****.**
ESC △	Press the ESC key for 3 times and then the △ key for 3 times to enter the measurement mode.	0.00 % 0.000 m3

4.12.5. 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

Channel designation : CH1, CH2, CH ALL
* When using 2-pipe measurement, configure both CH1 and CH2. CH1 and CH2 can be configured simultaneously by selecting CH ALL.
* No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Change the damping from 5 to 20 sec. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key once to display “DAMPING”.	DAMPING 5.0 sec
ENT ▼	Press the ENT key once to blink the cursor.	DAMPING 005.0 sec
		005.0 sec
		025.0 sec
		025.0 sec
△ ▷ ▼	Set “20” by the △ key and the ▷ key.	DAMPING 020.0 sec
ENT ▼	Press the ENT key once to register.	DAMPING ** COMPLETE ** ↓
▼ ▼ ▼	——— DAMPING has been registered. ———	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

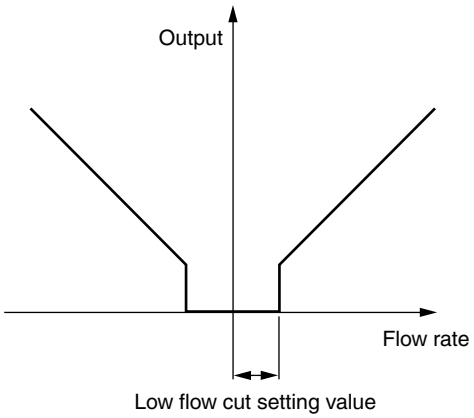
4.12.6. Low flow rate cutting

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 [m^3/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 "FLOW UNIT" in "MEASURE SETUP". (See section 4.11.2.)

Channel designation : CH1, CH2
* When using 2-pipe measurement, configure both CH1 and CH2.
* No channel setting is necessary for 1-path/energy measurement and 2-path measurement.



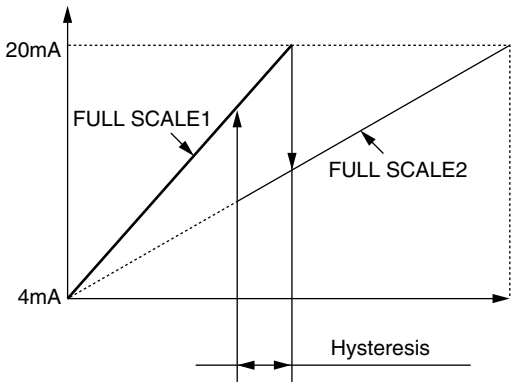
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the low flow rate cut point to 0.5 [m^3/h]. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key twice to display “CUT OFF”.	CUT OFF 0.150 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	CUT OFF 0000.150 m3/h
		0000.150 m3/h
		0000.550 m3/h
		0000.550 m3/h
△ ▷ ▼	Set “0.5” by the △ key and the ▷ key.	CUT OFF 0000.500 m3/h
ENT ▼	Press the ENT key once to register.	CUT OFF ** COMPLETE **
▼ ▼ ▼	——— CUT OFF has been registered. ———	↓ CUT OFF 0.500 m3/h
ESC △	Press the ESC key once and then press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.13. Application operation of parameter

4.13.1. Automatic 2 ranges

Description
- The function carries out a measurement while changing over the range according to the flow rate.
- The current output changes with the action range as illustrated on the right.
- The hysteresis can be set to between 0 and 20% of the smaller range.
- By setting DO1, DO2, DO3, and/or DO4 to "FULL SCALE 2", contact outputs are activated during "FULL SCALE 2" action. Select “ACTIVE ON” or “ACTIVE OFF” separately. (See 4.13.5.)
- Settable range: 0.3 to 32 [m/s] in terms of flow velocity in piping for any of FULL SCALE1 and FULL SCALE2.
  * Preset PIPE PARAMETER and FLOW UNIT.
  * If a value beyond the settable range is inputted, "INPUT ERROR" appears and then last setting is resumed.
  * If "FLOW UNIT" has been changed after setting the range, redo the range setting.
  * When FULL SCALE2 is not used (in the case of single range), set “0” to FULL SCALE2.



<Note> The flow rate unit is as selected by "FLOW UNIT". Before setting range, set the "FLOW UNIT". (See 4.11.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

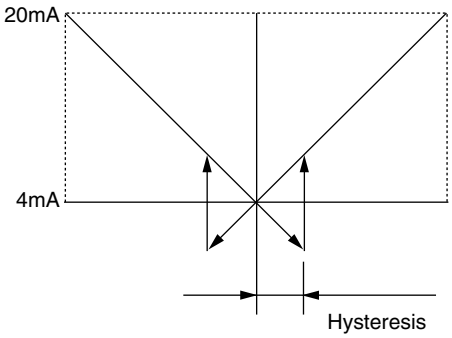
Operation (example)	Set “AUTO 2” to “RANGE TYPE”, 10[m^3/h] to “FULL SCALE1”, and 60[m^3/h] to “FULL SCALE2”. Set “RANGE HYS.” to 7%. * Preset “PIPE PARAMETER” and “FLOW UNIT”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
△ ▼	Press the △ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE TYPE SINGLE
△ ▼	Press the △ key once, and select “AUTO 2”.	RANGE TYPE AUTO 2
ENT ▼	Press the ENT key once to display “AUTO 2”.	RANGE TYPE AUTO 2
△ ▼	Press the △ key once to display “FULL SCALE1”.	FULL SCALE1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	FULL SCALE1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	FULL SCALE1 0020.0000 m3/h
△ ▼	Press the △ key several times to change to “1”.	FULL SCALE1 0010.0000 m3/h
	Note) To change the decimal point position, align the cursor with a place to change to, and press the △ key.	
ENT ▼	Press the ENT key once to register.	FULL SCALE1 ** COMPLETE ** ↓

▼ ▼ ▼	——— FULL SCALE1 has been registered. ———	FULL SCALE1 10.0000 m3/h
△	Press the △ key once to display “FULL SCALE2”.	FULL SCALE2 0.0000 m3/h
ENT	Press the ENT key once to blink the cursor.	FULL SCALE2 0000.0000 m3/h
▷	Press the ▷ key twice to move the cursor.	FULL SCALE2 0000.0000 m3/h
△	Press the △ key for 6 times to set “6”.	FULL SCALE2 0060.0000 m3/h
ENT	Press the ENT key once to register.	FULL SCALE2 ** COMPLETE ** ↓
▼ ▼ ▼ ▼	——— FULL SCALE2 has been registered. ———	FULL SCALE2 60.0000 m3/h
△	Press the △ key once to display “RANGE HYS.”.	RANGE HYS. 5.00 %
ENT	Press the ENT key once to blink the cursor.	RANGE HYS. 05.00 %
▷	Press the ▷ 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

4.13.2. Bi-directional range

Description

- The function measures the flow rate of either forward or reverse flow while changing over the range corresponding to the flow direction.
- The current output changes with the action range as illustrated on the right.
- The hysteresis can be set to between 0 and 20% of the action range.
- By setting DO1, DO2, DO3, and/or DO4 to "FULL SCALE2", contact output is activated during "FULL SCALE2" action.
  Select “ACTIVE ON” or “ACTIVE OFF” separately. (See section 4.13.5.)
- Settable range: ±0.3 to 32[m/s] in terms of flow velocity in piping for any of FULL SCALE1 and FULL SCALE2.
  * Preset PIPE PARAMETER and FLOW UNIT.
  * If a value beyond the settable range is inputted, "INPUT ERROR" appears and then last setting is resumed.
  * If "FLOW UNIT" is changed after setting the range, redo the range setting.
  * When FULL SCALE2 is not used (in the case of single range), set FULL SCALE2 to “0”.



<Note> The flow rate unit is as selected by "FLOW UNIT" in “MEASURE SETUP” mode. Before setting range, set the "FLOW UNIT". (See section 4.11.2.)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

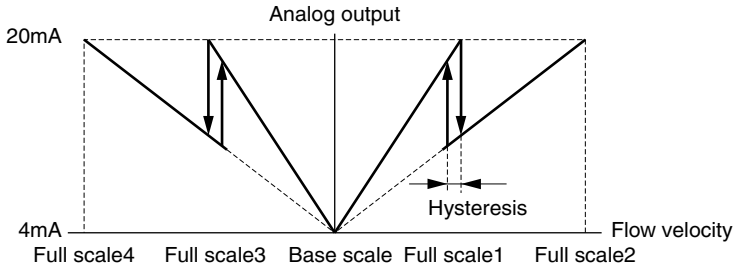
Operation (example)	Set “BI-DIR” to “RANGE TYPE”, 20[m3/h] to “FULL SCALE1”, and -10[m3/h] to “FULL SCALE2”. Set “RANGE HYS.” to 7%. * Preset “PIPE PARAMETER” and “FLOW UNIT”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
△ ▼	Press the △ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE SINGLE
△ ▼	Press the △ key twice, and select “BI-DIR”.	RANGE TYPE BI-DIR
ENT ▼	Press the ENT key for 4 times to display “RANGE TYPE”.	RANGE TYPE BI-DIR
△ ▼	Press the △ key once to display “FULL SCALE1”.	FULL SCALE1 50.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FULL SCALE1 0050.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “5”.	FULL SCALE1 0050.0000 m3/h
△ ▼	Press the △ key several times to set “2”.	FULL SCALE1 0020.0000 m3/h
	Note) To change the decimal point position, align the cursor with a place to change to, and press the △ key.	
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— FULL SCALE1 has been registered. ———	FULL SCALE1 ** COMPLETE ** ↓ FULL SCALE1 20.0000 m3/h
△ ▼	Press the △ key once to display “FULL SCALE2”.	FULL SCALE2 0.0000 m3/h

ENT	Press the ENT key once to register.	FULL SCALE2 0000.0000 m3/h
△	Press the △ key several times to display “-” on the 1st line.	FULL SCALE2 -000.0000 m3/h
▷	Press the ▷ key twice to move the cursor.	FULL SCALE2 -000.0000 m3/h
△	Press the △ key once to set “1”.	FULL SCALE2 -010.0000 m3/h
ENT	Press the ENT key once to register.	FULL SCALE2 ** COMPLETE ** ↓
	——— FULL SCALE2 has been registered. ———	FULL SCALE2 -10.0000 m3/h
△	Press the △ key once to display “RANGE HYS.”.	RANGE HYS. 5.00 %
ENT	Press the ENT key once to blink the cursor.	RANGE HYS. 05.00 %
▷	Press the ▷ key once to move the cursor.	RANGE HYS. 05.00 %
△	Press the △ key twice to set “7”.	RANGE HYS. 07.00 %
ENT	Press the ENT key once to register.	RANGE HYS. ** COMPLETE ** ↓
	——— RANGE HYS. has been registered. ———	RANGE HYS. 7.00 %
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.13.3. Bi-directional auto 2 range

Description

- The function measures the flow rate of either forward or reverse flow while changing over the range corresponding to the flow direction.
- The current output changes with the action range as illustrated on the right.
- The hysteresis can be set to between 0 and 20% of either range of FULL SCALE1 or FULL SCALE2 and FULL SCALE3 or FULL SCALE4 whichever the span is smaller.
- By setting DO1, DO2, DO3, and/or DO4 to "FULL SCALE2", contact output is activated during "FULL SCALE2" action.
  Select “ACTIVE ON” or “ACTIVE OFF” separately. (See section 4.13.5.)



- Settable range: ±0.3 to 32[m/s] in terms of flow velocity in piping for any of FULL SCALE1 and FULL SCALE2.
  When FULL SCALE1 and FULL SCALE2 are set, FULL SCALE3 and FULL SCALE4 are automatically set.
  FULL SCALE1 and FULL SCALE3, FULL SCALE2 and FULL SCALE4 are related as follows.
  |FULL SCALE1| = |FULL SCALE3|
  |FULL SCALE2| = |FULL SCALE4|
  * Preset PIPE PARAMETER and FLOW UNIT.
  * If a value beyond the settable range is inputted, "INPUT ERROR" appears and then last setting is resumed.
  * If "FLOW UNIT" is changed after setting the range, redo the range setting.
  * When FULL SCALE2 is not used (in the case of single range), set FULL SCALE2 to “0”.

<Note> The flow rate unit is as selected by "FLOW UNIT" in “MEASURE SETUP” mode. Before setting range, set the "FLOW UNIT". (See section 4.11.2.)

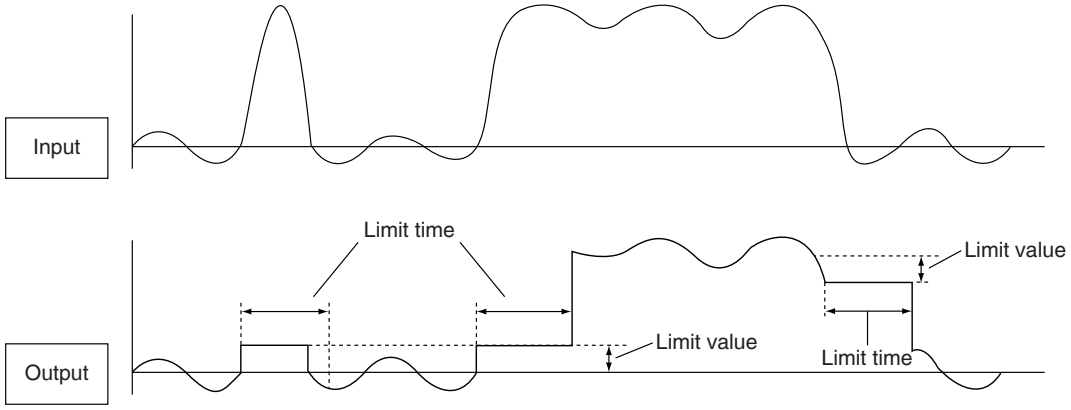
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set “BI-DIR AUTO 2” to “RANGE TYPE”, 10[m^3/h] to “FULL SCALE1”, and 60[m^3/h] to “FULL SCALE2”. Set “RANGE HYS.” to 7%. * Preset “PIPE PARAMETER” and “FLOW UNIT”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display “KIND”	KIND FLOW RATE
△ ▼	Press the △ key once to display “RANGE TYPE”	RANGE TYPE SINGLE RANGE
ENT ▼	Press the ENT key twice to blink the cursor.	RANGE TYPE SINGLE
△ ▼	Press the △ key for 3 times, and select “BI-DIR AUTO 2”.	RANGE TYPE BI-DIR AUTO 2
ENT ▼	Press the ENT key once to display “RANGE TYPE”.	RANGE TYPE BI-DIR AUTO 2
△ ▼	Press the △ key once to display “FULL SCALE1”.	FULL SCALE1 20.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor on the 2nd line.	FULL SCALE1 0020.0000 m3/h
▷ ▼	Press the ▷ key several times to align the cursor to “2”.	FULL SCALE1 0020.0000 m3/h
△ ▼	Press the △ key several times to set “1”. Note) To change the decimal point position, align the cursor with a place to change to, and press the △ key.	FULL SCALE1 0010.0000 m3/h

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

4.13.4. Rate limit

Description
- Spike noise input such as slurry fluid 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 set: 0[m^3/h])
  (2) RATE TIMER Enter in the range of 0 to 900 sec. (Factory set: 0sec)



(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.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set 5m^3/h to RATE LIMIT, and 10sec to RATE LIMIT TIMER. * Preset “PIPE PARAMETER” and “FLOW UNIT”. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 4 times to display “RANGE”.	RANGE
ENT ▼	Press the ENT key once to display ““KIND”	KIND FLOW RATE
△ ▼	Press the △ key for 9 times to display “RATE LIMIT”.	RATE LIMIT 0.000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	RATE LIMIT 00000.000 m3/h
▷ ▼	Press the ▷ key for 4 times to align the cursor.	RATE LIMIT 00000.000 m3/h
△ ▼	Press the △ key several times to set “5”.	RATE LIMIT 00005.000 m3/h
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— RATE LIMIT has been registered. ———	RATE LIMIT ** COMPLETE ** ↓ RATE LIMIT 5.000 m3/h
△ ▼	Press the △ key once to display “RATE LIMIT TIMER”.	RATE LIMIT TIMER 0 sec
ENT ▼	Press the ENT key once to blink the cursor.	RATE LIMIT TIMER 000 sec
▷ ▼	Press the ▷ key once to align the cursor.	RATE LIMIT TIMER 000 sec

△ ▼	Press the △ key several times to set “1”.	RATE LIMIT TIMER 010 sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— RATE LIMIT TIMER has been registered. ———	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

4.13.5. DO output

4.13.5.1. FULL SCALE 2 output

Description
● Select a contact output as DO1, DO2, DO3, and/or DO4 at FULL SCALE2 measurement status.

FULL SCALE 2 : Contact output is activated during FULL SCALE2 measurement. (AUTO 2, BI-DIR, BI-DIR AUTO2)
FS 2(THERMAL) : Contact output is activated during FS2(THERMAL) measurement. (for use in 1-path/energy measurement)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the DO1 output to “FULL SCALE2”. Also, set the contact to “ACTIVE ON”. * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 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

4.13.5.2. Alarm output

Description
- Select a contact output as DO1, DO2, DO3, and/or DO4 when received wave or E^2PROM is abnormal.
- Settable range
  ALL : Select a contact output when hardware and received wave (nothing, unstable) are abnormal.
  HARDWARE FAULT: Select a contact output when circuit is abnormal.
  PROCESS ERROR : Select a contact output when received wave is abnormal.

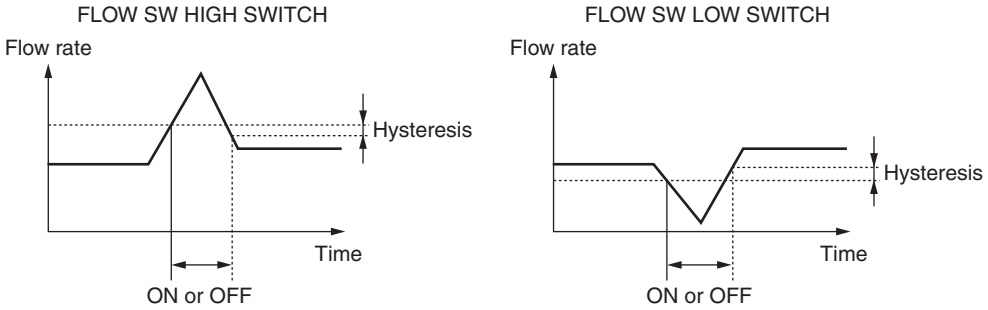
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the DO1 output to “PROCESS ERROR”. Also, set the contact to “ACTIVE ON”. * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 4 times to display “ALARM” on the 2nd line.	DO1 OUT ALARM
ENT ▼	Press the ENT key once to display the ALARM select panel.	ALARM ALL
△ ▼	Press the △ key twice to display “PROCESS ERROR”.	ALARM PROCESS ERROR
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “PROCESS ERROR” has been registered. ———	ALARM ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON”(normally off). * To select normally on, press the △ key. ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC △	Press the ESC key twice and then 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 “4.12.1.4 Analog output at error (Burnout)”.
Note) If “Process error” or “All” is issued, the burnout timer is enabled. If “Device error” is issued, the burnout timer is disabled.

