Document No. KF06-001E

Ultrasonic Doppler Flowmeter

UVH-2000

Operation Manual

TOKYO KEIKI

Safety Precautions

The following safety precautions contain important information. Read it well and apply them without fail. These precautions allow you to use TOKYO KEIKI's flowmeter correctly without risk of physical danger or property damage. Before reading the text, be sure you understand the following markings and their meanings.
Keep this manual in an easy-to-access place for quick reference when necessary.

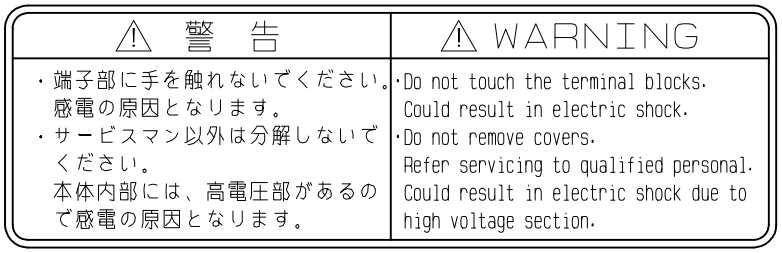
1. Markings

The safety markings used in this document and on the product have the following meanings:

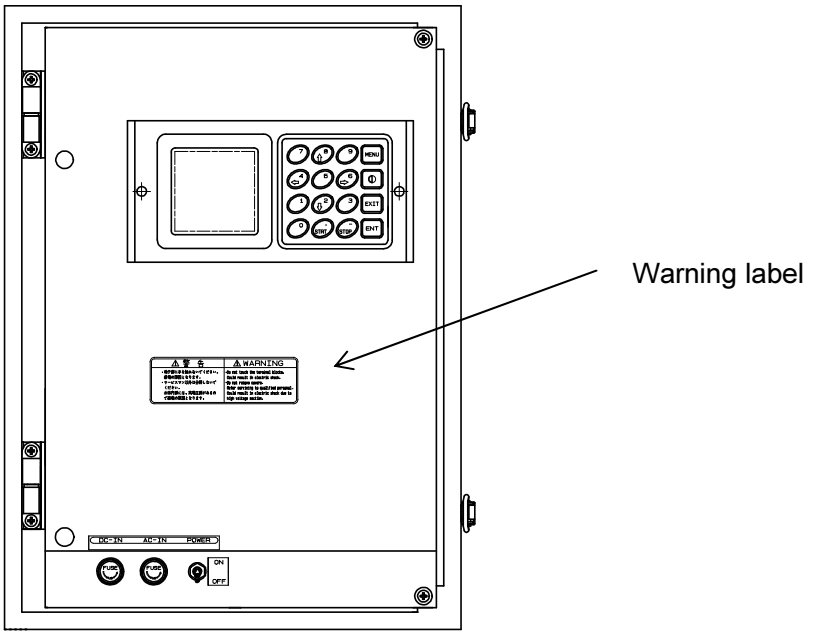
Marking	Meaning
 Danger	Failure to adhere to this precaution is likely to result in **death or serious injury**.
 Warning	Failure to adhere to this precaution may result in **death or serious injury**.
 Caution	Failure to adhere to this precaution may result in **physical injury or property damage**.

2. Warning Label

This product bears the following warning label:



The warning label is affixed to the main unit at the following position:



UVH-2000 Panel (front)

Notes on Use

To ensure the best performance and allow safe use of this product, take note of the following:	
Notes	1) If all of the following requirements is not satisfied, the equipment may fail in measurement or output an incorrect value. ・The product shall be used within the supply voltage range prescribed in the specifications or elsewhere. ・During measurement, there shall be no bubbles or foreign matter that may cause significant disturbance in ultrasonic propagation. ・The flow velocity transducers shall be installed at a position where the necessary straight channel length can be ensured. ・The transducer shall be protected from vibration and shock. ・The flowmeter, transducers, and cable shall be installed where they are not affected by external noise. ・The flowmeter and transducers shall be used in the specified range of ambient temperature and humidity. ・The flow shall be natural and uniform. ・Wood or other hard and heavy drifts shall not flow into the water channel. ・There shall be no sediment accumulation in the water channel.
	2) If the flow velocity calculation unit and the level gauge fail to detect the necessary signal level, the LCD panel in the main unit displays an ROFF (VROFF, HROFF) or HHALT warning. When a warning is displayed, ・flow velocity and water level values immediately before warning is displayed might be displayed. ・flow rate value might be displayed, according to the setting of [ROFF OPE].
	3) When entering settings (maximum flow rate, unit of integration, etc.) into the flowmeter, read this manual well and set them correctly. Incorrect settings will cause the equipment to fail in measurement or output an incorrect value.
	4) Do not alter or disassemble the product. Doing so may result in electric shock or a fault in the equipment.
	5) If you lose this manual, contact the nearest office of TOKYO KEIKI or representative