4.13.5.3. Flow switch

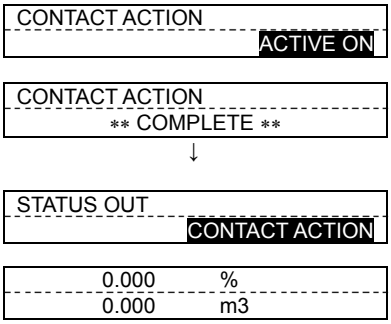
Description
- Select a contact output as DO1, DO2, DO3, and/or DO4 when the flow rate exceeds a setting.
- Select a contact output as DO1, DO2, DO3, and/or DO4 when the instantaneous energy exceeds a setting. (for 1-path/energy measurement)



- Settable range
  Flow rate : 0 to 32m/s in terms of flow velocity.
  Thermal flow : 0.000001 to 99999999
  Action : FLOW SW HIGH or FLOW SW LOW
  FLOW SW HIGH(Thermal) or FLOW SW LOW(Thermal)
  Contact action: ACTIVE ON : DO1/DO2/DO3/DO4: Normally off
  ACTIVE OFF: DO1/DO2/DO3/DO4: Normally on
  Note) The hysteresis value set in Section 4.12.1 "Setting of flow rate range" is applied to the action range.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

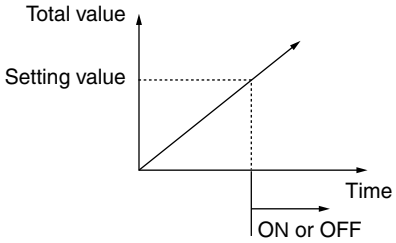
Operation (example)	Set the DO1 output to "FLOW SW HIGH", and upper limit flow rate to 12 [m^3/h]. Also, set the contact to "ACTIVE ON". * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display "DO1 OUT". * Use the △ key to select "DO2 OUT", "DO3 OUT", or "DO4 OUT".	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 5 times to display "FLOW SWITCH" on the 2nd line.	DO1 OUT FLOW SWITCH
ENT ▼	Press the ENT key once to display the flow rate setting screen of "FLOW SW HIGH". * Press the △ key once to display the flow rate setting screen of "FLOW SW LOW".	FLOW SW HIGH 10.0000 m3/h
ENT ▼	Press the ENT key once to blink the cursor.	FLOW SW HIGH 0010.0000 m3/h
▷ ▼	Press the ▷ key for 3 times to move the cursor.	FLOW SW HIGH 0010.0000 m3/h
△ ▼	Press the △ key twice to set "2".	FLOW SW HIGH 0012.0000 m3/h
ENT ▼	Press the ENT key once to register.	FLOW SW HIGH ** COMPLETE ** ↓
▼ ▼	——— "FLOW SW HIGH" has been registered. ———	STATUS OUT CONTACT ACTION

ENT ▼ ENT ▼ ▼ ▼ ▼ ESC △	Press the ENT key once to display “CONTACT ACTION”. Press the ENT key once to register “ACTIVE ON”(normally off). * To select normally on, press the △ key. ——— “ACTIVE ON” has been registered. ——— Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	

4.13.5.4. Total switch

Description
- Contact output DO1, DO2, DO3, and/or DO4 are activated when the totalized value exceeds a setting.
- Contact output DO1, DO2, DO3, and/or DO4 are activated when the instantaneous energy exceeds a setting. (for 1-path/energy measurement)
- Settable range: 0.000001 to 99999999

Action :TOTAL SWITCH, TOTAL SWITCH(Thermal)
Contact action:
ACTIVE ON : DO1/DO2/DO3/DO4: Normally off
ACTIVE OFF: DO1/DO2/DO3/DO4: Normally on
Note) Different values can be assigned to DO1, DO2, DO3, and DO4.



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the DO1 output to “TOTAL SWITCH”, and change the setting value from 10000[m^3] to 100[m^3]. Also, set the contact to “ACTIVE ON”. * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 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 “TOTAL SWITCH” on the 2nd line.	DO1 OUT TOTAL SWITCH
ENT ▼	Press the ENT key once to display the setting screen of “TOTAL SWITCH”.	TOTAL SWITCH 10000 m3
ENT ▼	Press the ENT key once to blink the cursor.	TOTAL SWITCH 00010000 m3
▷ ▼	Press the ▷ key for 3 times to move the cursor.	TOTAL SWITCH 00010000 m3
△ ▼	Press the △ key for 10 times to set “0”.	TOTAL SWITCH 00000000 m3
▷ ▼	Press the ▷ key twice to move the cursor.	TOTAL SWITCH 00000000 m3
△ ▼	Press the △ key once to set “1”.	TOTAL SWITCH 00000100 m3
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “TOTAL SWITCH” has been registered. ———	TOTAL SWITCH ** 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 m^3

4.13.5.5. Range over output and pulse range over output

Description
- AO RANGE OVER : Contact output to DO1, DO2, DO3, and/or DO4 are activated when the flow rate is outside the setting range.
- PULSE RANGE OVER: Contact output to DO1, DO2, DO3, and/or DO4 are activated when the total pulse output exceeds the maximum output frequency value.
- AO RANGE OVER(T) : Contact output to DO1, DO2, DO3, and/or DO4 are activated when the thermal energy is outside the setting range. (This item is used only in 1-path/energy measurement)
- P:RANGE OVER(T) : Contact output to DO1, DO2, DO3, and/or DO4 are activated when the total energy pulse output exceeds the maximum output frequency value. (This tem is used only in 1-path/energy measurement)

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the DO1 output to “AO RANGE OVER”. Also, set the contact to “ACTIVE ON”. * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 OUT”.	DO1 OUT NOT USED
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USED
△ ▼	Press the △ key for 7 times to display “AO RANGE OVER” on the 2nd line. * Press the △ key again to display “PULSE RANGE OVER”.	DO1 OUT AO RANGE OVER
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “RANGE OVER”. ——— “RANGE OVER” has been registered. ———	DO1 OUT ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ENT ▼	Press the ENT key once to display “CONTACT ACTION”.	CONTACT ACTION ACTIVE ON
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “ACTIVE ON”(normally off). * To select normally on, press the △ key. ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC △	Press the ESC key twice and then press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

4.13.5.6. Output at the minus flow direction

Description
- Select a contact output as DO1, DO2, DO3, and/or DO4 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 4.5.1.)

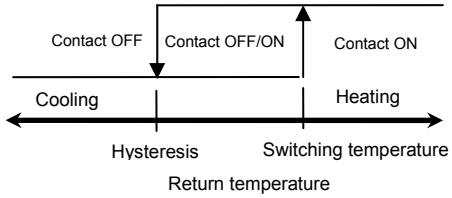
Operation (example)	Set the DO1 output to "-: FLOW DIRECTION". Also, set the contact to "ACTIVE ON". * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display "OUTPUT SETUP".	OUTPUT SETUP
ENT ▼	Press the ENT key once to display "ZERO ADJUSTMENT".	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display "DO1 OUT". * Use the △ key to select "DO2 OUT", "DO3 OUT", or "DO4 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 "-:FLOW DIRECTION" on the 2nd line.	DO1 OUT -:FLOW DIRECTION
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register "-:FLOW DIRECTION". ——— "-:FLOW DIRECTION" 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

4.13.5.7. Cooling/heating mode switching output

Description

- Cooling/heating switching signal is output when operating mode of energy measurement is set to “AIR-CONDITIONING”.
  During the cooling mode, energy calculation is based on the thermal coefficient for cooling.
  During the heating mode, energy calculation is based on the thermal coefficient for heating.

  AIR-CONDITIONING: Switching between heating and cooling operations activate contact output to DO1, DO2, DO3, and/or DO4.
  (This function is used only in 1-path/energy measurement)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set DO1 OUT to “AIR-CONDITIONING” and DO1 output operation to “Active ON”.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”.	DO1 OUT NOT USE
	* Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 OUT”.	
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USE
△ ▼	Press the △ key 17 times to display “AIR-CONDITIONING” on the second line.	DO1 OUT AIR-CONDITIONING
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “AIR-CONDITIONING”. ——— “AIR-CONDITIONING” 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” (Normal OFF). * Use the △ key when selecting “ACTIVE OFF” (Normal ON). ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ** COMPLETE ** ↓ STATUS OUT CONTACT ACTION
ESC △	Press the ESC key twice, and the △ key 3 times to return to the measurement mode.	0.000 % 0.000 m3

4.13.5.8. Temperature alarm

Description

- TEMP.ALARM : Contact outputs DO1, DO2, DO3, and/or DO4 are activated when: the temperature is outside the measuring range(-40 to 200℃), a break in the resistance bulb occurs, or temperature circuit is abnormal. (This function is used only in 1-path/energy measurement.)

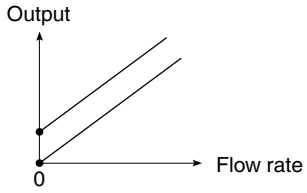
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set DO1 OUT to “TEMP.ALARM” and contact action to “ACTIVE ON”.	
Key operation	Description	Display
△ ▼	Press the △ key twice to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “ZERO ADJUSTMENT”.	ZERO ADJUSTMENT SET ZERO
△ ▼	Press the △ key for 8 times to display “DO1 OUT”. * Use the △ key to select “DO2 OUT”, “DO3 OUT”, or “DO4 OUT”.	DO1 OUT NOT USE
ENT ▼	Press the ENT key once to blink the cursor.	DO1 OUT NOT USE
△ ▼	Press the △ key 18 times to display “TEMP.ALARM” on the second line.	DO1 OUT TEMP.ALARM
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register “TEMP.ALARM”. ——— “TEMP.ALARM” has been registered. ———	TEMP.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 (Normal OFF). * Use the △ key when selecting “ACTIVE OFF” (Normal ON). ——— “ACTIVE ON” has been registered. ———	CONTACT ACTION ＊＊ COMPLETE ＊＊ ↓ STATUS OUT CONTACT ACTION
ESC △	Press the ESC key twice, and the △ key 3 times to return to the measurement mode.	0.000 m／s 0.000 m3

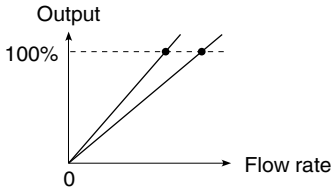
4.13.6. Calibrating the measured value

Description

- Measured value can be calibrated manually.
  Zero point and span adjustment can be made.
  Settable range
  (1) Channel designation : CH1, CH2
  * When using 2-pipe measurement, configure both CH1 and CH2.
  * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.
  (2) Zero point : -5 to +5 [m/s] in terms of flow velocity in piping.
  (3) Span : ±200%



Zero adjustment movement



Span movement

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

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

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Compensate the zero point to 0.5m³/h, and the span by +1%. * Below is an example for 1-path/energy measurement and 2-path measurement. Refer to Section 4.8.1 for channel designation of 2-pipe measurement.	
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 12 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” has been registered. ———	CALIBRATION ZERO ** COMPLETE ** ↓ 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” has been registered. ———	CALIBRATION SPAN ** COMPLETE ** ↓ 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

4.13.7. Setting the operation mode (normal/high-speed)

Description
- Used to switch computation cycle and output cycle.
- Settable range
  NORMAL : Standard mode (factory-set value), computation/output cycle is approximately 0.5 seconds.
  HIGH SPEED: High speed response mode, computation/output cycle is approximately 0.2 seconds.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Switch the operation mode to the high speed response mode.	
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 14 times to display “OPERATION MODE”.	OPERATION MODE NORMAL
ENT ▼	Press the ENT key once to blink the cursor.	OPERATION MODE NORMAL
△ ▼	Press the △ key for 6 times to move the cursor.	OPERATION MODE HIGH SPEED
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “OPERATION MODE” has been registered. ———	OPERATION MODE ** COMPLETE ** ↓ OPERATION MODE HIGH SPEED
ESC △	Press the ESC key once and then press the △ key for 3 times to enter the measurement mode.	0.000 % 0.000 m3

Reference
The difference between standard mode and high speed mode
High speed mode is unfit for the measurement when foreign objects or air bubbles are contained.
Standard mode is about 10 times more resistant to entry of foreign objects or air bubbles than high speed mode.

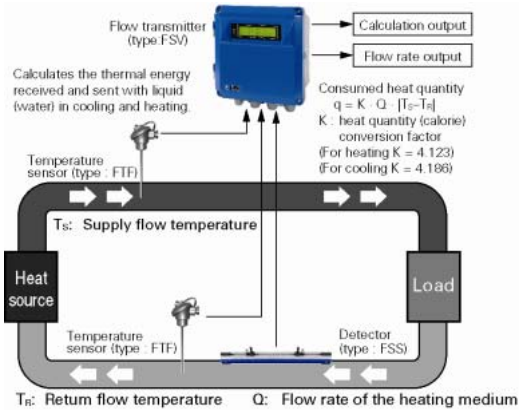
4.14. Energy measurement

4.14.1. Settings for energy measurement

Description

- This is a function to measure the thermal energy received and sent with liquid in cooling and heating system.
- Energy measurement can be started by setting MODE to “USED” and input signal to “Pt100”.
- Instantaneous energy can be output as analog signal. See section 4.12.1. for more detail.
- Totalization can be divided into heating totalization and cooling totalization. In addition, totalized pulse can be output. See section 4.12.1.
- Status (alarm, energy flow switch, energy total switch, etc.) can be output. See section 4.12.3.
- Settable range:

1. MODE : NOT USED, USED(factory set)
2. OPERATION : COOLING(factory set)
   COEFFICIENT
   (1.000 to 9.999 (factory set: 4.186))
   HEATING
   COEFFICIENT
   (1.000 to 9.999 (factory set: 4.123))
   AIR-CONDITIONING
   CHANGE TEMP.(-40 to 200°C （factory set: 30°C)
   TEMP.HYS (-40 to 200°C (factory set: 25°C)
3. INPUT SIGNAL : NOT USED, Pt100 (factory set)
4. SUPPLY TEMP. :TS INPUT
   CALIBRATION ZERO (-40 to 40°C (factory set: 0°C))
   CALIBRATION SPAN (50 to 150% (factory set: 100%))
   DAMPING (0 to 120sec (factory set: 5sec))
   SETTING
   TEMPERATURE (-40 to 200°C (factory set: 25°C)
5. RETURN TEMP.: TR INPUT
   CALIBRATION ZERO (-40 to 40°C (factory set: 0°C))
   CALIBRATION SPAN (50 to 150% (factory set: 100%))
   DAMPING (0 to 120sec (factory set: 5sec))
   SETTING
   TEMPERATURE (-40 to 200°C (factory set: 25°C)



<Note> When temperature difference is 0.5°C or less, thermal energy is indicated as zero.
Minus-totalization is not available when the direction of flow is reverse.

4.14.1.1. Mode setting and temperature input signal

Description
- Used for setting energy measurement.
- Settable range:
  1. MODE : NOT USED, USED(factory set)
  2. INPUT SIGNAL : NOT USED, Pt100 (factory set)

* Set the measurement mode to “1 PATH” beforehand. (See section 4.7)
* Energy measurement is not available when MODE is set to “NOT USED”.

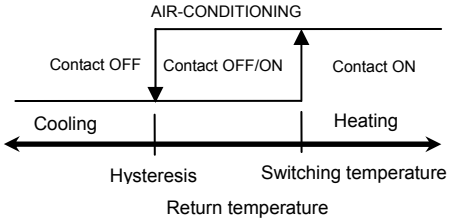
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set MODE to “USED” and INPUT SIGNAL to “Pt100”.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key for 8 times to display “ENERGY MODE”.	ENERGY MODE
ENT ▼	Press the ENT key once to display “MODE”. Check that USED (factory set) is registered.	MODE USED
△ ▼	Press the △ key twice to display “INPUT SIGNAL”. Check that Pt100 (factory set) is registered.	INPUT SIGNAL Pt100
ESC △	Press the ESC key twice and the △ key twice to return to the measurement mode.	0.000 % 0.000 m3

4.14.1.2. Operation mode (cooling/heating/air-conditioning)

Description
- Specify the condition of the pipe to be measured.
- Thermal energy is calculated with the thermal coefficient for cooling when “COOLING” is selected. Totalized value is integrated to total cooling energy (C: TOTAL (THERMAL)).
- Thermal energy is calculated with the thermal coefficient for heating when “HEATING” is selected. Totalized value is integrated to total heating energy (H: TOTAL (THERMAL)).
- In “AIR-CONDITIONING” mode, cooling/heating is automatically switched when the return temperature is at the temperature of “CHANGE TEMP.” and “TEMP.HYS”.
  During the cooling mode, energy calculation is performed with the thermal coefficient for cooling.
  During the heating mode, energy calculation is performed with the thermal coefficient for heating.
  Switching signal can be output (DO output). (See section 4.13.5.7)
- Settable range:

1. Operation : COOLING (factory set)
   COEFFICIENT
   (1.000 to 9.999 (factory set: 4.186))
   HEATING
   COEFFICIENT
   (1.000 to 9.999 (factory set: 4.123))
   AIR-CONDITIONING
   CHANGE TEMP. (-40 to 200℃ (factory set: 30℃)
   TEMP.HYS (-40 to 200℃ (factory set: 25℃)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

① Setting procedure for heating mode

Operation (example)	Set operation mode to “HEATING” and coefficient to “4.11.3”.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key for 8 times to display “ENERGY MODE”.	ENERGY MODE
ENT ▼	Press the ENT key once to display “MODE”.	MODE USED
△ ▼	Press the △ key once to display “OPERATION”.	OPERATION COOLING
ENT ▼	Press the ENT key once to blink the cursor.	OPERATION COOLING
△ ▼	Press the △ key once to display “HEATING” on the second line.	OPERATION HEATING
ENT ▼	Press the ENT key once to register.	OPERATION ** COMPLETE **
▼ ▼ ▼	——— “HEATING” has been registered. ——— “COEFFICIENT” will be displayed.	COEFFICIENT 4. 123
ENT ▼	Press the ENT key once to blink the cursor.	COEFFICIENT 4. 123
▷ ▼	Press the ▷ key twice to move the cursor.	COEFFICIENT 4. 123
△ ▼	Press the △ key for 9 times to enter “1”.	COEFFICIENT 4. 113
ENT ▼	Press the ENT key once to register.	COEFFICIENT ** COMPLETE **
▼ ▼ ▼	——— “COEFFICIENT” has been registered. ———	COEFFICIENT 4. 113
ESC △	Press the ESC key twice and the △ key twice to return to the measurement mode.	0. 000 % 0. 000 m3

② Setting procedure for air-conditioning mode

Operation (example)	Set operating mode to “AIR-CONDITIONING”, “CHANGE TEMP.” to “40℃”, and “TEMP.HYS” to “20℃”. * “COEFFICIENT” for both cooling and heating should be configured beforehand.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key for 8 times to display “ENERGY MODE”.	ENERGY MODE
ENT ▼	Press the ENT key once to display “MODE”.	MODE USED
△ ▼	Press the △ key once to display “OPERATION”.	OPERATION COOLING
ENT ▼	Press the ENT key once to blink the cursor.	OPERATION COOLING
△ ▼	Press the △ key once to display “AIR-CONDITIONING” on the second line.	OPERATION AIR-CONDITIONING
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “AIR-CONDITIONING” has been registered. ——— “CHANGE TEMP.” will be displayed.	OPERATION ** COMPLETE ** ↓ CHANGE TEMP. ３０．０ ℃
ENT ▼	Press the ENT key once to blink the cursor.	CHANGE TEMP. ＋０３０．０ ℃
▷ ▼	Press the ▷ key twice to move the cursor.	CHANGE TEMP. ＋０３０．０ ℃
△ ▼	Press the △ key once to enter “4”.	CHANGE TEMP. ＋０４０．０ ℃
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “CHANGE TEMP.” has been registered. ———	CHANGE TEMP. ** COMPLETE ** ↓ CHANGE TEMP. ４０．０ ℃
△ ▼	Press the △ key once to display “TEMP. HYS”.	TEMP. HYS ２５．０ ℃
ENT ▼	Press the ENT key once to blink the cursor.	TEMP. HYS ＋０２５．０ ℃
▷ ▼	Press the ▷ key for 3 times to move the cursor.	TEMP. HYS ＋０２５．０ ℃
△ ▼	Press the △ key for 5 times to enter “0”.	TEMP. HYS ＋０２０．０ ℃
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “TEMP. HYS” has been registered. ———	TEMP. HYS ** COMPLETE ** ↓ TEMP. HYS ２０．０ ℃
ESC △	Press the ESC key twice and the △ key twice to return to the measurement mode.	０．０００ % ０．０００ m３

4.14.1.3. Calibrating the temperature

Description

- CALIBRATION ZERO and CALIBRATION SPAN: Used to calibrate measured value manually.
  Zero point and/or span can be calibrated. Calibration equation is shown below.

$$\text{Temperature} = \frac{\text{Measured value} \times [\text{Set span value \%}]}{100} + \text{Zero point}$$

- DAMPING : Used to reduce fluctuation of measured value.
  The default value is a time constant. (Response time: approx. 63%)
- SETTING : Used when calculating thermal energy based on set temperature, instead of temperature input.