Introduction

This manual gives safety precautions for the Ultrasonic Doppler Flowmeter UVH-2000 and explains specifications, structure, installation, operations, and troubleshooting in detail. Use this equipment correctly, with a full understanding of the points covered in the manual.

How to use this manual

1. Read the manual well.
   Be sure to study the manual thoroughly to obtain important information.

2. Keep this manual with care.
   The equipment needs to be handled with reference to this manual. Determine a person to take charge and a storage place where the manual may be kept safely and available for immediate use when necessary.

3. Deliver this manual to the user of the equipment.
   An agency or intermediary for the sale of the equipment must deliver this manual to the actual user.

4. If you lose this manual, obtain a new copy immediately.
   If you lose this manual, contact TOKYO KEIKI or representative and obtain a new copy. Note that the new copy is not free.

5. Check that the warning label is not peeling.
   If the warning label on the equipment is dirty or peeling, contact TOKYO KEIKI or representative and obtain a new label. Note that the new warning label is not free.

Notes on the manual

This manual is based on the standard specifications of the equipment.
If your approved drawing of specifications is different from the manual, priority shall be given to the drawing.

Prohibitions and precautions for equipment protection

For equipment protection, adhere to the following precautions:

1. Do not cause a shock to the flowmeter or detector by dropping.

2. Use the equipment in the specified environment (ambient temperature and humidity).

3. Do not use the equipment outside the specified voltage.

4. Do not use a scratched or exposed cable (power, coaxial, or signal cable).

5. The equipment contains high-voltage circuits. When the power is on, never touch the terminals or the inside of the equipment.

6. For equipment operations, open the door at the front of the flowmeter and use the LCD panel and keyboard on the panel. Do not alter the electronic circuits (PC board or electronic parts) inside the panel.

7. Never disassemble or alter the equipment. If the equipment becomes faulty, contact TOKYO KEIKI.

8. This equipment and its accessories cannot be used in an explosion-proof area.

9. For a dielectric strength test on this equipment, consult TOKYO KEIKI.

Contents

Chapter 1 General

Thank you very much for purchasing TOKYO KEIKI's Ultrasonic Doppler Flowmeter UVH-2000. You are requested to read this manual before using the equipment.

For performance enhancement, specifications and appearance are subject to change without notice.

UVH-2000 is a flowmeter used to obtain a flow rate in a water channel where waste water, agricultural effluents, or industrial effluents flow with free surfaces by measuring the water level and flow velocity. This flowmeter has the following features:

1.1 Features

(1) Since TOKYO KEIKI's ultrasonic level gauge is used as the water level detector (standard specification), the water level can be measured accurately without contact with the object of measurement.

(2) Instead of the ultrasonic level gauge, TOKYO KEIKI's Radar Level Gauge MRG-10 or MRF-10 can be used. Other external level gauges are also available.

(3) With TOKYO KEIKI's level gauge, a flow rate can be measured at all water levels from zero to full. The flow velocity detector is compactly designed in order to minimize flow disturbance and is also easy to attach.

(4) Flow rate signals, flow velocity signals, and water level signals can be output independently.

1.2 Related Manual

Radar Level Gauge MRG-10 User's Guide

1.3 Terms

Flow velocity can be described as point flow velocity or average flow velocity. This manual refers to average flow velocity as flow velocity. For details about point flow velocity and average flow velocity, see Chapter 8.