- Settable range
  1. Supply temperature : TS INPUT
     CALIBRATION ZERO (-40 to 40°C (factory set: 0°C))
     CALIBRATION SPAN (50 to 150% (factory set: 100%))
     DAMPING (0 to 120sec(factory set: 5sec))
     SETTING
     TEMPERATURE (-40 to 200°C (factory set: 25°C))
  2. Return temperature : TR INPUT
     CALIBRATION ZERO (-40 to 40°C (factory set: 0°C))
     CALIBRATION SPAN (50 to 150% (factory set: 100%))
     DAMPING (0 to 120sec(factory set: 5sec))
     SETTING
     TEMPERATURE (-40 to 200°C (factory set: 25°C))

Temperature conversion table

°C	K	F
-40	233.15	-40.00
0	273.15	32.00
40	313.15	104.00

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Change the value of DAMPING of SUPPLY TEMP. and RETURN TEMP. to “10sec”.	
Key operation	Description	Display
△ ▼	Press the △ key for 3 times to display “OUTPUT SETUP”.	OUTPUT SETUP
ENT ▼	Press the ENT key once to display “MEASUREMENT MODE”.	MEASUREMENT MODE 1 PATH
△ ▼	Press the △ key for 8 times to display “ENERGY MODE”.	ENERGY MODE
ENT ▼	Press the ENT key once to display “MODE”.	MODE USED
△ ▼	Press the △ key once to display “SUPPLY TEMP.”.	SUPPLY TEMP. TS INPUT
ENT ▼	Press the ENT key once to blink the cursor.	SUPPLY TEMP. TS INPUT
ENT ▼	Press the ENT key once to display “CALIBRATION ZERO”.	CALIBRATION ZERO 0.0 ℃
△ ▼	Press the △ key twice to display “DAMPING”.	DAMPING 5 sec
ENT ▼	Press the ENT key once to blink the cursor.	DAMPING 005 sec
△ ▷ ▼ ▼ ▼ ▼	Use the ▷ key to move the cursor, and the △ key to change the value.	005 sec 015 sec 010 sec
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “DAMPING” has been registered. ———	DAMPING ** COMPLETE ** ↓ DAMPING 10 sec
ESC ▼	Press the ESC key once to display “SUPPLY TEMP.”	SUPPLY TEMP. TS INPUT
△ ▼	Press the △ key once to display “RETURN TEMP.”	RETURN TEMP. TR INPUT

ENT	Press the ENT key once to blink the cursor.	RETURN TEMP. TR INPUT
▼		
ENT	Press the ENT key once to display “CALIBRATION ZERO”.	CALIBRATION ZERO 0. 0 ℃
▼		
△	Press the △ key twice to display “DAMPING”.	DAMPING 5 sec
▼		
ENT	Press the ENT key once to blink the cursor.	DAMPING 005 sec
▼		
△ ▷	Use the ▷ key to move the cursor, and the △ key to change the value.	005 sec 015 sec 010 sec
▼		
▼		
▼		
ENT	Press the ENT key once to register.	DAMPING ** COMPLETE ** ↓
▼		
▼	——— “DAMPING” has been registered. ———	DAMPING 10 sec
▼		
ESC △	Press the ESC key for 4 times and the △ key twice to return to the measurement mode.	0. 000 % 0. 000 m3

4.15. Maintenance mode

4.15.1. Copying the parameters

Description

- Set values of a parameter can be copied between channels. This function is available in 2-pipe measurement mode.

Channels to be copied

- ・CH2 ← CH1 : Copy CH1 (Path 1) to CH2 (Path 2)
- ・CH3 ← CH1 : Copy CH1 (Path 1) to CH3 (Calculated value)
- ・CH1 ← CH2 : Copy CH2 (Path 2) to CH1 (Path 1)
- ・CH3 ← CH2 : Copy CH2 (Path 2) to CH3 (Calculated value)
- ・CH1 ← CH3 : Copy CH3 (Calculated value) to CH1（Path 1）
- ・CH2 ← CH3 : Copy CH3 (Calculated value) to CH2（Path 2）

Contents to be copied ○: Applicable, －: Not applicable

Parameter		CH1	CH2	CH3
OUTPUT SETUP	DAMPING	○	○	－
	CUTOFF	○	○	－
	RANGE	○	○	○
	TOTAL	○	○	○
	CALIBRATION ZERO	○	○	－
	CALIBRATION SPAN	○	○	－
MEASURE SETUP	FLOW UNIT	○	○	○
	TOTAL UNIT	○	○	○
	PROCESS SETTING	○	○	－
MAINTENANCE MODE	DETAILS	○	○	－

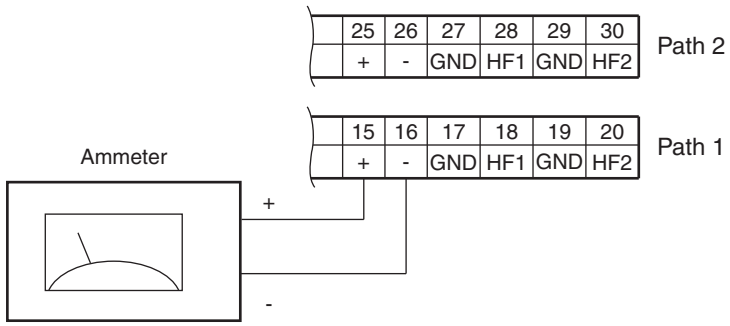
<Note> If the total mode of the source channel is set to “RESET” or “START”, set the total mode of the destination channel to “STOP”.
Before performing the totalization after copying parameters, be sure to set the total mode of the destination channel to “RESET” according to the section 4.12.2.5.
When copying is completed, return to the measurement mode and turn OFF the power, and then power ON.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Copy CH3 (Calculated value) to CH1 (Path 1). * Below is an example for 2-pipe measurement mode.	
Key operation	Description	Display
		0.000 m／s 0.000 m3／h
△ ▼	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION CH1
△ ▼	Press the △ key once to display “COPY”.	COPY CH2 ← CH1
ENT ▼	Press the ENT key once to blink the display of second line.	COPY CH2 ← CH1
△ ▼	Press the △ key for 4 times to display “CH1←CH3” on the second line.	COPY CH1 ← CH3
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— “COPY” has been registered. ———	COPY ** COMPLETE ** ↓ COPY CH1 ← CH3
ESC △	Press the ESC key once and the △ key once to return to the measurement mode.	0.000 % 0.000 m3

4.15.2. 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: AO1: between Path 1 terminal board (15 to 16)
  AO2: between Path 2 terminal board (25 to 26)



For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

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 INFORMATION”.	RAS INFORMATION
△ ▼	Press the △ key once to display “AO1 CURRENT”.	AO1 CURRENT CARIBRATION
	When selecting “AO2 CURRENT”, press the △ key twice.	
ENT ▼	Press the ENT key twice to enter the calibration mode of 4mA output.	AO1 CARIBRATION 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. ——— 4mA adjustment result has been registered. ———	AO1 CARIBRATION ** COMPLETE ** ↓ AO1 CARIBRATION 4 mA
△ ▼	Press the △ key once, and select 20mA.	AO1 CARIBRATION 20mA
ENT ▼	Press the ENT key twice to enter the calibration mode of 20mA output.	AO1 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. ——— 20mA adjustment result has been completed. ———	AO1 CARIBRATION ** COMPLETE ** ↓ AO1 CARIBRATION 20mA
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.15.3. 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

- This operation sets AO1 and AO2 the same contact action.
- Before operation, check whether it is permitted to change AO output.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

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 INFORMATION”.	RAS INFORMATION
△ ▼	Press the △ key for 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. Note) Constant current output starts.	OUTPUT SETTING +000 %
▷ △ ▼	Enter “5” by using the ▷ key and the △ key.	OUTPUT SETTING +050 %
ENT ▼ ▼ ▼ ▼	Press the ENT key once to output 12mA. ——— Outputting 12mA. ———	OUTPUT SETTING ** COMPLETE ** ↓ 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

4.15.4. 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 4.12.2.1.)
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, DO2, DO3, and DO4 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 4.5.1.)

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 INFORMATION”.	RAS INFORMATION
△ ▼	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. Note) Start simulated pulse output.	TOTAL PULSE 001 PULSE/s
▷ ▼	Press the ▷ key twice to move the cursor.	TOTAL PULSE 001 PULSE/s
△ ▼	Press the △ key for 4 times to set “5”.	TOTAL PULSE 005 PULSE/s
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— 5 PULSE/s has been registered. ——— 5 PULSE/s simulated pulse is output.	TOTAL PULSE ** COMPLETE ** ↓ TOTAL PULSE 005 PULSE/s
ESC ▼	After checking the output, press the ESC key once to stop simulated pulse output.	TOTAL PULSE 005 PULSE/s
ESC △	Press the ESC key once and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.15.5. Checking the status output

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

⚠ CAUTION

- This operation sets DO1, DO2, DO3, and DO4 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 4.5.1.)

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 INFORMATION”.	RAS INFORMATION
▼		
△	Press the △ key for 5 times to display “STATUS”.	DO CHECK OFF
▼		
ENT	Press the ENT key once to blink the cursor.	DO CHECK OFF
▼	Note) Contact output is displayed at this time. “OFF” is given at right.	
△	Press the △ key once, and select “ON”.	DO CHECK ON
▼		
ENT	Press the ENT key once to register “ON”.	DO CHECK ** COMPLETE **
▼		↓
▼	——— “ON” has been registered. ———	DO CHECK ON
▼	* Check the contact output “ON”.	
△	Press the △ key once, and select “OFF”.	DO CHECK OFF
▼		
ENT	Press the ENT key once to register “OFF”.	DO CHECK ** COMPLETE **
▼		↓
▼	——— “OFF” has been registered. ———	DO CHECK OFF
▼	* Check the contact output “OFF”.	
ESC	Press the ESC key once to stop the cursor from blinking.	DO CHECK OFF
▼	* It returns to contact output at the normal measurement status.	
ESC △	Press the ESC key once and then press the △ key once to enter the measurement mode.	0.000 % 0.000 m3

4.15.6. Confirming the input temperature

Description
- The input temperature can be indicated. This function is available only in 1-path/energy measurement.

Display contents: TS: Supply temperature TR: Return temperature
* To activate this function, “MODE” selection of the “ENERGY MODE” has to be set to “USED” and “INPUT SIGNAL” to “Pt100”.

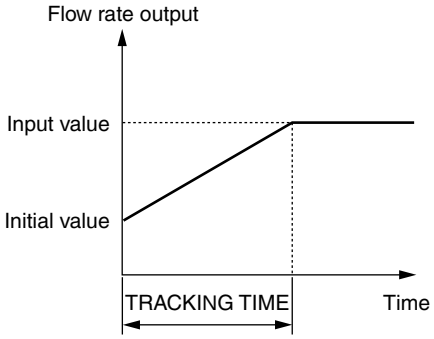
For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

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 INFORMATION”.	RAS INFORMATION 0000000000000000
△ ▼	Press the △ key for 8 times to display “TEMP. CHECK”.	TEMP. CHECK
ENT ▼	Press the ENT key once to display temperatures.	TS: 0.0 ℃ TR: 0.0 ℃
ESC ▼	Press the ESC key once to stop the cursor blinking.	TEMP. CHECK
ESC △	Press the ESC key once and the △ key once to return to the measurement mode.	0.000 % 0.000 m3

4.15.7. Test mode (simulated flow rate output)

Description

- Checks different outputs (LCD indication, analog output, DO output) upon simulating flow rate outputs.
  With the output at the actuated time as an initial value, the output changes up to the input value (simulated 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 4.12.5).

⚠ CAUTION

- By performing the operation, the output of analog outputs AO1 and AO2, and output DO1, DO2, DO3, and DO4 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 4.5.1.)

Operation (example)	Set the simulated flow rate target to 100%, and the tracking time to 100 [s]. *Set the “FLOW RATE (%)” before hand. Refer to “4.12.4 LCD indication” * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼		
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼		
△	Press the △ key for 9 times (7 times for 2-pipe mode) 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 ▼ ▼ ▼ ▼ ESC △	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. 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.	TRACKING TIME 100 sec TRACKING TIME ** COMPLETE ** ↓ TRACKING TIME 100 s T 0.00 % 0.000 m3/h ↓ T 100.00 % 10.000 m3/h

4.15.8. 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 (factory set) or 19200 bps, 38400bps.
Parity	: NONE, EVEN (factory set), ODD
Stop bits	: 1 BIT (factory set), 2 BITS
Station No.	: 1 to 31 (factory set: 1)
Communication protocol	: MODBUS RTU mode (factory set) or M-Flow (Fuji Electric's M-Flow [Type: FLR] protocol)

Note) For the transmission specifications, refer to the separate instruction manual "Ultrasonic Flowmeter Communication functions" (INF-TN5A1951-E).

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the baud rate to 9600bps, the parity to "NONE", the stop bits to "1 BIT", and the slave No. to "5". * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△ ▼	Press the △ key for 4 times to display "MAINTENANCE MODE".	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display "RAS INFORMATION".	RAS INFORMATION 0000000000000000
△ ▼	Press the △ key for 10 times (8 times for 2-pipe mode) to display "COMMUNICATION".	COMMUNICATION
ENT ▼	Press the ENT key once to display " RS-485 "	MODE RS-485
△ ▼	Press the △ key once to display "BAUD RATE". Because "9600 bps" is set, go to the next step. To select other baud rate, press the ENT key, and select by the △ key, and register by the ENT key.	BAUD RATE 9600bps
△ ▼	Press the △ key once to display "PARITY".	PARITY ODD
ENT ▼	Press the ENT key once to blink on the 2nd line.	PARITY ODD
△ ▼	Press the △ key once to display "NONE".	PARITY NONE
ENT ▼ ▼ ▼ ▼	Press the ENT key once to register. ——— "NONE" has been registered. ———	PARITY ** COMPLETE ** ↓ 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
△ ▼	Press the △ key once to display “PROTOCOL”. Because “MODBUS” is set, setting is completed. To select other protocol, press the ENT key, and select a protocol by the △ key, and register it by the ENT key.	PROTOCOL MODBUS
ESC △	Display the measurement mode by the ESC key and the △ key.	0.000 % 0.000 m3/h

4.15.9. Setting the ID No.

Description
- Set the ID No. for parameters (Section 4.5.1).
  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 4.5.1.)

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 4.5.1.)
If you forget the ID number you set, contact us.

Operation (example)	Set “1106” as the ID No. * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼		
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼		
△	Press the △ key for 12 times (10 times for 2-pipe mode) 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 △	Display the measurement mode by the ESC key and the △ key.	0.000 %
		0.000 m3/h
	Note) To set the protection, set the protection to "PROTECT ON". (See Section 4.5.1.)	

4.15.10. 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. * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼		
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼		
		*
△	Press the △ key for 13 times (11 times for 2-pipe mode) to display	FSV****2
▼	“VER. NO.”.	Ver.20B 11
ESC △	After checking, display the measurement mode by the ESC key or the	0.000 %
	△ key.	0.000 m3/h

* The indicated version number is display example.

4.15.11. Initializing setting parameters

Description
- Initializes the setting parameters saved in the memory.
- Initializes those other than the zero adjusted values or analog output calibration value.

Initialize code: 0100 (4-digit number)

⚠ CAUTION

- This parameter is intended for our service personnel.
- Do not attempt to initialize the setting parameters. Otherwise measurement is disabled.
  When the parameter is initialized, display language is set to English.
  To switch the display language, refer to “4.6. Display language”.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Initializes the setting parameters. * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△ ▼	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
△ ▼	Press the △ key for 14 times (12 times for 2-pipe mode) to display “MEMORY INITIAL”.	MEMORY INITIAL
ENT ▼	Press the ENT key twice to blink on the 2nd line.	MEMORY INITIAL 0000
▷ △ ▼	Set “0100” by the ▷ key and the △ key.	MEMORY INITIAL 0100
ENT ▼	Press the ENT key once to register.	MEMORY INITIAL ** COMPLETE ** ↓
▼	— Flow transmitter is reset, and the measurement mode is displayed. —	0.000 m/s 0.000 m3/h

4.15.12. LCD backlight setting

Description
- Sets the operation of the LCD backlight.
  You can set that light is ON all the time/ light is OFF all the time/ light is ON only when key operation and light is OFF at setting time.

Setting content
- ON: LCD backlight is ON all the time.
- OFF: LCD backlight is OFF all the time
- 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. Backlight relights when you operate a key, and turns off 10 seconds after the last key operation.

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

Operation (example)	Set the backlight ON time to 10minuites after key operation is completed. * Below is an example for 1-path/energy measurement and 2-path measurement.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼		
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼		
△	Press the △ key for 15 times (13 times for 2-pipe mode) to display	LCD BACKLIGHT ON
▼	“LCD BACKLIGHT”	
ENT	Press the ENT key once to blink the cursor.	LCD BACKLIGHT ON
▼		
△	Press the △ key once to select “OFF”	LCD BACKLIGHT OFF
▼		
ENT	Press the ENT key once to register “OFF”	LCD BACKLIGHT OFF
▼		↓
ENT	Press the ENT key once to blink the cursor on line2.	LIGHT-OFF TIME 05min
▼		
▷ △	Set “10” by the ▷ key and the △ key.	LIGHT-OFF TIME 10min
▼		
ENT	Press the ENT key once to register.	LIGHT-OFF TIME ＊＊ COMPLETE ＊＊
▼		↓
▼	——— LCD BACKLIGHT has been registered ———	LIGHT-OFF TIME 10min
ESC △	Display the measurement mode by the ESC key and the △ key.	0.000 m/s 0.000 m3/h

4.15.13. Advanced settings

Description
- The data required for time difference measurement can be set as follows.
- Channel designation : CH1, CH2, CH ALL
  * When using 2-pipe measurement, configure both CH1 and CH2. CH1 and CH2 can be configured simultaneously by selecting CH ALL.
  * No channel setting is necessary for 1-path/energy measurement and 2-path measurement.

⚠ CAUTION

- This parameter is intended for our service personnel.
- Do not change the setting by yourself. Otherwise measurement may be disabled.
- Make the detailed setting only when a problem should arise in flow rate measurement with factory default settings, and instructed to do so by a trained factory representative. Setting need not be made in other cases.

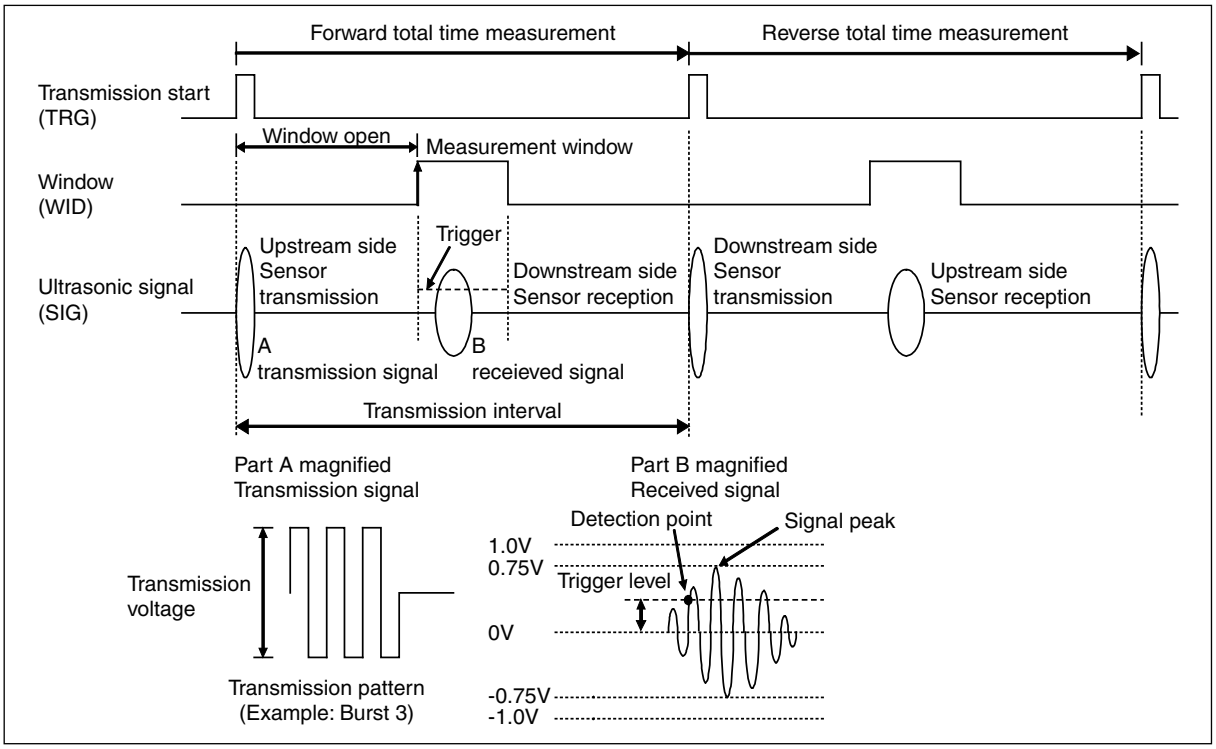
- Setting items

Item	Input method	Function, range or menu
Transmission count	Select	The number of transmission of ultrasonic signals per flow rate signal output[*1]. (Factory-set value: 128) When standard mode is selected for the operation mode: • 8, 16, 32, 64, 128, 256 When high speed response mode is selected for the operation mode: • 4, 8, 16, 32, 64, 128
Trigger control	Select Numeric value	Control method setting of the trigger level (detection point) of ultrasonic signals. (Factory-set value: AUTO) • AUTO • MANUAL Select the detection point according to the rate against the peak of receiving wave regarded as 100%. • Trigger level: 10% to 90%.
Window control	Select Numeric value Numeric value	Setting of control method of measurement window that takes in signals (Factory-set value: AUTO) • AUTO • MANUAL Set the time of starting taking in signals (period from the start of transmission until the startup of window signals) • U: open time: 1µs to 16383µs • D: open time: 1µs to 16383µs Note) U: forward direction, D: reverse direction In case of MANUAL, set U and D.
Saturation (level)	Numeric value	The number of times that the amplitude of received signals fluctuates and exceeds ±1.0V (saturation) per 1 flow rate signal output. Used as the threshold value for judging the error status of signals. A signal error occurs if the specified number of times is exceeded. (Factory-set value: 128) Refer to diagram *1) in the next page. • 0 to 256
Measurement method	Select	Setting of measurement method for measuring transit time. (Factory-set value: method 2) • Method 1: Strong against interference • Method 2: Controls triggers on the plus side of the direction of voltage of received signals. • Method 3: Controls triggers on the minus side of the direction of voltage of received signals.
Signal balance	Numeric value	Setting of threshold value used for judging the existence of transit time. A signal error occurs if the specified value is exceeded. (Factory-set value: 25%) • 0% to 100% Note) Set to 50% or higher for Method 1.
Transmission pattern	Select	Setting of transmission pattern of ultrasonic signals (Factory-set value: Burst 3) • Select from BURST 1, BURST 2, BURST 3, BURST 4, BURST 5, CHIRP 4 and CHIRP 8.
AGC gain	Select Numeric value Numeric value	Setting of control method of signal AGC gain (Factory-set value: AUTO) Signal peak is controlled to be kept at $1.5V_{PP}$. • AUTO • MANUAL Make the setting so that the signal peak in both forward and reverse directions is kept at $1.5V_{PP}$. • Forward gain: 1.00% to 99.00% • Reverse gain: 1.00% to 99.00%
Signal peak	Select	Setting of signal peak threshold value per 1 flow rate signal output *1). Used as the threshold value for judging the error status of signals. A signal error occurs if the value becomes lower than the specified value. (Factory-set value: 3072) • 0.5V(4096) : Equivalent to $0.5V_{0P}$ • 0.375V(3072) : Equivalent to $0.375V_{0P}$ • 0.25V(2048) : Equivalent to $0.25V_{0P}$ • 0.125V(1024) : Equivalent to $0.125V_{0P}$
Transmission wait time	Numeric value	Transmission interval of ultrasonic signals. (Factory-set value: 5msec) • 5msec to 30msec

For actual keying, refer to the typical operation indicated below. Set the protection to OFF beforehand. (See Section 4.5.1.)

*1) Forward-direction signals are taken in with forward total time measurement, while reverse-direction signals are taken in with reverse total time measurement. They are conducted alternately for the transmission count. Forward and reverse signal data is added for the transmission count and averaged. The result is 1 output of signal in forward/reverse direction.

[Outline drawing of signal processing]



Note) Make the setting, following the description in “6.5.7.Checking received waveforms”.

Operation (example)	Set measurement method to “METHOD 1”. * Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.	
Key operation	Description	Display
△	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
▼		
ENT	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
▼		
△	Press the △ key for 18 times (16 times for 2-pipe mode) to display “DETAILS”.	DETAILS
▼		
ENT	Press the ENT key once to display “TRANS.COUNT”.	TRANS.COUNT 128
▼		
△	Press the △ key for 4 times to display “MEAS.METHOD”.	MEAS.METHOD METHOD:2
▼		
ENT	Press the ENT key once to select, and press it once again to blink on the 2nd line.	MEAS.METHOD METHOD:2
▼		
△	Press the △ key twice to display “METHOD 1”.	MEAS.METHOD METHOD:1
▼		
ENT	Press the ENT key once to register.	MEAS.METHOD ** COMPLETE **
▼		↓
▼	——— “METHOD 1” has been registered. ———	MEAS.METHOD METHOD:1
▼		
ESC △	Press the ESC key twice and then press the △ key once to enter the measurement mode.	0.000 m/s 0.000 m3/h

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.

Reference section	Work item	: Outline steps
5.2	Selection of mounting method	: Check the V/Z method, pipe size, and detector.
↓		
5.3	Mounting method on the pipe	: Apply acoustic coupler to the detector oscillation surface, and connect the sensor cable.

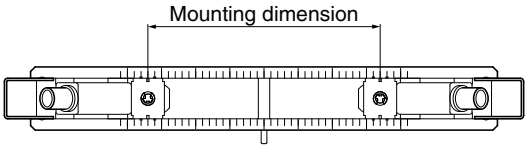
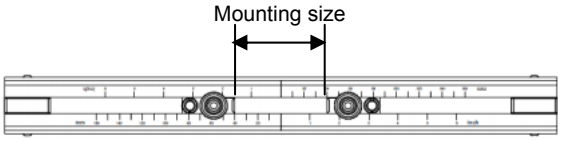
For the “5.3.Mounting method on the pipe”, refer to the separate instruction manual “ULTRA SONIC FLOW METER DETECTOR”

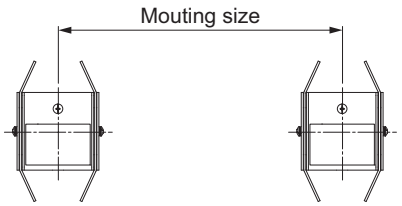
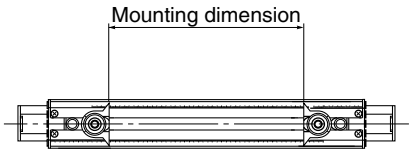
5.1.1. Mounting of detector

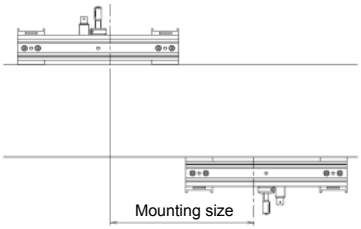
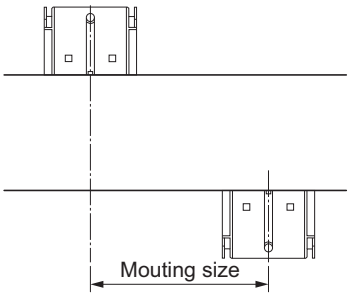
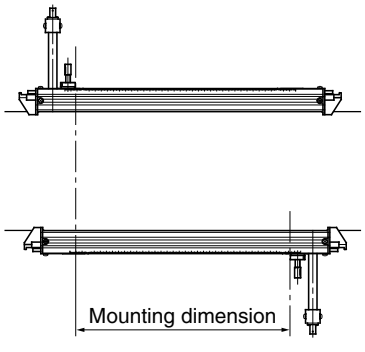
For sensor spacing, select either method in advance.

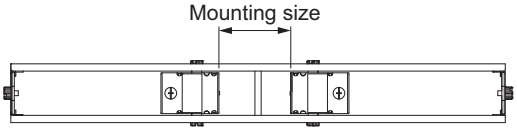
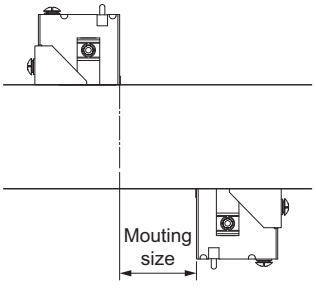
- Calculate from flow transmitter
  Turn ON the flow transmitter.
  Enter the piping information, etc described in Section 4.9.2, and display it.
  Display example: PROCESS SETTING S=16 (48mm)
  During wiring work, be sure to turn the power off.
- Calculate from our website.
  Address http://www.fujielectric.com/ products/instruments/products/flowmeter/top.html
- Calculate from the CD attached to the equipment.

5.1.2. Image figure of mounting dimension

Type	FSS, FLS_12, FLS_22	FSSC
Mounting method	V method	V method
Mounting dimension		

Type	FSSE, FSG_50, FSG_51	FSSD, FSD22, FSD32
Mounting method	V method	V method
Mounting dimension		

Type	FSSC	FSSE, FSG50, FSG51	FSSH, FSD32
Mounting method	Z method	Z method	Z method
Mounting dimension			

Type	FSG31, FSG32	FSG41
Mounting method	V method	Z method
Mounting dimension		

5.2. Selection of mounting method

There are 2 methods for mounting the detector; V method and Z method. (See Fig. 5-1.)

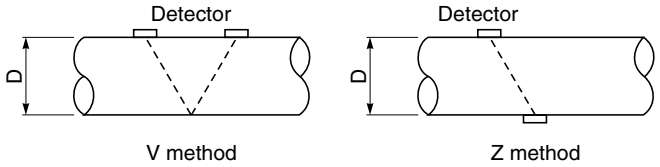


Fig. 5-1 Mounting method

The Z method should be used in the following cases.
- Where a V mounting space is not available.
- When measuring fluid of high turbidity such as sewage.
- When the pipe has a mortar lining.
- Piping is old and presumed to have a deposit of a thick layer of scales inside the piping.

Selection standard
The Z method for large size sensor is recommended for outer diameter 300mm or more.

Type	Fluid temperature [°C]	Mounting method	Inner diameter of piping ø (mm) 13 25 50 100 200 250 300 400 600 1000 3000 6000
FSSA	-20 to 100	V	25 P, M 225
FSSC	-40 to 120	V	50 P, M 600 50 Px 300
		Z	200 P, M 1200 200 Px 600
FSSE	-40 to 80	V	200 Px, P, M 3000
		Z	200 Px, P, M 6000
FSSD	-40 to 100	V	13 Px, P, M 100
FSSH	-40 to 200	V	50 Px, P, M 250
		Z	150 Px, P, M 400

Classification of piping materials
- Px : PP, PVDF
- P : Plastic (PVC, etc.)
- M : Msetallic piping (steel pipe, copper pipe, aluminum, etc.)

Note: If ultrasonic waves cannot pass through the piping because the piping material category is Px or the turbidity of the fluid is high, it is recommended to use FSSC, FSSE types.
Note: Appricable pipe diameter for 2-path measurement is ø50mm and above.

5.3. Mounting method on the pipe

Refer to the separate instruction manual “ULTRASONIC FLOWMETER DETECTOR”

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 detector mounting band 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.
- Whether temperature is abnormal (LED lit red). ⇒ Check whether resistance bulb (RTD) is damaged or not, temperature is outside the range or not. (When 1-path/energy measurement is selected.)

6.2. Periodic Inspection

6.2.1. Checking zero point

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

6.2.2. Reapplying grease

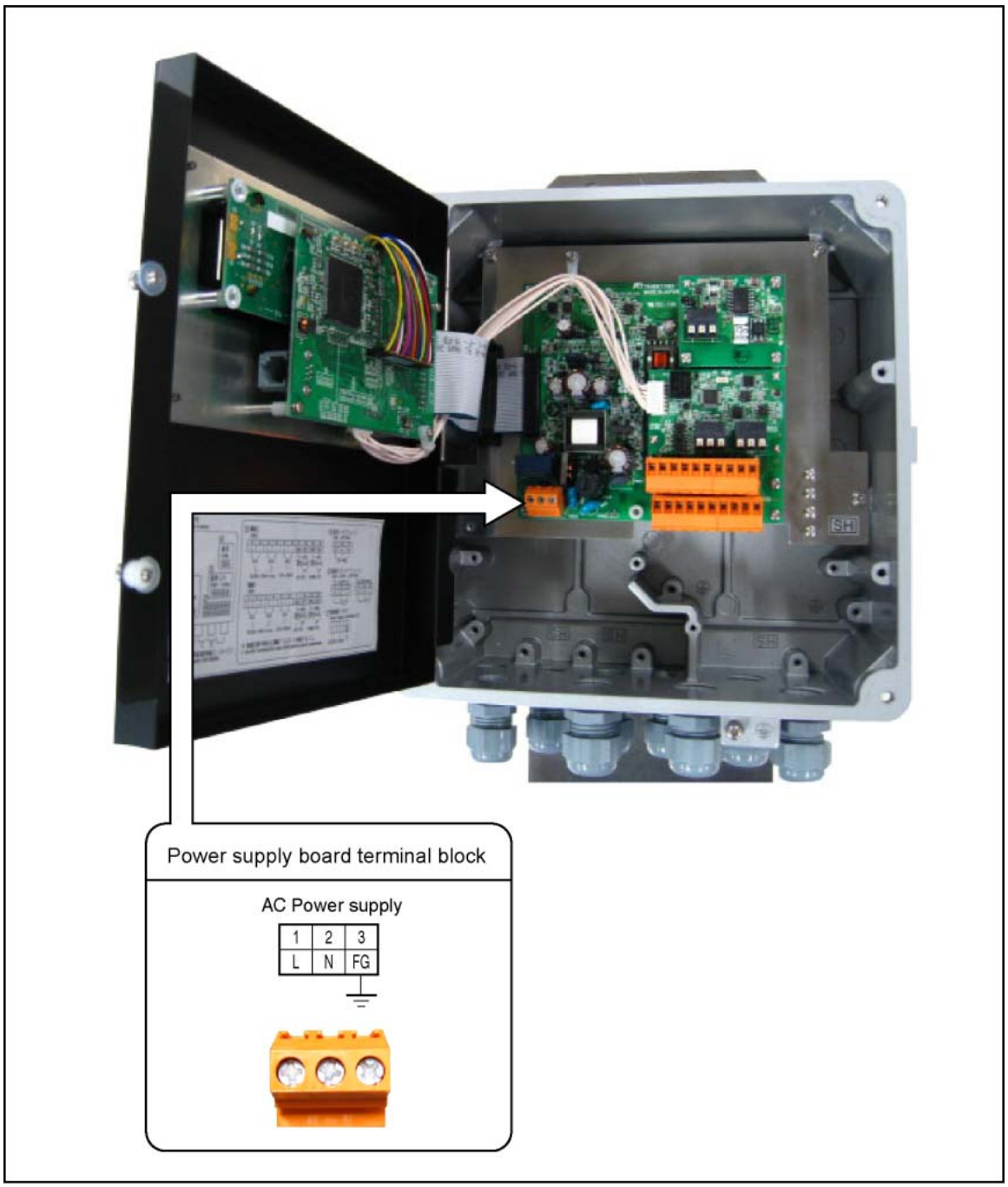
When using grease for the acoustic coupler, reapply it on the transmission surface of the sensor unit approximately once every 6 months.
Note) Silicone rubber need not be reapplied.

Refer to the separate instruction manual “ULTRA SONIC FLOWMETER DETECTOR”

6.2.3. How to measure the insulation resistance

⚠ CAUTION

Turn off the power before opening the flow transmitter cover.
The power terminals are provided with an arrester as standard.
Measurement point : Between power terminal and ground terminal
Between each outputs and ground terminal
The insulation resistance performance of the equipment is 100 MΩ/500 V DC.

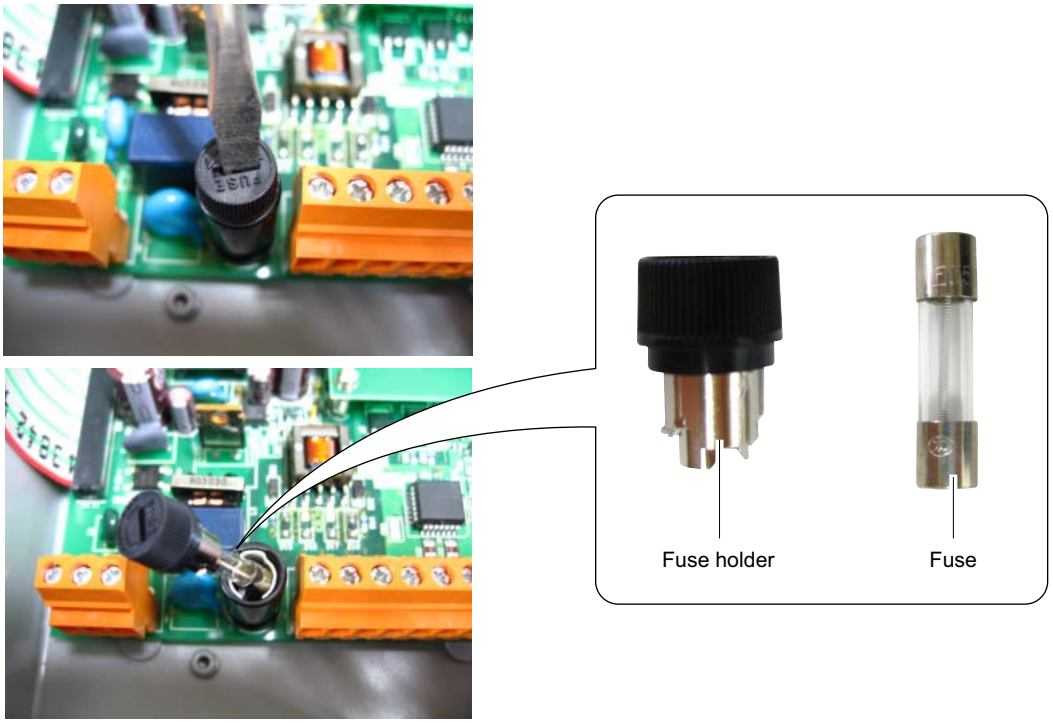


6.3. How to replace the fuse

⚠ CAUTION

- Be sure to turn off the power before replacing the fuse.
  Fuse specifications
  (1) AC power supply (100V and 200V): 5.0m (diameter) × 20mm (long), 250V, 0.5A.
  Example: 218,500M x P 250V, 0.5A manufactured by littelfuse.

(1) Open the cover after turning off the power.
Loosen 4 screws from the flow transmitter front, and open the cover.
(2) Loosen 2 screws from the setting section of the display unit, and open the panel.
(3) Replace the fuse.
Detach the fuse holder from the power supply board, and replace the fuse. Then, return the fuse holder in place.
(4) Close the cover, and tighten 4 screws.



⚠ CAUTION

- Turn on power only after closing the cover.

6.4. How to replace the LCD

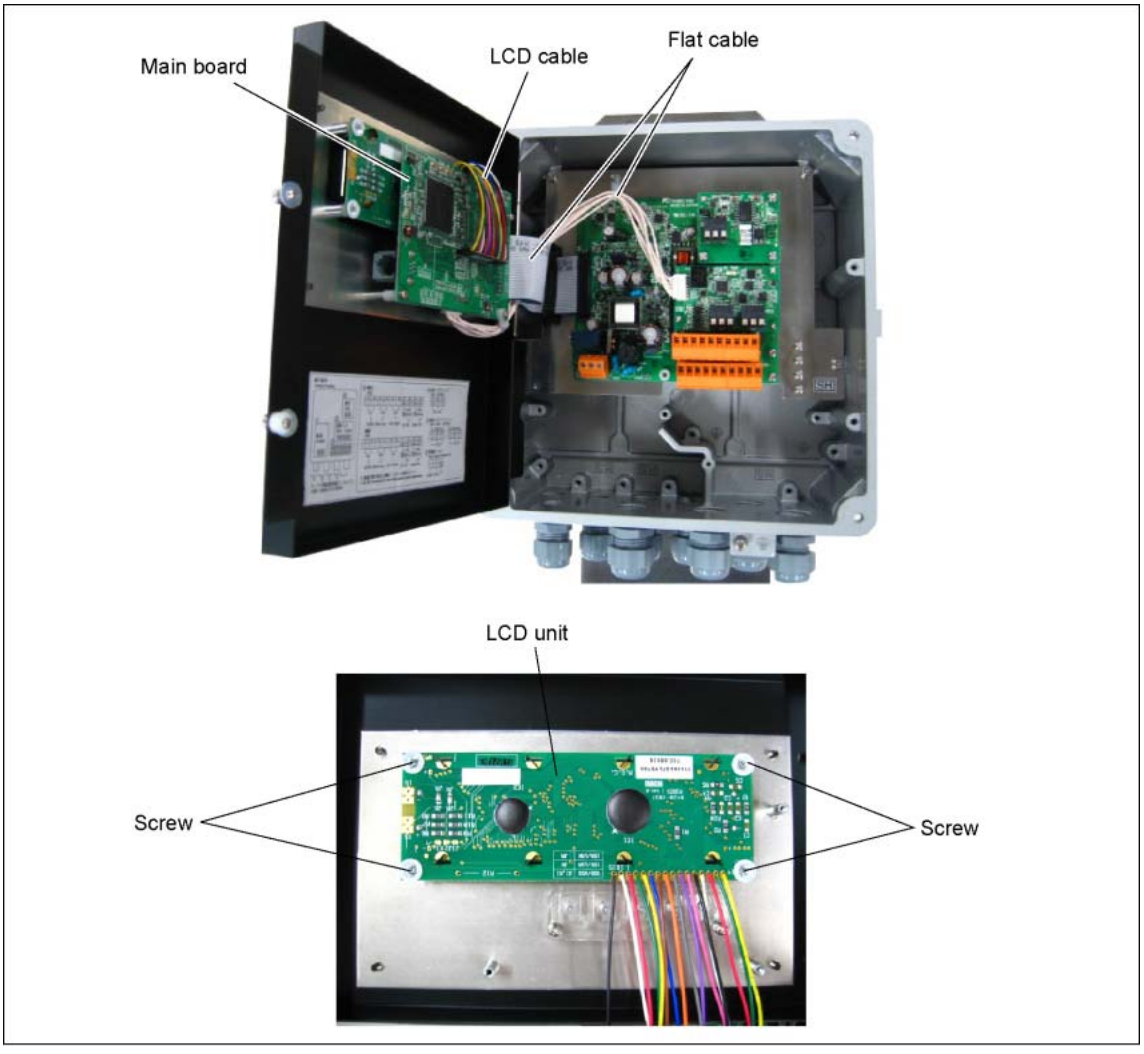
The nominal service life of the LCD is 7 years. The contrast gradually deteriorates with time.
Replace it about 5 years after starting its use.