Chapter 2 Standard Configuration

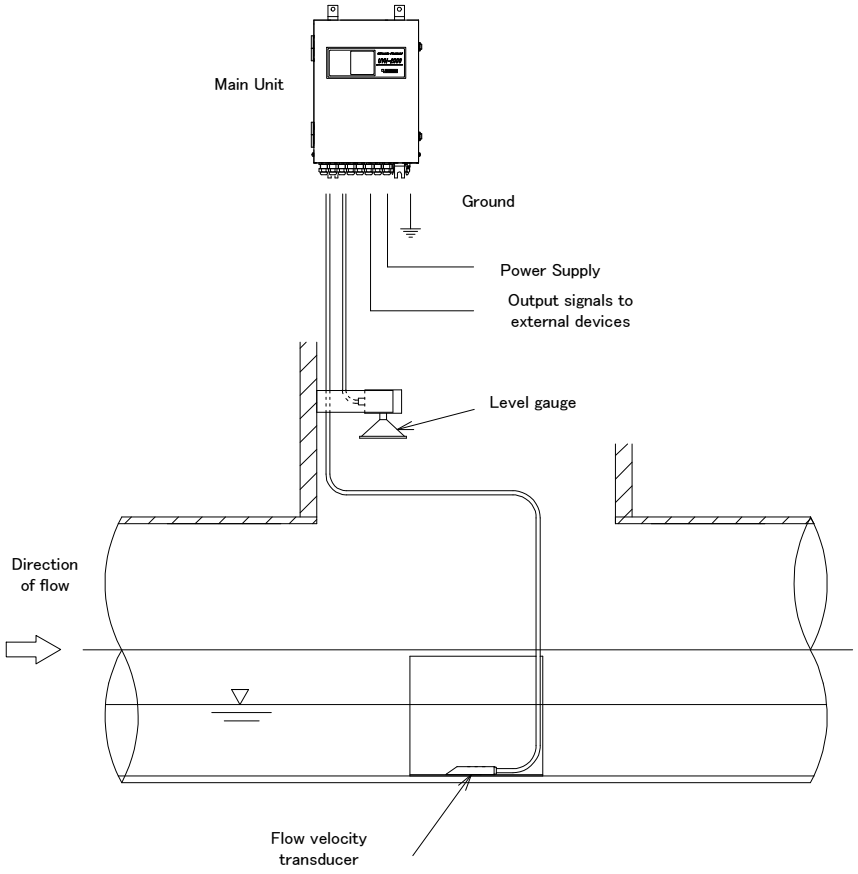
This chapter introduces the standard configuration of the equipment. A schematic of the standard configuration is shown in Fig. 2-1. (The channel is assumed to be open, with Sensor SE204020B at the bottom.)

2.1 Using Ultrasonic Level Gauge

Item		Quantity	Description
Main unit		1	Flowmeter main unit (with built-in ultrasonic level gauge)
Flow velocity transducer	Transducer	1	Ultrasonic transmitter-receiver
	Coaxial cable	1	Used to connect flowmeter main unit with the transducers
	Other	1 set	Coupling material (or junction box) used to connect the coaxial cables and the transducer
Level gauge	Detector	1	Ultrasonic level gauge
	Cable	1	Used to connect the flowmeter main unit with Ultrasonic level detector

2.2 Using Optional Radar Level Gauge MRG-10 or MRF-10

Item		Quantity	Description
Main unit		1	Flowmeter main unit
Flow velocity transducer	Transducer	1	Ultrasonic transmitter-receiver
	Coaxial cable	1	Used to connect flowmeter main unit with the ransducers
	Other	1 set	Coupling material (or junction box) used to connect the coaxial cables and the transducer
Level gauge	Detector	1	Radar Level Gauge MRG-10 (or MRF-10)
	Cable	1	Used to connect the flowmeter main unit with MRG-10 (or MRF-10)



The installation method may vary depending on the site.

Fig. 2-1 Basic configuration

Chapter 3 Section Names and Functions

3.1 Front of Main Unit

The front of the main unit has an LCD display ① for flow rates and integrated values.
To activate or switch off the equipment and to carry out menu operations, use the panel ⑤. To expose the panel, release the locks ③ and open the front door ④ toward the left.
To prevent key operation errors and the entry of dust, the equipment should normally be used with the door closed.