[How to replace]

(1) Open the cover after turning OFF power.
(2) Loosen 2 screws from the setting section of the display unit, and open the cover.
(3) Remove the flat cable connector.
(4) Remove the LCD cable connector.
(5) Loosen 3 screws from main board.
(6) Loosen 4 screws from the LCD unit.
(7) Mount a new LCD unit (see parts list).
(8) Mount the main board.
(9) Connect the LCD cable connector.
(10) Connect the flat cable connector. (Insert it securely all the way.)
(11) Close the setting section of the display unit, and tighten 2 screws.
(12) Close the cover and turn on the power.
(13) Check that the LCD display and key operation are functioning correctly.
(14) Be sure to conduct the contrast adjustment for brightness of the display.

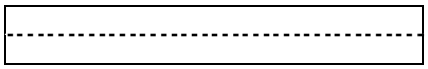
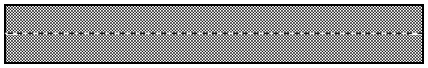
⚠ CAUTION

- Be sure to turn off the power before opening the cover. The unit contains high voltage.
- Do not conduct the replacement when your body holds the static electricity. It causes the failure.
- Do not conduct the replacement with wet hands. It causes failure.



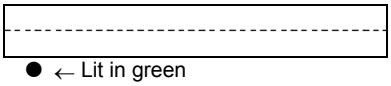
6.5. Error and remedy

6.5.1. Display error

State	Probable cause
 Nothing is displayed.	● Power supply is not turned on. ● Low power supply voltage ● Fuse is blown out. ● LCD error ⇒ Refer to “6.5.8. Remedying a hardware fault”. ● Reverse polarity of DC power supply
 Upper side appears black.	● Low power supply voltage ● Reverse polarity of DC power supply ● LCD error ⇒ Refer to “6.5.8. Remedying a hardware fault”.
 Irrational display	● Hardware error ⇒ Refer to “6.5.8. Remedying a hardware fault”.
 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 “6.5.1.1. Checking the LCD/LED” for LCD/LED. The dots on the LCD are missing or the LED does not come on. ⇒ Refer to “6.5.8. Remedying a hardware fault”.
LED is displayed in red. (ST1 or ST2)	● Received wave is abnormal. ⇒ Refer to “6.5.1.2. Checking the LED lit in red (1)”.
LED is displayed in red. (ST2)	● Temperature is abnormal. ⇒ Refer to “6.5.1.2. Checking the LED lit in red (2)”.

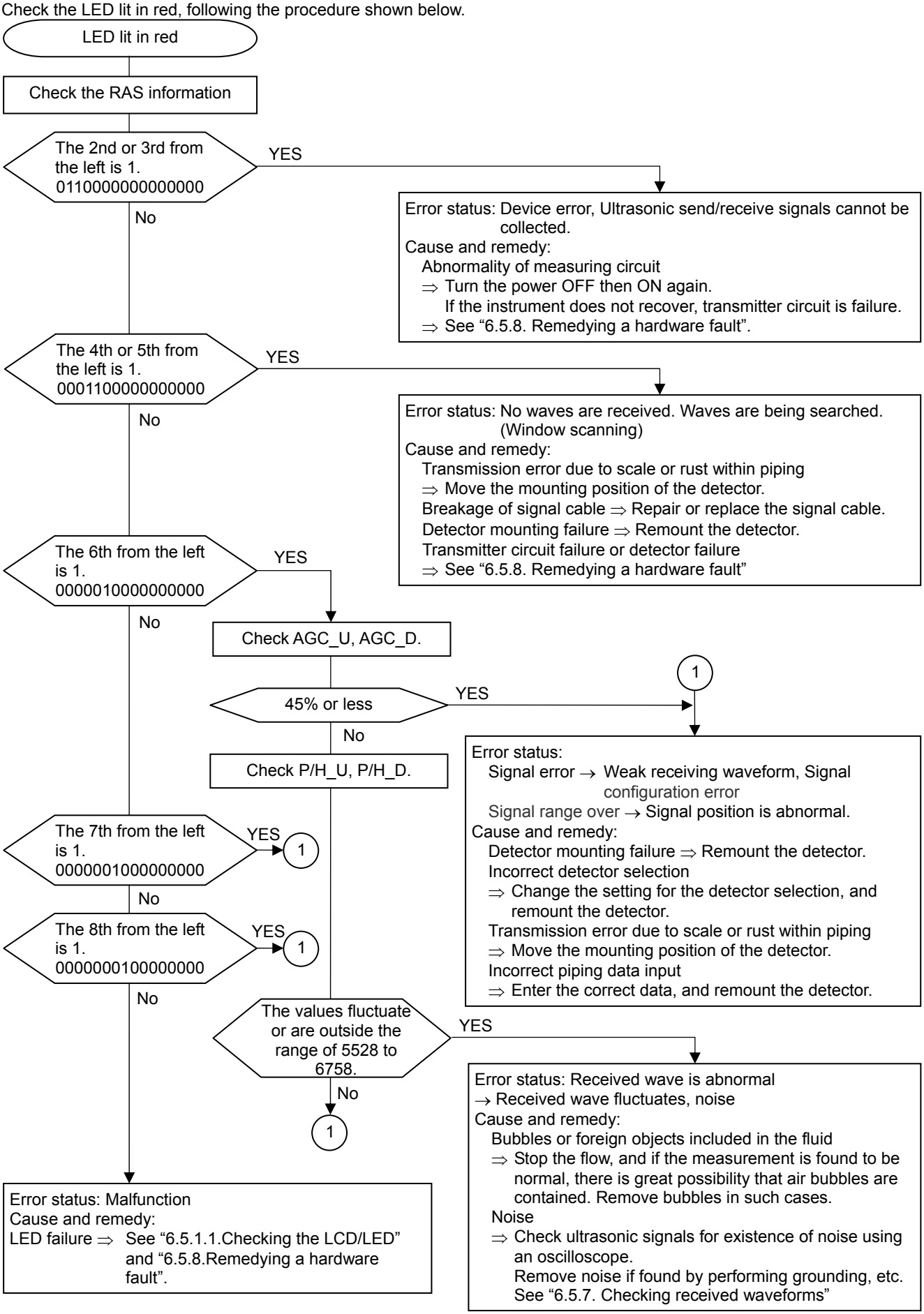
6.5.1.1. Checking the LCD/LED

Follow the procedure shown below to check possible display errors.

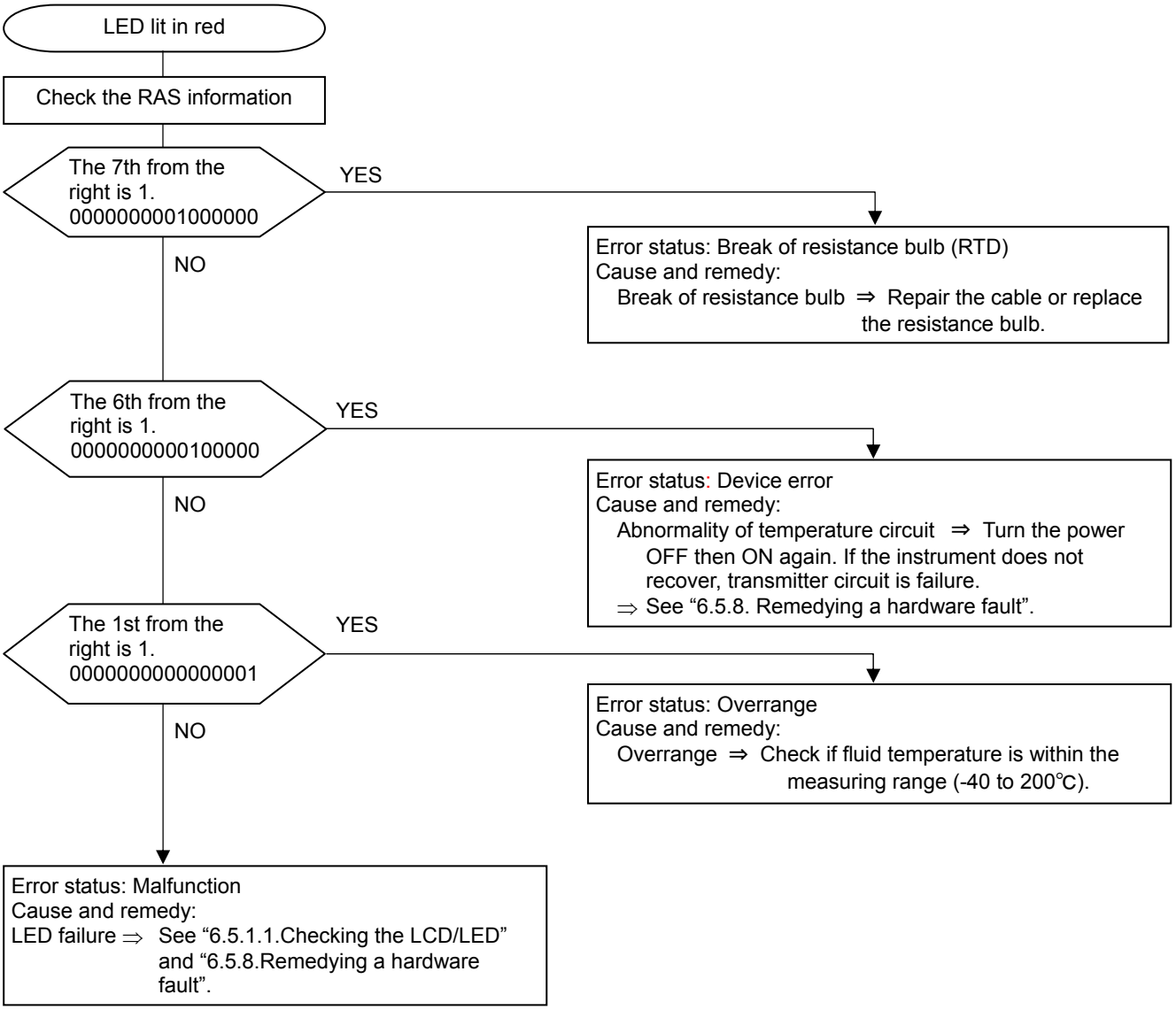
Key operation	Description	Display
△ ▼	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION 0000000000000000
△ ▼	Press the △ key for 16 times (14 times for 2-pipe mode) to display “LCD/LED CHECK”.	LCD/LED 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

6.5.1.2. Checking the LED lit in red

(1) Diagnosis of an abnormality of received wave (when indicator lamp ST1 or ST2 lit in red)
Check the LED lit in red, following the procedure shown below.



(2) Diagnosis of an abnormal temperature (when indicator lamp ST2 lit in red) (For 1-path/energy measurement mode)
Check the LED lit in red, following the procedure shown below.



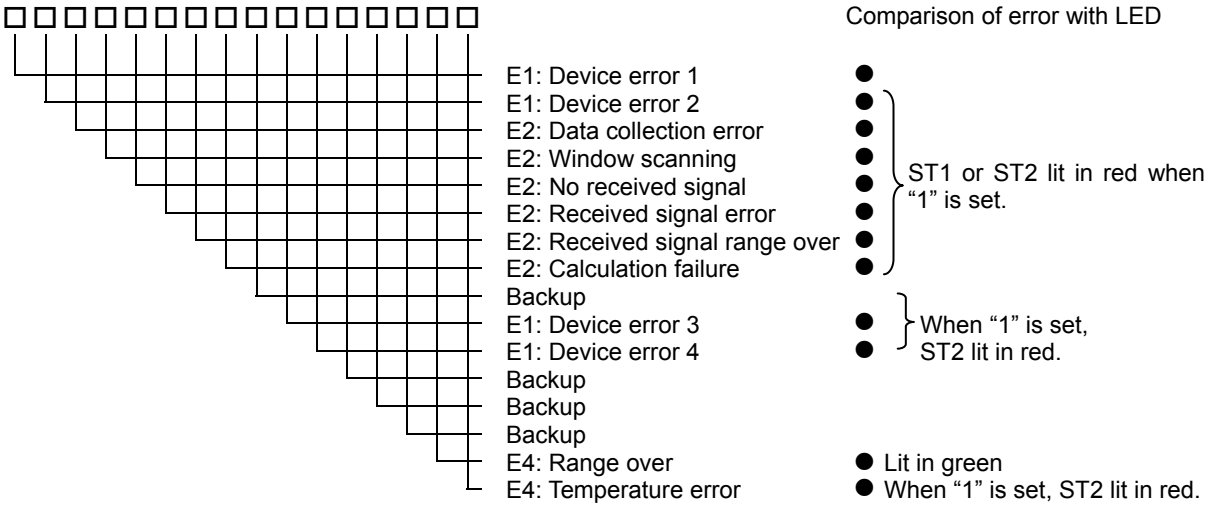
6.5.1.3. Checking the RAS information

When the red LED lights up, check the error contents according to the RAS information.
* Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.

Key operation	Description	Display
△ ▼ ENT	Press the key for 4 times to display “MAINTENANCE MODE”. Press the key once to display “RAS INFORMATION”.	MAINTENANCE MODE RAS INFORMATION 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: Device error 1	Backup memory failure	See “6.5.8. Remedying a hardware fault”.
E1: Device error 2	Abnormality of measuring circuit	Turn the power off then on again. If the instrument does not recover properly, refer to “6.5.8. Remedying a hardware fault”.
E2: Data collection error	Ultrasonic send/receive signals cannot be collected.	
E2: Window scanning	The ultrasonic receiving signal waveform is being detected.	Move the mounting position of the detector, and remount the detector.
E2: No received signal	No ultrasonic receiving signal waveform	Repair or replace the signal cable. Transmitter circuit failure or detector failure ⇒ See “6.5.8. Remedying a hardware fault”.
E2: Received signal error	The status of received waveform is poor.	Check the air bubbles or foreign objects. Check the receive sensitivity. ⇒ Move the mounting position of the detector, and remount the detector.
E2: Received signal range over	Receiving signal waveform is outside the appropriate range.	Check the piping data. Check the detector mounting dimensions.
E2: Calculation failure	The value of detected measurement data is abnormal.	Check the piping data. Check the receive sensitivity. ⇒ Move the mounting position of the detector, and remount the detector.
E1: Device error 3	Break of resistance bulb	Repair the cable or replace the resistance bulb.
E1: Device error 4	Abnormality of temperature circuit	Turn the power OFF then ON again. If the instrument does not recover, temperature circuit is failure. ⇒ See “6.5.8. Remedying a hardware fault”.
E4: Range over	Analog output and total output exceed the range.	Check the range data and the totalize setting.
E4: Temperature error	The fluid temperature is outside the measuring range.	Check the fluid temperature.

Correspondence between DO output and Alarm

“All” : Alarm is issued at occurrence of E1:Device error 1 or E1:Device error 2 or E2. [Burnout timer is enabled]

“Device error” : Alarm is issued at occurrence of E1:Device error 1 or E1:Device error 2. [Burnout timer is disabled]

“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.

6.5.2. Displaying the data in maintenance mode

Follow the procedure shown below to check possible display errors.
* Below is an example for 1-path/energy measurement. Refer to Section 4.8.1 for channel designation of 2-path measurement and 2-pipe measurement.

Key operation	Description	Display
△ ▼	Press the △ key for 4 times to display “MAINTENANCE MODE”.	MAINTENANCE MODE
ENT ▼	Press the ENT key once to display “RAS INFORMATION”.	RAS INFORMATION
△ ▼	Press the △ key for 17 times (15 times for 2-pipe mode) 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 correction coefficient of flow velocity distribution, K, and flow velocity, V.	K: 1.3333 V: 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 45% or more. If the display appears as 0%, no signals are being received. Ultrasonic waves may not be transmitted because of insufficient water volume or rust of piping.	AGC U: 0.00 % AGC D: 0.00 %
△ ▼	Press the △ key once. ● Displays the peak value of received signal waveform. Normal values stably fall within the range from 5528 to 6758. If the value fluctuates significantly, objects that constitute barriers against ultrasonic wave transmission such as air bubbles or foreign matter may be contained in the fluid. Stop the flow and check if normal value is resumed. If so, there is a possibility that air bubbles are contained.	P/H U: 6143 P/H D: 6143
△ ▼	Press the △ key once. ● Displays the detection level value of received signal waveform.	TRG U: 25.00% TRG D: 25.00%
ESC △	Press the ESC key or the △ key to display the measurement mode.	

6.5.3. Key error

Status	Probable cause
No response is made to key input.	● Hard failure ⇒ Refer to “6.5.8. Remedying a hardware fault”.
Certain key is not responded. Action is not as defined.	

6.5.4. Error in measured value

<table>
<tr><th>Status</th><th>Probable cause</th><th>Troubleshooting</th></tr>
<tr><td rowspan="2">The reading appears with “-” (minus).</td><td>● Connection between main unit and sensor units (upstream, downstream) are inverted.</td><td>→ Connect properly.</td></tr>
<tr><td>● Flow of fluid is reversed.</td><td></td></tr>
<tr><td rowspan="3">Measured value fluctuates though flow rate is constant.</td><td>● Straight pipe length is inadequate.</td><td>→ Move the sensor to the place where the length of 10D can be assured on upstream side and 5D on downstream side.</td></tr>
<tr><td>● Pump, valve, or others which disturb the flow are located nearby.</td><td>→ Mount the instrument with a clearance of 30D or more.</td></tr>
<tr><td>● Pulsation exists in flow.</td><td>→ Set the damping to increase the response time.</td></tr>
<tr><td>Measured value remains the same though flow rate is changing. (LED lit in red)</td><td colspan="2">Measured value is held because ultrasonic wave cannot be propagated into a pipe.

1. Incomplete installation

● Error in piping specifications
● Sensor is mounted on welding.
● Error in sensor mounting dimensions
● Error in acoustic coupler at the time of mounting the sensor
● Error in connection of the sensor cable.
→ Upon checking, remove the sensor, apply acoustic coupler, and slightly off position the sensor.

Sensor mounting is poor
● Mounting dimension
● The sensor is coming off the pipe.
→ ● Mount the sensor in parallel with pipe, allowing correct sensor unit spacing.
● Mount the sensor properly so that it is kept in close contact with the pipe.

2. Problem on pipe or fluid

○ Pipe not filled with fluid
→ Locate a place which is completely filled on the same piping line, and shift the sensor there.
● Attach the sensor to the lowest place on the pipeline.

○ Bubbles present in the fluid

Bubbles are introduced if reading is normal when flow is stopped.
→ Eliminate ingress of bubbles.
● Raise the level of the pump well.
● Check the shaft seal of the pump.
● Retighten the flange of negative pressure pipe.
● Arrange so that fluid doesn’t fall into the pump well.

If mounted immediately downstream a valve, a cavitation causes the same phenomenon as when bubbles are introduced.
Move the sensor to the location where air bubbles have not entered.
● Inlet side of the pump
● Upstream side of the valve

(Continued on next page.)</td></tr>
</table>

Status	Probable cause	Troubleshooting
(Continued from the previous page.)	○ High turbidity [Turbidity is higher than those of sewage and return sludge.] →	
	○ Pipe is old and scale is attached on inside. →	
	○ Lining is thick. [Because of mortar lining or the like, thickness is tens mm or more.] →	● Move sensor to a place of smaller diameter on the same pipeline. ● Move the sensor to other places or to different piping.
	○ Lining is peeled. [There is a gap between the lining and the pipe.] →	
	○ Sensor is mounted on bend pipe or tapered pipe. →	Mount the sensor on straight pipe.
	3. Effect of external noise →	● Reduce the length of main unit sensor cable to a minimum. ● Ground the main unit and piping.
	[● There is a radio broadcasting station nearby. ● Measurement conducted near a passage of vehicles or electric cars.]	
	4. Hard failure →	Refer to “6.5.8. Remedying a hardware fault”.
Measured value not zero when fluid stops flowing.	● Fluid forms a convection inside the pipe. →	Normal
	● Zero point adjustment →	● Readjust the zero point after fluid has completely stopped flowing.
	● Pipe is not completely filled or is empty when water is at a standstill (LED lit red). →	Normal
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.
	● Scales exist on wall of old pipe. →	● Input scale as lining.
	● Insufficient linear pipe length (10D or more for upstream and 50D or more for downstream) →	Find another mounting place (upstream of disturbing objects).
		[No disturbing objects in flow within 30D 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.
	● Pipe is not filled with fluid or sludge is deposited in the pipe. →	Occurs particularly where sectional area is small. ● Move sensor to a vertical pipe.

6.5.5. Error in analog output

Status	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 FLOW” appears on the LCD.	Range over ● Recommence setting of range data of analog output.
The output becomes lower than 4mA.	“UNDER FLOW” 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.

6.5.6. Error in input temperature

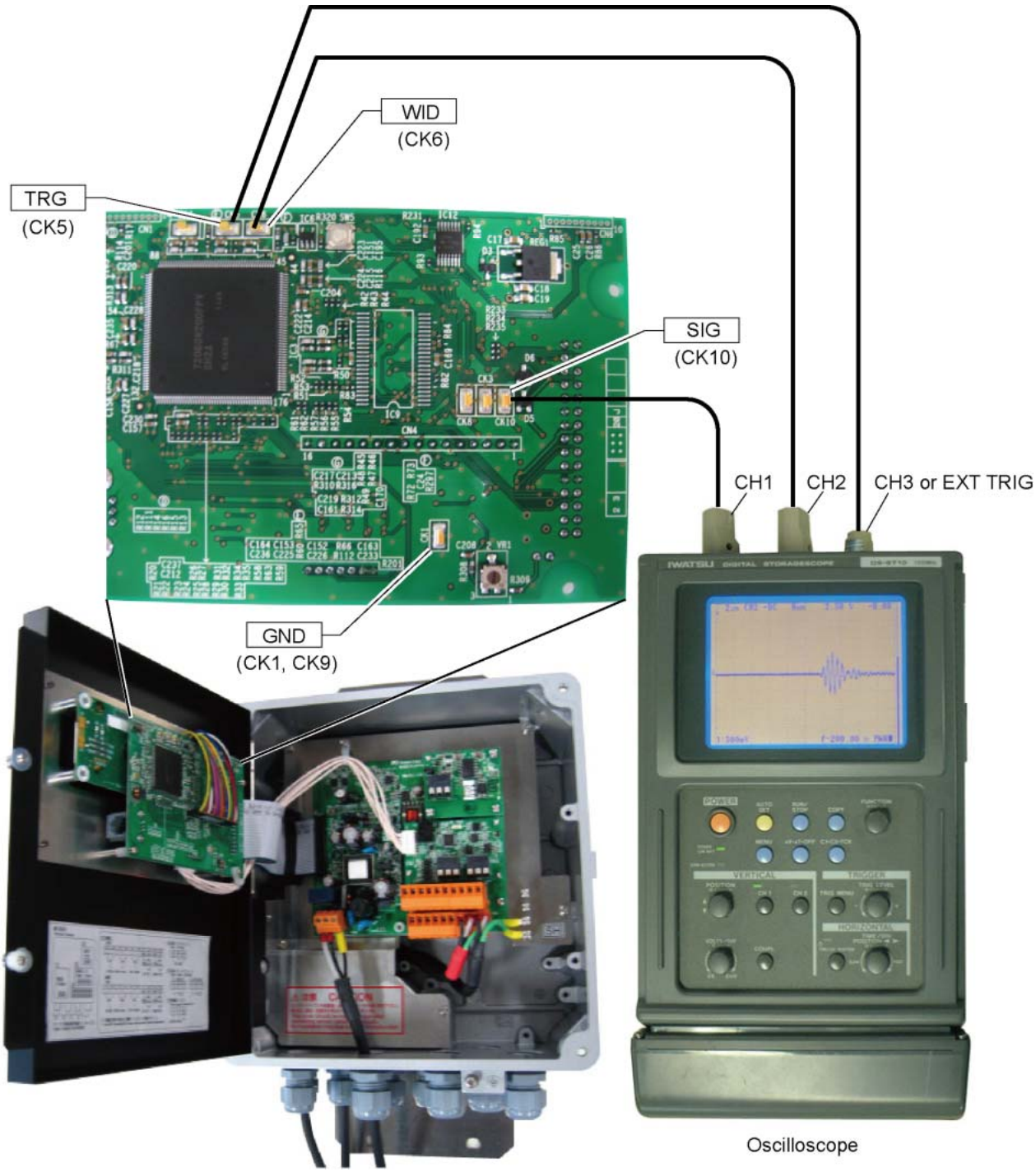
Status	Probable cause	Troubleshooting
”Underflow” is indicated on LCD display.	Fluid temperature is below -45°C. ⟶	Overrange ● Check fluid temperature.
”Overflow” is indicated on LCD display.	Fluid temperature is above 205°C. ⟶	Overrange ● Check fluid temperature.
”Underflow” and “-210°C” are indicated.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

6.5.7. Checking received waveforms

The unit has high-voltage part. Be sure to ask our service personnel for the steps described below.

6.5.7.1. How to connect the oscilloscope

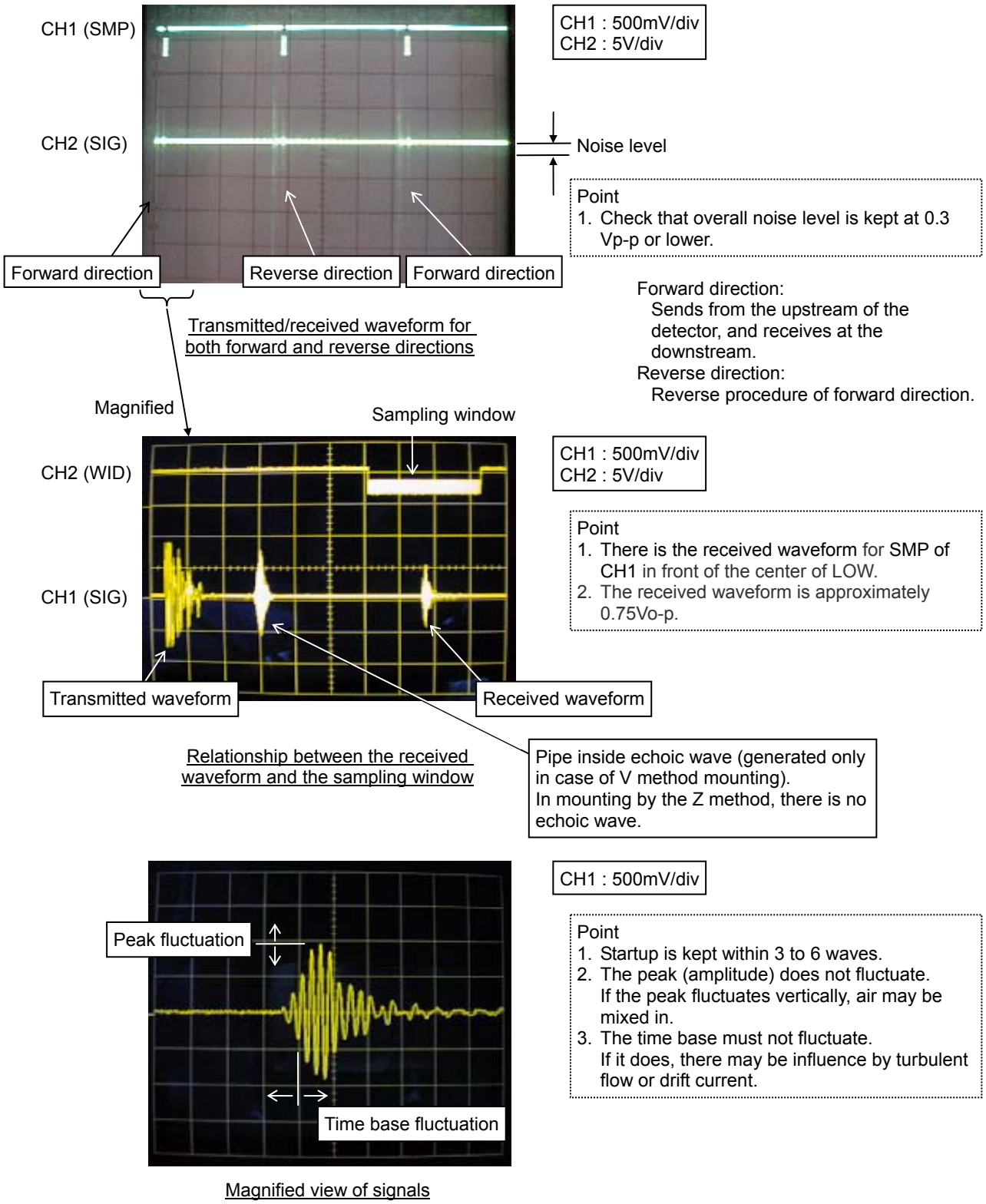
Open the cover, and connect an oscilloscope to the check pin on the printed board according to the following figure.
The unit has high-voltage components. Do not touch the parts other than those specified below.



6.5.7.2. Checking sending/receiving

Monitor the waveform, and check the status of received waveform.

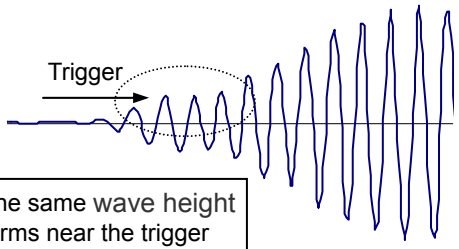
a) Normal status



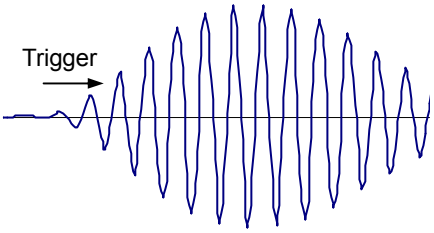
Magnified view of signals

The received waveform controls the peak to be approximately 1.5Vp-p.

Startup of signals is not good



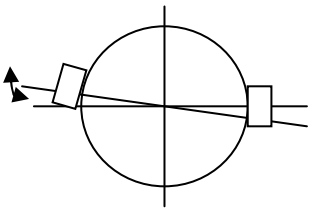
The same wave height forms near the trigger level.



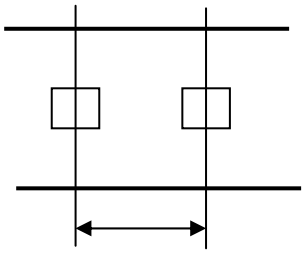
Startup of signals is not good
There is not large difference among triggering waveform.

Cause of the poor startup signals

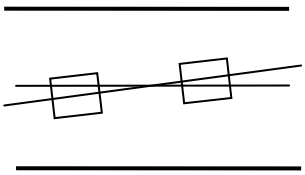
(1) Incorrect detector mounting, dimensions (sensor mounting dimension, outer diameter, etc) and detector mounting angle



Displacement from the center of the pipe.
(in case of Z method)



Displacement of the mounting dimension

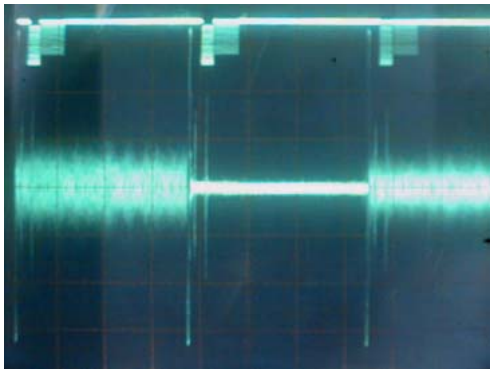


Displacement from the pipe axis.

⇒ Mount the detector properly.

(2) Interference from acoustic wave (It is likely to happen when the outer diameter is set longer than the actual length.)
⇒ Make a setting of the acoustic wave of the fluid type to be 20 to 50m/s lower, and remount the detector again.
Note) 1400m/s is set for water.

b) Noise on the one side

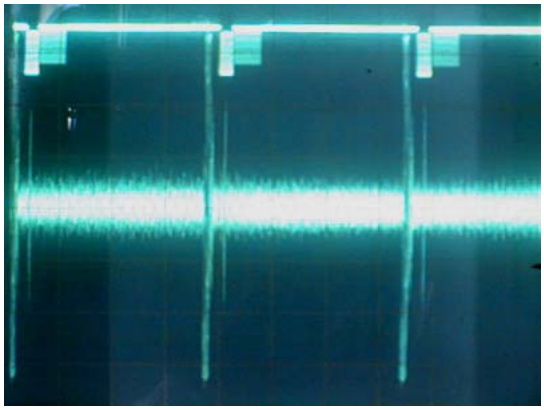


CH1 : 500mV/div
CH2 : 5V/div

Waveform with noise on the one side

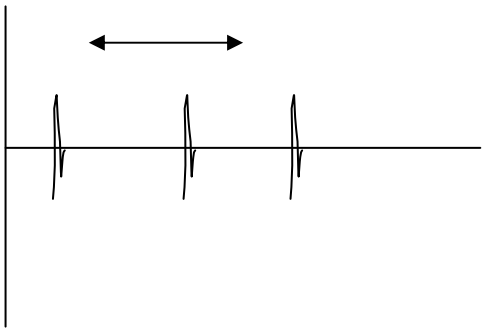
<Cause>	<Check>
Dedicated cable on the one side is abnormal.	Measure the insulation resistance.
Polarity of connected terminals is inverted.	Check the connection
Sensor on the one side is abnormal.	Peel off the detector and check the sensitivity
Detector bonding surface is peeling.	Peel off the detector and temporarily place it by grease, etc.
Dedicated cable is disconnecting.	Check the continuity.
Poor contact.	Check the connection

c) There is white noise all around.



Waveform with the overall noise

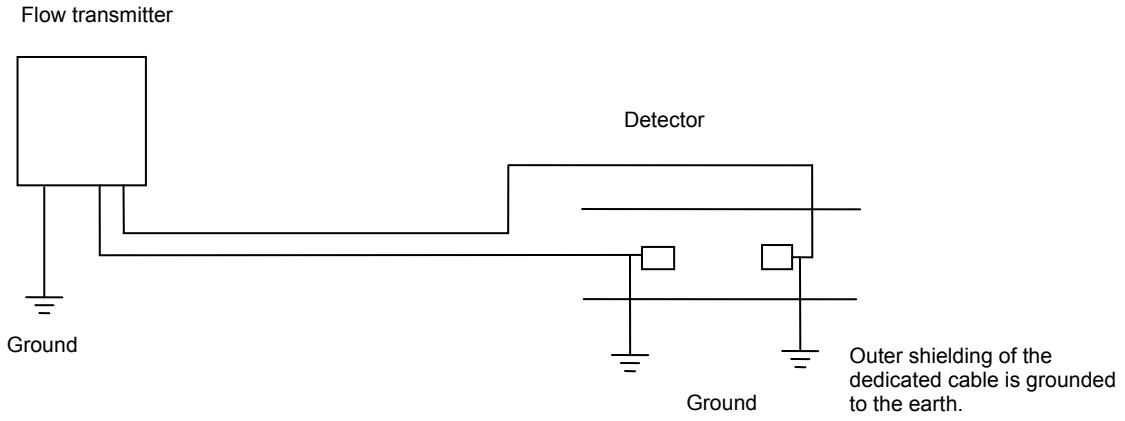
d) Pulsed noise is observed.



Waveform with pulsed noise on the signal line

Measurement can be performed if the noise level is smaller than the received waveform level ($0.75V_{0\text{-}p}$).

<Cause>	<Check>
Noise is placed on the power line.	Check the power line using an oscilloscope, and install a noise-suppression transformer.
Noise is placed on the grounding line (panel earth, etc).	Check the power line using an oscilloscope, and remove the ground wire.
Dedicated cable is picking the inductive noise.	Move the flow transmitter near the detector and perform confirmation. Keep the dedicated cable apart from the power cable.
The distance between the detector and the flow transmitter is long, and dedicated cable length is long.	Perform grounding according to the figure below.
Insufficient sensitivity Signal power (AGC_U, AGC_D) 45% or less	Change the detector. FSSA→FSSC FSSC→FSSE



6.5.8. Remedying a hardware fault

If the hardware is found faulty as a result of Section 6.5.1 to Section 6.5.7 above, provide specific details to Fuji Electric.

7. APPENDIX

7.1. Specifications

Operational specifications

System configuration:
Single-path or 2-path system with a flow transmitter (Model FSV) and a detector (Model FSS) (2-pipe version is also available)
Energy measurement by transmitter, detector, and resistance bulb (pt100).
Either 2-path/2-pipe measurement or energy measurement can be selected.

Applicable fluid:
Homogenous liquid where the ultrasonic signal can be transmitted
Bubble quantity: 0 to 12vol% (for pipe size 50A, water, velocity 1m/s)
Fluid turbidity: 10000mg/L max.
Type of flow: Fully-developed turbulent or laminar flow in a full-filled pipe

Flow velocity range:
0 to ±0.3 ... ±32m/s

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

Signal cable (between detector and converter):
Coaxial cable (150m max.) applicable up to 300m depending on the condition.
Heat resistance: 80°C

Installation environment:
Non-explosive area without direct sunlight, corrosive gas and heat radiation.

Ambient temperature:
Flow transmitter: -20 to +55°C
Detector: -20 to +60°C

Ambient humidity:
Flow transmitter: 95%RH max.
Detector: 90%RH max.

Grounding: Class D (100 Ω)

Arrester: Provided as standard at power supply

Applicable piping and fluid temperature:
2-pipe/energy measurement: ø13 to ø6000mm
2-path measurement: ø50 to ø6000mm

<table 1>

Detector Type	Pipe size (inner diameter) ø (mm)	Mounting method	Fluid temperature range (°C) (Note 2)	Applicable pipe material (Note 1)
FSSA	25 to 225	V method	-20 to +100	Plastic (PVC, etc.)
FSSC	50 to 600	V method	-40 to +100	
	300 to 1200	Z method		
FSSD	13 to 100	V method	-40 to +100	Metal pipe (SS, steel pipe, copper pipe, aluminum pipe, etc.)
FSSE	200 to 1000	V method	-40 to +80	
	500 to 6000	Z method		
FSSH	50 to 200	V method	-40 to +200	
	150 to 400	Z method		

Note1) Please select the FSSC type or FSSE type if following condition.
- When pipe material is PP and thickness is 15mm or more
- When pipe material is PVDF and thickness is 9mm or more
- When pipe material is cast iron pipe, lining pipe, old steel pipe or others through which the ultrasonic signal could not be transmitted easily.

Lining material: Tar epoxy, mortar, rubber, etc.
* If the lining is not properly glued to a pipe, the measurement may be impossible.

Note2) When silicon grease is used as acoustic coupler, Fluid temperature limit is 0 to 60°C no matter what detector is selected.

Note3) Heat-resistant shock temperature: for 30 minutes at 150°C For the detector FSSA or FSSC

Performance specifications

Rated accuracy: <table 2>

Detector Type	Pipe size (diameter) ø (mm)	Flow velocity (m/s)	Accuracy	
			Plastic pipe	Metal pipe
FSSA	25 to 50	2 to 32	±2.0% of rate	
		0 to 2	±0.04m/s	
	50 to 225	2 to 32	±1.0% of rate	±2.0% of rate
		0 to 2	±0.02m/s	±0.04m/s
FSSC	50 to 200	2 to 32	±1.5% of rate	
		0 to 2	±0.03m/s	
	200 to 1200	2 to 32	±1.0% of rate	
		0 to 2	±0.02m/s	
FSSD	13 to 50	2 to 32	±1.5% to ±2.5% of rate	
		0 to 2	±0.03 to ±0.05m/s	
	50 to 100	2 to 32	±1.5% of rate	
		0 to 2	±0.03m/s	
FSSE	200 to 300	2 to 32	±1.5% of rate	
		0 to 2	±0.03m/s	
	300 to 1200	0.75 to 32	±1.5% of rate	
		0 to 0.75	±0.0113m/s	
	1000 to 6000	1 to 32	±1.0% of rate	
		0 to 1	±0.02m/s	
FSSH	50 to 300	2 to 32	±1.0% of rate	
		0 to 2	±0.02m/s	
	300 to 400	0.75 to 32	±1.0% of rate	
		0 to 0.75	±0.0075m/s	

Response time:
0.5s (standard mode)
0.2s as selected (quick response mode)

Power consumption:
30VA max. (AC power supply)

Functional specifications

Analog signal:
4 to 20mA DC (2 points maximum)
Load resistance: 600Ω max.

Digital output:
Forward total, reverse total, totalized energy, temperature alarm, and cooling/heating modes, alarm, acting range, flow switch, total switch
assignable arbitrarily
Transistor contact (isolated, open collector)
- Outputs: 4 points max.
- Normal: ON/OFF selectable
- Contact capacity: 30V DC, 50mA
- Output frequency: 100P/s max. (pulse width: 5, 10, 50, 100, 200, 500, 1000ms)

Serial communication (option):
RS-485 (MODBUS), isolated, arrester incorporated
Connectable quantity: 31 units
Baud rate: 9600, 19200, 38400bps
Parity: None/Odd/Even selectable
Stop bits: 1 or 2 bits selectable
Cable length: 1km max.
Data: Flow velocity, flow rate, forward total, reverse total, status, energy flow, energy calculation for cooling system, energy calculation for heating system, temperature, etc.

Display device:
2-color LED (Normal: green, Extraordinary: red)
2 indicator lamps (for path 1 and 2)
LCD with 2 lines of 16 characters and back light

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

Flow velocity/flow rate indication:
Instantaneous flow velocity, instantaneous flow rate indication (minus indication for reverse flow)
Numerals: 8 digits (decimal point is counted as 1 digit)
Unit: Metric/Inch system selectable

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/d, km^3/d, Mm^3/d, BBL/s, BBL/min, BBL/h, BBL/d, kBBL/d, MBBL/d

Energy indication:
indication of energy consumption
energy consumption of heat medium
energy flow:
MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kWh, MWh
totalized energy:
MJ, GJ, BTU, kBTU, MBTU, kW, MW
J: Joule
BTU: British thermal unit
W: Watt
Note1) Minus-totalization of thermal energy is not available when the flow direction is reverse.
Note2) The amount of thermal energy is detected as zero when the difference in temperature is 0.5°C or less.
Temperature indication: °C, K
Operation mode:
Cooling mode, Heating mode, Cooling/heating automatic change mode
Temperature input:
Input type: Resistance bulb (Pt100, 3-wire)
Input range: -40 to + 200°C
Indication accuracy (at 23°C): ±1.0% FS

Configuration:
Fully configurable from the 4-key pad (ESC, △, ▷, ENT)

Zero adjustment: Set zero/Clear available

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

Output setting: <table 3>

Measuring mode	Output type	Analog signal	Digital output
2-path	Path 1 flow rate Path 2 flow rate Average value	2 points max. (select from the lieft column)	4 points max.
2-pipe	Path 1 flow rate Path 2 flow rate Average value Added value Subtracted value	2 points max. (select from the left column)	4 points max.
Energy	Path 1 flow rate Energy flow	2 points max.	4 points max.

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

External total preset:
Preset total settable upon contact input setting

Backup of power failure:
backup by non-volatile memory

Physical specifications

Type of enclosure:
Flow transmitter: IP67
Detector:
FSSA, FSSC:
IP65 (When waterproof BNC connector is provided)
FSSD, FSSH: IP52
FSSE:
IP67 (Silicone rubber is filled up on the terminal block)
FSSC, FSSE (waterproofing):
IP68 (submerged resistant structure for 5days)

Mounting method:
Flow transmitter: Mounted on wall or by 2B pipe
Detector: Clamped on pipe surface

Acoustic coupler:
Acoustic coupler is a filling between detector and pipe.
Type of acoustic coupler: <table 4>

Type	Silicone rubber (KE-348W)	Silicone grease (G40M)	Silicone-free grease (HIGH Z)	Grease for high temperature (KS62M)
Fluid temperature	-40 to +150°C	-30 to +150°C	0 to +60°C	-30 to +250°C
Teflon piping	×	○	○	○

In case of Teflon piping, use grease.

Material: Flow transmitter: Aluminum alloy
Detector: <table 5>

Detector Type	Sensor housing	Cover	Guide rail
FSSA	PBT	–	SUS304
FSSC	PBT	–	Aluminum alloy + PBT
FSSD	PBT	–	Aluminum alloy + PBT
FSSE	PBT	SUS304	–
FSSH	SUS304	SUS304	Aluminum alloy

Signal cable:
- Structure: Heat-resisting high-frequency coaxial cable
- Sheath: Flame-resisting PVC
- Outer diameter: ø7.3mm

Terminal treatment: <table 6>

Cable type	FLYD
Applicable detector	FSSA, FSSC, FSSD, FSSE, FSSH
Terminal of flow transmitter side	Rod terminal ×2 Amplifier terminal (M3) ×1
Terminal of detector side	BNC connector × 1 Amplifier terminal (M4) ×1

Dimension, Mass: <table 7>

Type		Dimensions (mm)	Mass.(kg)
Flow transmitter	FSV	H240 × W247 × D134	5
Detctor	FSSA	H50 × W348 × D34	0.4
	FSSC	H88 × W480 × D53	1
	FSSD	H90 × W320 × D52.5	0.6
	FSSE	H67 × W78 × D84	1.2
	FSSH	H205 × W530 × D52	1.6
Signal cable	FLYD	ø7.3mm	90g/m

External terminal of flow transmitter:
plug terminal

■ PC Loader software

Provided as standard

•Compatible model is PC/AT compatible instrument.

•Main functions: Software for Main unit parameter setting/ change on PC

•OS: Windows 2000/XP or Windows 7 (Home Premium, Professional)

•Memory requirement: 125MB min.

•Disk unit: CD-ROM drive compatible with Windows 2000/ XP or Windows 7 (Home Premium, Professional)

•Hard disk capacity: Minimum vacant capacity of 52MB or more

Note: Optional communication board (specified at the 5th digit of code symbols).

Note: Communication converter

For tne 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]

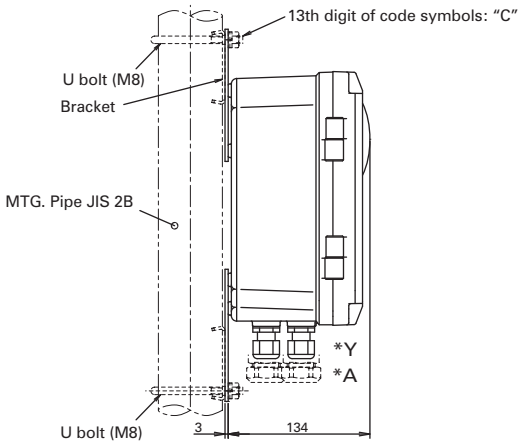
RC-770X(manufactured by SYSMEX RA)

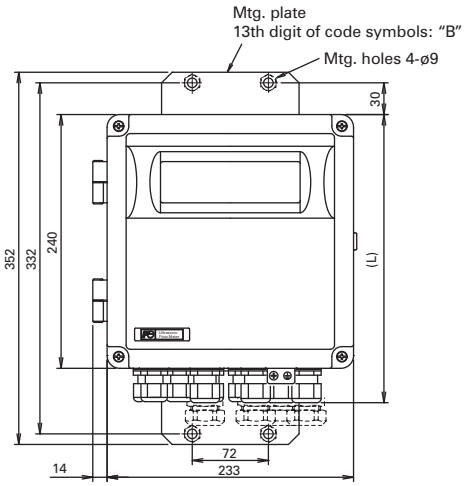
[USB - RS-232C converter]

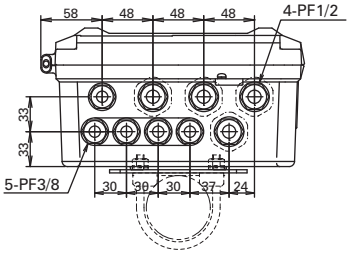
USB-CVRS9 (manufactured by SANWA SUPPLY)

7.2. Outline diagram

Flow transmitter (Type: FSV…L)







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 Measurement mode: 1-path/energy measurement>

Setting item			Initial value	Setting value	Setting range
ID No			0000		ID No. is invalid when 0000 is selected.
Language			Japanese		English, Japanese, German, French, Spanish
Measurement mode			1 path		1 path, 2 path, 2 pipes
Calculation output			Average	—	Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1)
Operation mode			Normal		Normal, High speed
System unit			Metric		Metric or Inch
Measuring conditions	Unit	Flow unit	㎥/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
		Total unit	㎥		mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
		Temperature unit	℃		℃, K, F
		Thermal unit	MJ/h		MJ/h, GJ/h, BTU/h, kBTU/h, MBTU/h, kWh, MWh
		Total unit (thermal)	MJ		MJ, GJ, BTU, kBTU, MBTU, kW, MW
	Process setting	Outer diameter	60.00mm		6.00 to 6200.00mm
		Pipe material	PVC		Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP Pipe sound velocity (Sound velocity: [m/s, ft/s])
		Wall thickness	4.00mm		4.00mm
		Lining material	No lining		No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC Lining S.V. (Sound velocity: [m/s, ft/s])
		Lining thickness	—		0.01 to 100.00mm
		Kind of fluid	Water		Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410 Fluid S.V. (Sound velocity: [m/s, ft/s])
		Viscosity	1.0038×10^{-6} ㎡/s		0.001 to $999.999\times10^{-6}$$m^2$/s
		Sensor mounting method	V method		V method, Z method
		Sensor type	FSSA		FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32
	Energy measuremet	Energy mode	Used		Not used, Used
		Operation mode	Cooling		Cooling, Heating, Air-conditionning
		Thermal coefficient for cooling	4.186		1.000 to 9.999
		Thermal coefficient for heating	4.123		1.000 to 9.999
Output conditions	Damping		5.0 sec		0.0 to 100.0sec
	Low flow cut		0.15 ㎥/h		0 to 5m/s in terms of flow velocity
	Analog output	Analog output 1 source channel	CH1：Thermal flow		CH1: Flow rate, CH1: Thermal flow
		Analog output 2 source channel	CH1：Flow rate		CH1: Flow rate, CH1: Thermal flow
		Kind	Flow rate		Velocity, Flow rate
		Range type	Single		Single, Auto 2, Bi-dir, Bi-dir Auto 2
		Full scale 1	15.000 ㎥/h		0, ±0.3 to ±32m/s in terms of flow velocity
		Full scale 2	0.000 ㎥/h		0, ±0.3 to ±32m/s in terms of flow velocity
		Full scale 1 (thermal)	0.000 MJ/h		0.000000 to 99999999
		Full scale 2 (thermal)	0.000 MJ/h		0.000000 to 99999999
		Hysteresis	10.00 %		0.00 to 20.00%
		Burnout (current)	Hold		Not used, Hold, Lower, Upper and Zero
		Burnout timer	10 sec		10 to 900sec
		Output limit low	-20 %		-20 to 0%

		Output limit high	120 %		100 to 120%
	Total output	Total mode	Stop		Start, Stop, Reset
		Total rate	0 ㎥		0.000000 to 99999999
		Total preset	0 ㎥		0.000000 to 99999999
		Total rate (thermal)	0 MJ		0.000000 to 99999999
		Total preset (thermal)	0 MJ		0.000000 to 99999999
		Pulse width	50msec		5msec, 10msec, 50msec, 100msec, 200msec, 500msec, 1000msec
		Burnout (total)	Hold		Not used, Hold
		Burnout timer	10 sec		10 to 900 sec
	Contact output	DO1 output type	Not used		Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error] Flow switch ☐Flow SW high [ ] ☐Flow SW low [ ], Total switch [ ], AO range over, Pulse range over, –Flow direction, H: Total pulse (T), C: Total pulse (T), Full scale 2 (T), Flow switch (T) ・Flow SW high [ ] ・Flow SW low [ ] , Total switch (T) [ ] , AO range over (T), P: range over (T), Air-conditioning, Temp. alarm
		DO1 output operation	Active ON		Active ON, Active OFF
		DO2 output type	Not used		Same as “DO1 output type”
		DO2 output operation	Active ON		Active ON, Active OFF
		DO3 output type	Not used		Same as “DO1 output type”
		DO3 output operation	Active ON		Active ON, Active OFF
		DO4 output type	Not used		Same as “DO1 output type”
		DO4 output operation	Active ON		Active ON, Active OFF
	Display	Content of display 1st Line	Thermal flow (MJ/h)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse, H: Total (thermal), H: Total pulse (T), C: Total (thermal), C: Total pulse (T), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference
		Decimal point position of display 1st line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
		Content of display 2nd Line	Flow rate (m/s)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse, H: Total (thermal), H: Total pulse (T), C: Total (thermal), C: Total pulse (T), Thermal flow, Thermal flow (%), Supply temp., Return temp., Temp difference
		Decimal point position of display 2nd line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
Communication	Communication mode		RS-485		MODBUS
	Baud rate		9600bps		9600bps, 19200bps, 38400bps
	Parity		Odd		None, Odd, Even
	Stop bit		1 bit		1 bit, 2 bits
	Station No.		1		1 to 31
LCD	LCD backlight		ON		ON, OFF
	Lights-out time		5 min		0 to 99min

<Parameter specification table Measurement mode: 2-path >

Setting item			Initial value	Setting value	Setting range
ID No			0000		ID No. is invalid when 0000 is selected.
Language			Japanese		English, Japanese, German, French, Spanish
Measurement mode			2 path		1 path, 2 path, 2 pipes
Calculation output			Average		Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1)
Action mode			Normal		Normal, High speed
System unit			Metric		Metric or Inch
Measuring conditions	Unit	Flow unit	㎥/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
		Total unit	㎥		mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
	Process setting	Outer diameter	60.00mm		6.00 to 6200.00mm
		Pipe material	PVC		Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP Pipe sound velocity (Sound velocity: [m/s, ft/s])
		Wall thickness	4.00mm		4.00mm
		Lining material	No lining		No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC Lining S.V. (Sound velocity: [m/s, ft/s])
		Lining thickness	—		0.01 to 100.00mm
		Kind of fluid	Water		Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410 Fluid S.V. (Sound velocity: [m/s, ft/s])
		Viscosity	1.0038×10^{-6} ㎡/s		0.001 to $999.999\times10^{-6}m^2$/s
		Sensor mounting method	V method		V method, Z method
		Sensor type	FSSA		FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32
Output conditions	Damping		5.0 sec		0.0 to 100.0sec
	Low flow cut		0.15 ㎥/h		0 to 5m/s in terms of flow velocity
	Analog output	Analog output 1 source channel	CH1: Flow rate		CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2)
		Analog output 2 source channel	CH2: Flow rate		CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2)
		Kind	Flow rate		Velocity, Flow rate
		Range type	Single		Single, Auto 2, Bi-dir, Bi-dir Auto 2
		Full scale 1	15.000 ㎥/h		0, ±0.3 to ±32m/s in terms of flow velocity
		Full scale 2	0.000 ㎥/h		0, ±0.3 to ±32m/s in terms of flow velocity
		Hysteresis	10.00 %		0.00 to 20.00%
		Burnout (current)	Hold		Not used, Hold, Lower, Upper and Zero
		Burnout timer	10 sec		10 to 900sec
		Output limit low	-20 %		-20 to 0%
		Output limit high	120 %		100 to 120%
	Total output	Total mode	Stop		Start, Stop, Reset
		Total rate	0 ㎥		0.000000 to 99999999
		Total preset	0 ㎥		0.000000 to 99999999
		Pulse width	50msec		5msec, 10msec, 50msec, 100msec, 200msec, 500msec, 1000msec
		Burnout (total)	Hold		Not used, Hold
		Burnout timer	10 sec		10 to 900sec
	Contact output	DO1 source channel	CH1		CH1, CH2, CH3
		DO1 output type	Not used		Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error] Flow switch ☐Flow SW high [ ] ☐Flow SW low [ ], Total switch [ ], AO range over, Pulse range over, –Flow direction
		DO1 output operation	Active ON		Active ON, Active OFF
		DO2 source channel	CH1		CH1, CH2, CH3
		DO2 output type	Not used		Same as “DO1 output type”
		DO2 output operation	Active ON		Active ON, Active OFF
		DO3 source channel	CH1		CH1, CH2, CH3
		DO3 output type	Not used		Same as “DO1 output type”
		DO3 output operation	Active ON		Active ON, Active OFF
		DO4 source channel	CH1		CH1, CH2, CH3
		DO4 output type	Not used		Same as “DO1 output type”
		DO4 output operation	Active ON		Active ON, Active OFF

	Display	Source channel of display 1st line	CH1		CH1, CH2, CH3
		Content of display 1st line	Flow rate (㎥/h)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse
		Decimal point position of display 1st line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
		Source channel of display 2nd line	CH2		CH1, CH2, CH3
		Content of display 2nd line	Flow rate (㎥/h)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse
		Decimal point position of display 2nd line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
Communication	Communication mode		RS-485		MODBUS
	Baud rate		9600bps		9600bps, 19200bps, 38400bps
	Parity		Odd		None, Odd, Even
	Stop bit		1 bit		1 bit, 2 bits
	Station No.		1		1 to 31
LCD	LCD backlight		ON		ON, OFF
	Lights-out time		5 min		0 to 99min

<Parameter specification table Measurement mode: 2-pipe>

Setting item			Initial value	Setting value		Setting range
ID No			0000			ID No. is invalid when 0000 is selected.
Language			Japanese			English, Japanese, German, French, Spanish
Measurement mode			2 pipes			1 path, 2 path, 2 pipes
Calculation output			Average			Average, Addition, Sub (CH1-CH2), Sub (CH2-CH1)
Action mode			Normal			Normal, High speed
System unit			Metric			Metric or Inch
Setting item			Initial value	Path 1 (CH1)	Path 2 (CH2)	Setting range
Measuring conditions	Unit	Flow unit	㎥/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
		Total unit	㎥			mL, L, m^3, km^3, Mm^3, mBBL, BBL, kBBL
	Process setting	Outer diameter	60.00mm			6.00 to 6200.00mm
		Pipe material	PVC			Carbon steel, Stainless, PVC, Copper, Cast iron, Aluminum, FRP, Ductile iron, PEEK, PVDF, Acrylic and PP Pipe sound velocity (Sound velocity: [m/s, ft/s])
		Wall thickness	4.00mm			4.00mm
		Lining material	No lining			No lining, Tar epoxy, Mortar, Rubber, Teflon, Pyrex glass, PVC Lining S.V. (Sound velocity: [m/s, ft/s])
		Lining thickness	—			0.01 to 100.00mm
		Kind of fluid	Water			Water, seawater, dist. water, ammonia, alcohol, benzene, bromide, ethanol, glycol, kerosene, milk, methanol, toluol, lube oil, fuel oil, petrol and refrigerant R410 Fluid S.V. (Sound velocity: [m/s, ft/s])
		Viscosity	1.0038×10^{-6} ㎡/s			0.001 to $999.999\times10^{-6}m^2$/s
		Sensor mounting method	V method			V method, Z method
		Sensor type	FSSA			FSSA/FSSG,FLS_12/FLS_22,FSSC,FSG_32, FSG_31/FSG_41,FSSE/FSG_50FSSF/FSG_51, FSD12,FSSD/FSD22,FSSH/FSD32

Setting item			Initial value	Path 1 (CH1)	Path 2 (CH2)	Calculated value (CH3)	Setting range
Output conditions	Damping		5.0 sec			—	0.0 to 100.0sec
	Low flow cut		0.15 ㎥/h			—	0 to 5m/s in terms of flow velocity
	Analog output	Analog output 1 source channel	CH1: Flow rate				CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2)
		Analog output 2 source channel	CH2: Flow rate				CH1: Flow rate, CH2: Flow rate, CH3: Flow rate (Note2)
		Kind	Flow rate			Flow rate	Velocity, Flow rate
		Range type	Single				Single, Auto 2, Bi-dir, Bi-dir Auto 2
		Full scale 1	15.000 ㎥/h				0, ±0.3 to ±32m/s in terms of flow velocity
		Full scale 2	0.000 ㎥/h				0, ±0.3 to ±32m/s in terms of flow velocity
		Hysteresis	10.00 %				0.00 to 20.00%
		Burnout (current)	Hold				Not used, Hold, Lower, Upper and Zero
		Burnout timer	10 sec				10 to 900sec
		Output limit low	-20 %				-20 to 0%
		Output limit high	120 %				100 to 120%
	Total output	Total mode	Stop				Start, Stop, Reset
		Total rate	0 ㎥				0.000000 to 99999999
		Total preset	0 ㎥				0.000000 to 99999999
		Pulse width	50msec				5msec, 10msec, 50msec, 100msec, 200msec, 500msec, 1000msec
		Burnout (total)	Hold				Not used, Hold
		Burnout timer	10 sec				10 to 900sec

Output conditions	Contact output	DO1 source channel	CH1		CH1, CH2, CH3
		DO1 output type	Not used		Not used, +Total pulse, -Total pulse, Full scale 2, Alarm [All, Hardware fault, Process error] Flow switch □Flow SW high [ ] □Flow SW low [ ], Total switch [ ], AO range over, Pulse range over, –Flow direction
		DO1 output operation	Active ON		Active ON, Active OFF
		DO2 source channel	CH1		CH1, CH2, CH3
		DO2 output type	Not used		Same as “DO1 output type”
		DO2 output operation	Active ON		Active ON, Active OFF
		DO3 source channel	CH1		CH1, CH2, CH3
		DO3 output type	Not used		Same as “DO1 output type”
		DO3 output operation	Active ON		Active ON, Active OFF
		DO4 source channel	CH1		CH1, CH2, CH3
		DO4 output type	Not used		Same as “DO1 output type”
		DO4 output operation	Active ON		Active ON, Active OFF
	Display	Source channel of display 1st line	CH1		CH1, CH2, CH3
		Content of display 1st line	Flow rate (㎥/h)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse
		Decimal point position of display 1st line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
		Source channel of display 2nd line	CH2		CH1, CH2, CH3
		Content of display 2nd line	Flow rate (㎥/h)		Velocity, Flow rate, Flow rate (%), +Total (Actual), +Total pulse, -Total (Actual), -Total Pulse
		Decimal point position of display 2nd line	****. ***		*. ******, **. *****, ***. ****, ****. ***, *****. **, ******. *, ********
Communication	Communication mode		RS-485		MODBUS
	Baud rate		9600bps		9600bps, 19200bps, 38400bps
	Parity		Odd		None, Odd, Even
	Stop bit		1 bit		1bit, 2 bits
	Station No.		1		1 to 31
LCD	LCD backlight		ON		ON, OFF
	Lights-out time		5 min		0 to 99min

Note 1) When selecting "total pulse" for DO1, DO2, DO3, and/or DO4, 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

Stainless steel pipe for pipe arrangement (JIS G3459-2012)

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
250	10	267.4	3.4	4.0	6.5	9.3	15.1	21.4	28.6
300	12	318.5	4.0	4.5	6.5	10.3	17.4	25.4	33.3
350	14	355.6	-	-	-	11.1	19.0	27.8	35.7
400	16	406.4	-	-	-	12.7	21.4	30.9	40.5
450	18	457.2	-	-	-	14.3	23.8	34.9	45.2
500	20	508.0	-	-	-	15.1	26.2	38.1	50.0
550	22	558.8	-	-	-	15.9	28.6	41.3	54.0
600	24	609.6	-	-	-	17.5	31.0	46.0	59.5
650	26	660.4	-	-	-	18.9	34.0	49.1	64.2

Polyethylene pipe for city water (JIS K6762-2004)

Nominal diameter (mm)	Outer diameter (mm)	1st type (Soft pipe)		2nd type (Hard pipe)	
		Thickness (mm)	Weight (kg/m)	Thickness (mm)	Weight (kg/m)
13	21.5	3.5	0.184	2.5	0.143
20	27.0	4.0	0.269	3.0	0.217
25	34.0	5.0	0.423	3.5	0.322
30	42.0	5.6	0.595	4.0	0.458
40	48.0	6.5	0.788	4.5	0.590
50	60.0	8.0	1.216	5.0	0.829

Galvanized steel pipe for city water SGPW (JIS G3442-2010)

How to call pipe		Outer diameter (mm)	Thickness (mm)
(A)	(B)		
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
200	8	216.3	5.8
250	10	267.4	6.6
300	12	318.5	6.9
350	14	355.6	7.9
400	16	406.4	7.9
450	18	457.2	7.9
500	20	508.0	7.9

Polyethylene pipe for general use (JIS K6761-2004)

Nominal diameter	Outer diameter (mm)	1st type (Soft pipe)	2nd type (Hard pipe)
		Thickness (mm)	Thickness (mm)
13	21.5	2.7	2.4
20	27.0	3.0	2.4
25	34.0	3.0	2.6
30	42.0	3.5	2.8
40	48.0	3.5	3.0
50	60.0	4.0	3.5
65	76.0	5.0	4.0
75	89.0	5.5	5.0
100	114	6.0	5.5
125	140	6.5	6.5
150	165	7.0	7.0
200	216	-	8.0
250	267	-	9.0
300	318	-	10.0

PVC pipe for city water (JIS K6742-2007)
VP: PVC pipe
HIVP: anti-shock PVC pipe etc..

Nominal diameter	Outer diameter	Pipe thickness
13	18.0	2.5
16	22.0	3.0
20	26.0	3.0
25	32.0	3.5
30	38.0	3.5
40	48.0	4.0
50	60.0	4.5
75	89.0	5.9
100	114.0	7.1
150	165.0	9.6

PVC pipe PVC-u (JIS K6741-2007)

Type / Nominal (mm)	VP		VU	
	Outer diameter	Thickness	Outer diameter	Thickness
13	18	2.2	-	-
16	22	2.7	-	-
20	26	2.7	-	-
25	32	3.1	-	-
30	38	3.1	-	-
40	48	3.6	48	1.8
50	60	4.1	60	1.8
65	76	4.1	76	2.2
75	89	5.5	89	2.7
100	114	6.6	114	3.1
125	140	7.0	140	4.1
150	165	8.9	165	5.1
200	216	10.3	216	6.5
250	267	12.7	267	7.8
300	318	15.1	318	9.2
350	-	-	370	10.5
400	-	-	420	11.8
450	-	-	470	13.2
500	-	-	520	14.6
600	-	-	630	17.8
700	-	-	732	21.0

IWVP : PVC pipe (ISO 4422-2)

Nominal diameter of pipe	Outer diameter	Pipe thickness
ND32	32	1.6
ND40	40	1.9
ND50	50	2.4
ND63	63	3.0
ND75	75	3.6
ND90	90	4.3
ND110	110	4.2
ND125	125	4.8
ND140	140	5.4
ND160	160	6.2

Vertical type cast iron pipe (JIS G5521)

Nominal diameter D	Pipe thickness T		Actual outer diameter D1
	Normal pressure pipe	Low pressure pipe	
75	9.0	-	93.0
100	9.0	-	118.0
150	9.5	9.0	169.0
200	10.0	9.4	220.0
250	10.8	9.8	271.6
300	11.4	10.2	322.8
350	12.0	10.6	374.0
400	12.8	11.0	425.6
450	13.4	11.5	476.8
500	14.0	12.0	528.0
600	15.4	13.0	630.8
700	16.5	13.8	733.0
800	18.0	14.8	836.0
900	19.5	15.5	939.0
1000	22.0	-	1041.0
1100	23.5	-	1144.0
1200	25.0	-	1246.0
1350	27.5	-	1400.0
1500	30.0	-	1554.0

Carbon steel pipe for pipe arrangement SGP (JIS G3452-2010)

How to call pipe		Outer diameter (mm)	Thickness (mm)
(A)	(B)		
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
225	9	241.8	6.2
250	10	267.4	6.6
300	12	318.5	6.9
350	14	355.6	7.9
400	16	406.4	7.9
450	18	457.2	7.9
500	20	508.0	7.9

Coated steel pipe for city water STW (JIS G3443-1 2007)

Nominal diameter (A)	Outer diameter (mm)	Symbol for type			
		STW 290	STW 370	STW 400	
				Nominal thickness	
				A	B
		Thickness (mm)	Thickness (mm)	Thickness (mm)	Thickness (mm)
80	89.1	4.2	4.5	-	-
100	114.3	4.5	4.9	-	-
125	139.8	4.5	5.1	-	-
150	165.2	5.0	5.5	-	-
200	216.3	5.8	6.4	-	-
250	267.4	6.6	6.4	-	-
300	318.5	6.9	6.4	-	-
350	355.6	-	-	6.0	-
400	406.4	-	-	6.0	-
450	457.2	-	-	6.0	-
500	508.0	-	-	6.0	-
600	609.6	-	-	6.0	-
700	711.2	-	-	7.0	6.0
800	812.8	-	-	8.0	7.0
900	914.4	-	-	8.0	7.0
1000	1016.0	-	-	9.0	8.0
1100	1117.6	-	-	10.0	8.0
1200	1219.2	-	-	11.0	9.0
1350	1371.6	-	-	12.0	10.0
1500	1524.0	-	-	14.0	11.0
1600	1625.6	-	-	15.0	12.0
1650	1676.4	-	-	15.0	12.0
1800	1828.8	-	-	16.0	13.0
1900	1930.4	-	-	17.0	14.0
2000	2032.0	-	-	18.0	15.0
2100	2133.6	-	-	19.0	16.0
2200	2235.2	-	-	20.0	16.0
2300	2336.8	-	-	21.0	17.0
2400	2438.4	-	-	22.0	18.0
2500	2540.0	-	-	23.0	18.0
2600	2641.6	-	-	24.0	19.0
2700	2743.2	-	-	25.0	20.0
2800	2844.8	-	-	26.0	21.0
2900	2946.4	-	-	27.0	21.0
3000	3048.0	-	-	29.0	22.0

Centrifugal nodular graphite cast iron pipe for city water (A type) (JWWA G-105 1971)

Nominal diameter	Pipe thickness			Actual outer diameter
D	T			D_1
	1st type pipe	2nd type pipe	3rd type pipe	
75	7.5	-	6.0	93.0
100	7.5	-	6.0	118.0
150	7.5	-	6.0	169.0
200	7.5	-	6.0	220.0
250	7.5	-	6.0	271.6
300	7.5	-	6.5	332.8
350	7.5	-	6.5	374.0
400	8.5	7.5	7.0	425.6
450	9.0	8.0	7.5	476.8
500	9.5	8.5	7.0	528.0

Centrifugal nodular graphite cast iron pipe for city water (K type) (JWWA G-105 1971)

Nominal diameter	Pipe thickness			Actual outer diameter
D	1st type pipe	2nd type pipe	3rd type pipe	D_1
400	8.5	7.5	7.0	425.6
450	9.0	8.0	7.5	476.8
500	9.5	8.5	8.0	528.0
600	11.0	10.0	9.0	630.8
700	12.0	11.0	10.0	733.0
800	13.5	12.0	11.0	836.0
900	15.0	13.0	12.0	939.0
1000	16.5	14.5	13.0	1041.0
1100	18.0	15.5	14.0	1144.0
1200	19.5	17.0	15.0	1246.0
1350	21.5	18.5	16.5	1400.0
1500	23.5	20.5	18.0	1554.0

Arc welded large-diameter stainless steel pipe for pipe arrangement SUS (JIS G3468-2011)

Nominal diameter		Outer diameter (mm)	Nominal thickness			
			Schedule 5S	Schedule 10S	Schedule 20S	Schedule 40S
A	B		Thickness mm	Thickness mm	Thickness mm	Thickness mm
150	6	165.2	2.8	3.4	5.0	7.1
200	8	216.3	2.8	4.0	6.5	8.2
250	10	267.4	3.4	4.0	6.5	9.3
300	12	318.5	4.0	4.5	6.5	10.3
350	14	355.6	4.0	5.0	8.0	11.1
400	16	406.4	4.5	5.0	8.0	12.7
450	18	457.2	4.5	5.0	8.0	14.3
500	20	508.0	5.0	5.5	9.5	15.1
550	22	558.8	5.0	5.5	9.5	15.9
600	24	609.6	5.5	6.5	9.5	17.5
650	26	660.4	5.5	8.0	12.7	-
700	28	711.2	5.5	8.0	12.7	-
750	30	762.0	6.5	8.0	12.7	-
800	32	812.8	-	8.0	12.7	-
850	34	863.6	-	8.0	12.7	-
900	36	914.4	-	8.0	12.7	-
1000	40	1016.0	-	9.5	14.3	-

Ductile iron specials (JIS G5527-1998)

Nominal diameter (mm)	Pipe thickness (mm)
75	8.5
100	8.5
150	9.0
200	11.0
250	12.0
300	12.5
350	13.0
400	14.0
450	14.5
500	15.0
600	16.0
700	17.0
800	18.0
900	19.0
1000	20.0
1100	21.0
1200	22.0
1350	24.0
1500	26.0
1600	27.5
1650	28.0
1800	30.0
2000	32.0
2100	33.0
2200	34.0
2400	36.0

Dimensions of centrifugal sand mold cast iron pipe (JIS G5522). For reference, following items are discontinued.

Nominal diameter D	Pipe thickness (T)			Actual outer diameter D_1
	High pressure pipe	Normal pressure pipe	Low pressure pipe	
75	9.0	7.5	-	93.0
100	9.0	7.5	-	118.0
125	9.0	7.8	-	143.0
150	9.5	8.0	7.5	169.0
200	10.0	8.8	8.0	220.0
250	10.8	9.5	8.4	271.6
300	11.4	10.0	9.0	322.8
350	12.0	10.8	9.4	374.0
400	12.8	11.5	10.0	425.6
450	13.4	12.0	10.4	476.8
500	14.0	12.8	11.0	528.0
600	-	14.2	11.8	630.8
700	-	15.5	12.8	733.0
800	-	16.8	13.8	836.0
900	-	18.2	14.8	939.0

Dimensions of centrifugal sand mold cast iron pipe (JIS G5523 1977). For reference, following items are discontinued.

Nominal diameter (mm)	Pipe thickness (T)		Actual outer diameter D_1
	High pressure pipe	Normal pressure pipe	
75	9.0	7.5	93.0
100	9.0	7.5	118.0
125	9.0	7.8	143.0
150	9.5	8.0	169.0
200	10.0	8.8	220.0
250	10.8	9.5	271.6
300	11.4	10.0	322.8

Cast iron pipe for waste water FC150 (JIS G5525:2000)

Nominal diameter	Mechanical type								Insertion type	
	1st type pipe				2nd type pipe				RJ pipe	
	Straight pipe		Deformed pipe		Straight pipe		Deformed pipe		Straight/deformed pipe	
	Outer diameter	Pipe thickness	Outer diameter	Pipe thickness	Outer diameter	Pipe thickness	Outer diameter	Pipe thickness	Outer diameter	Pipe thickness
50	58	4	60	5	–		58	4	–	–
75	83	4	85	5	83	4	83	4	89	4.5
100	108	4	110	5	108	4	108	4	114	4.5
125	134	4.5	136	5.5	134	4.5	134	4.5	140	4.5
150	159	4.5	161	5.5	–	–	–	–	–	–
200	211	5.5	213	6.5	–	–	–	–	–	–

Arc welded carbon steel pipe STPY 400 (JIS G3457-2012)

Unit: kg/m

Nominal diameter		Thickness (mm) / Outer diameter (mm)	6.0	6.4	7.1	7.9	8.7	9.5	10.3	11.1	11.9	12.7	13.1	15.1	15.9
(A)	(B)														
350	14	355.6	51.7	55.1	61.0	67.7									
400	16	406.4	59.2	63.1	69.9	77.6									
450	18	457.2	66.8	71.1	78.8	87.5									
500	20	508.0	74.3	79.2	87.7	97.4	107	117							
550	22	558.8	81.8	87.2	96.6	107	118	129	139	150	160	171			
600	24	609.6	89.3	95.2	105	117	129	141	152	164	175	187			
650	26	660.4	96.8	103	114	127	140	152	165	178	190	203			
700	28	711.2	104	111	123	137	151	164	178	192	205	219			
750	30	762.0		119	132	147	162	176	191	206	220	235			
800	32	812.8		127	141	157	173	188	204	219	235	251	258	297	312
850	34	863.6				167	183	200	217	233	250	266	275	316	332
900	36	914.4				177	194	212	230	247	265	282	291	335	352
1000	40	1016.0				196	216	236	255	275	295	314	324	373	392
1100	44	1117.6						260	281	303	324	346	357	411	432
1200	48	1219.2						283	307	331	354	378	390	448	472
1350	54	1371.6									399	426	439	505	532
1500	60	1524.0									444	473	488	562	591
1600	64	1625.6											521	600	631
1800	72	1828.8											587	675	711
2000	80	2032.0												751	791

Stainless steel sanitary pipe SUS (JIS G3447-2009)

	Outer diameter (mm)	Thickness (mm)	Internal diameter (mm)
	25.4	1.2	23.0
	31.8	1.2	29.4
	38.1	1.2	35.7
	50.8	1.5	47.8
	63.5	2.0	59.5
	76.3	2.0	72.3
	89.1	2.0	85.1
	101.6	2.0	97.6
	114.3	3.0	108.3
	139.8	3.0	133.8
	165.2	3.0	159.2

PVDF-HP

	SDR33 S16　PN10	SDR21 S10　PN16	SDR17 S8　PN20
Outer diameter (mm)	Thickness (mm)	Thickness (mm)	Thickness (mm)
16		1.5	1.5
20		1.9	1.9
25		1.9	1.9
32		2.4	2.4
40		2.4	2.4
50		3.0	3.0
63	2.5	3.0	
75	2.5	3.6	
90	2.8	4.3	
110	3.4	5.3	
125	3.9	6.0	
140	4.3	6.7	
160	4.9	7.7	
180	5.5	8.6	
200	6.2	9.6	
225	6.9	10.8	
250	7.7	11.9	
280	8.6	13.4	
315	9.7	15.0	
355	10.8		
400	12.2		
450	13.7		

Heat-resistant hard vinyl chloride pipe PVC-C
(JIS K6776:2007)

Nominal diameter	Outer diameter (mm)	Thickness (mm)	Weight (kg/m)
13	18.0	2.5	0.180
16	22.0	3.0	0.265
20	26.0	3.0	0.321
25	32.0	3.5	0.464
30	38.0	3.5	0.561
40	48.0	4.0	0.818
50	60.0	4.5	1.161

Polyethylene pipe for city water service
(Japan Polyethylene Pipes Association for Water Service standard PTC K 03:2006)

Nominal diameter	Outer diameter (mm)	Thickness (mm)	Inner diameter (mm)	Weight (kg/m)
50	63.0	5.8	50.7	1.074
75	90.0	8.2	72.6	2.174
100	125.0	11.4	100.8	4.196
150	180.0	16.4	145.3	8.671
200	250.0	22.7	201.9	16.688

(a) Velocity of sound subject to change f temperature of water (0 to 100◦C)

T °C	V m/s	T °C	V m/s	T °C	V m/s	T °C	V m/s
0	1402.74						
1	1407.71	26	1499.64	51	1543.93	76	1555.40
2	1412.57	27	1502.20	52	1544.95	77	1555.31
3	1417.32	28	1504.68	53	1545.92	78	1555.18
4	1421.98	29	1507.10	54	1546.83	79	1555.02
5	1426.50	30	1509.44	55	1547.70	80	1554.81
6	1430.92	31	1511.71	56	1548.51	81	1554.57
7	1435.24	32	1513.91	57	1549.28	82	1554.30
8	1439.46	33	1516.05	58	1550.00	83	1553.98
9	1443.58	34	1518.12	59	1550.68	84	1553.63
10	1447.59	35	1520.12	60	1551.30	85	1553.25
11	1451.51	36	1522.06	61	1551.88	86	1552.82
12	1455.34	37	1523.93	62	1552.42	87	1552.37
13	1459.07	38	1525.74	63	1552.91	88	1551.88
14	1462.70	39	1527.49	64	1553.35	89	1551.35
15	1466.25	40	1529.18	65	1553.76	90	1550.79
16	1469.70	41	1530.80	66	1554.11	91	1550.20
17	1473.07	42	1532.37	67	1554.43	92	1549.58
18	1476.35	43	1533.88	68	1554.70	93	1548.92
19	1479.55	44	1535.33	69	1554.93	94	1548.23
20	1482.66	45	1536.72	70	1555.12	95	1547.50
21	1485.69	46	1538.06	71	1555.27	96	1546.75
22	1488.63	47	1539.34	72	1555.37	97	1545.96
23	1491.50	48	1540.57	73	1555.44	98	1545.14
24	1494.29	49	1541.74	74	1555.47	99	1544.29
25	1497.00	50	1542.87	75	1555.45	100	1543.41

Note) T: Temperature, V: Velocity

(b) Sound velocity and density of various liquids

Name of liquid	T °C	ρ g/cm^3	V m/s
Acetone	20	0.7905	1190
Aniline	20	1.0216	1659
Alcohol	20	0.7893	1168
Ether	20	0.7135	1006
Ethylene glycol	20	1.1131	1666
n-octane	20	0.7021	1192
o-xylol	20	0.871	1360
Chloroform	20	1.4870	1001
Chlorobenzene	20	1.1042	1289
Glycerin	20	1.2613	1923
Acetic acid	20	1.0495	1159
Methyl acetate	20	0.928	1181
Ethyl acetate	20	0.900	1164
Cyclohexane	20	0.779	1284
Dioxane	20	1.033	1389
Heavy water	20	1.1053	1388
Carbon tetrachloride	20	1.5942	938
Mercury	20	13.5955	1451
Nitrobenzene	20	1.207	1473
Carbon bisulfide	20	1.2634	1158
Chloroform	20	2.8904	931
n-propyl alcohol	20	0.8045	1225
n-pentane	20	0.6260	1032
n-hexane	20	0.654	1083
Light oil	25	0.81	1324
Transformer oil	32.5	0.859	1425
Spindle oil	32	0.905	1342
Petroleum	34	0.825	1295
Gasoline	34	0.803	1250
Water	13.5	1.	1460
Sea water (salinity: 3.5%)	16	1.	1510

Note) T: Temperature, ρ: Density, V: Velocity

(c) Sound velocity of pipe material

Material	V m/s
Steel	3000
Ductile cast iron	3000
Cast iron	2604
Stainless steel	3141
Copper	2260
Lead	2170
Aluminium	3080
Brass	2050
PVC	2307
Acrylic	2644
FRP	2505
6-6 Nylon	2680
Mortar	3000
Tar epoxy	2505
Polyethylene	1900
Teflon	1240
Rubber	1510
Pyrex glass	3280

Note) V: Velocity

(d) Kinematic viscosity coefficient of various liquids

Name of liquid	T °C	ρ g/cm^3	V m/s	v (×10^{-6}m^2/s)
Acetone	20	0.7905	1190	0.407
Aniline	20	1.0216	1659	1.762
Ether	20	0.7135	1006	0.336
Ethylene glycol	20	1.1131	1666	21.112
Chloroform	20	1.4870	1001	0.383
Glycerin	20	1.2613	1923	11.885
Acetic acid	20	1.0495	1159	1.162
Methyl acetate	20	0.928	1181	0.411
Ethyl acetate	20	0.900	1164	0.499
Heavy water	20	1.1053	1388	1.129
Carbon tetrachloride	20	1.5942	938	0.608
Mercury	20	13.5955	1451	0.114
Nitrobenzene	20	1.207	1473	1.665
Carbon bisulfide	20	1.2634	1158	0.290
n-pentane	20	0.6260	1032	0.366
n-hexane	20	0.654	1083	0.489
Spindle oil	32	0.905	1324	15.7
Gasoline	34	0.803	1250	0.4 to 0.5
Water	13.5	1.	1460	1.004 (20°C)

Note) T: Temperature, ρ: Density, V: Velocity, v: Kinematic viscosity coefficient

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