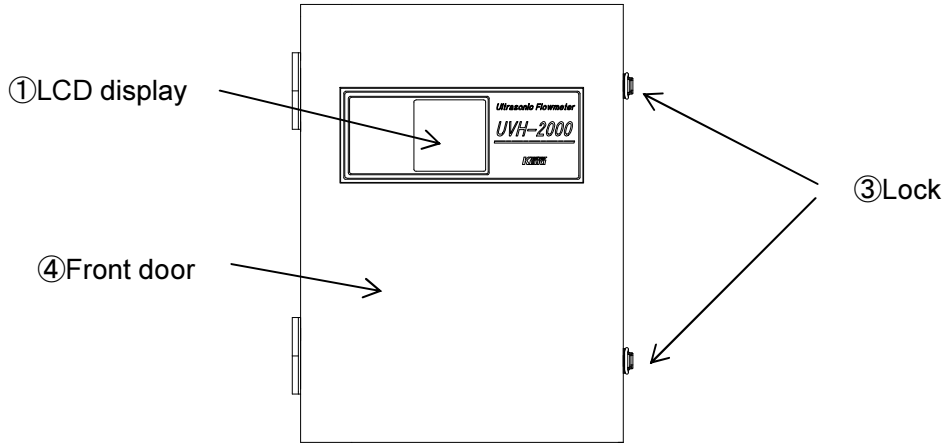


Fig. 3-1 Main unit (front)

3.2 Panel

With the door ④ open, you can do the following:

- Activate or switch off the equipment with the power switch ⑥.
- Change settings using the LCD display ① and the keyboard ②.
- Replace the fuse in the fuse holder ⑦. For fuse replacement, see 6.2, "Maintenance and Inspection of Main Unit."

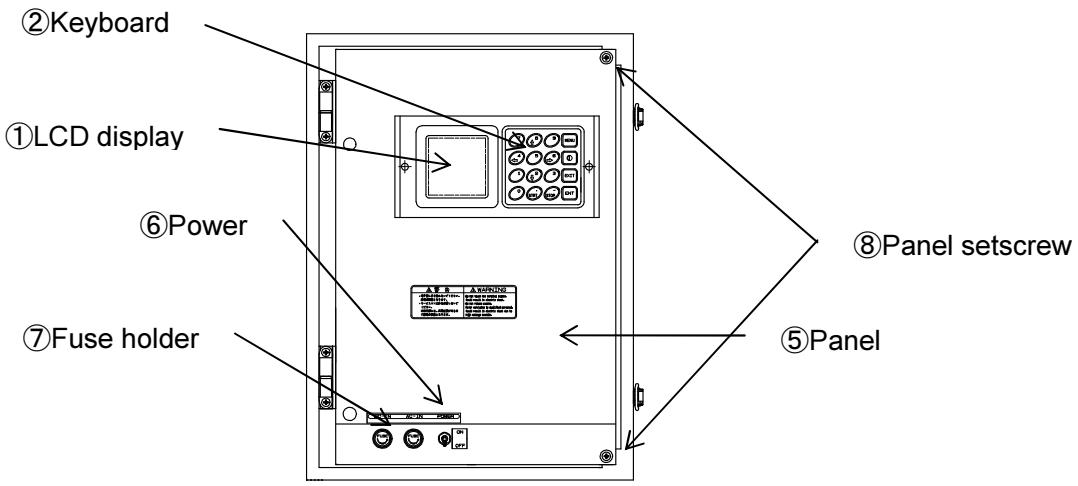


Fig. 3-2 Panel

Remove the panel setscrews ⑧ and open the panel toward the left to see the terminal blocks. Now you can connect the wires.

Warning

・Do not touch the terminal blocks.
Risk of electric shock.

・Do not remove covers.
Refer servicing to qualified personnel.
Risk of electric shock due to high-voltage area.

Chapter 4 Operations

4.1 Outline

This chapter explains how to activate and switch off the equipment, view the measurement screens, and operate the menu screens.

As a rule, service personnel set the equipment according to certain specifications at installation. Therefore, you can easily make basic measurements simply by turning the power on.

For data setting and other operations, use the keyboard inside the equipment. Interactive operations through the display make settings and changes easy.

Before operation, check that the equipment is set up correctly.

Note
- During menu operation, measurement (including integration) is suspended and held at the output value obtained immediately before.
- If the menu is operated during integration, integration restarts after menu operation, using the last obtained value.
- While the analog output check function is in operation, integration continues.
- Settings changed by menu operations are reflected when measurement is restarted.

4.2 Activation and Deactivation

(1) Activation

・Turn the power switch on.

If set-up has been complete, the equipment conducts a self-check and starts measurement automatically when activated.

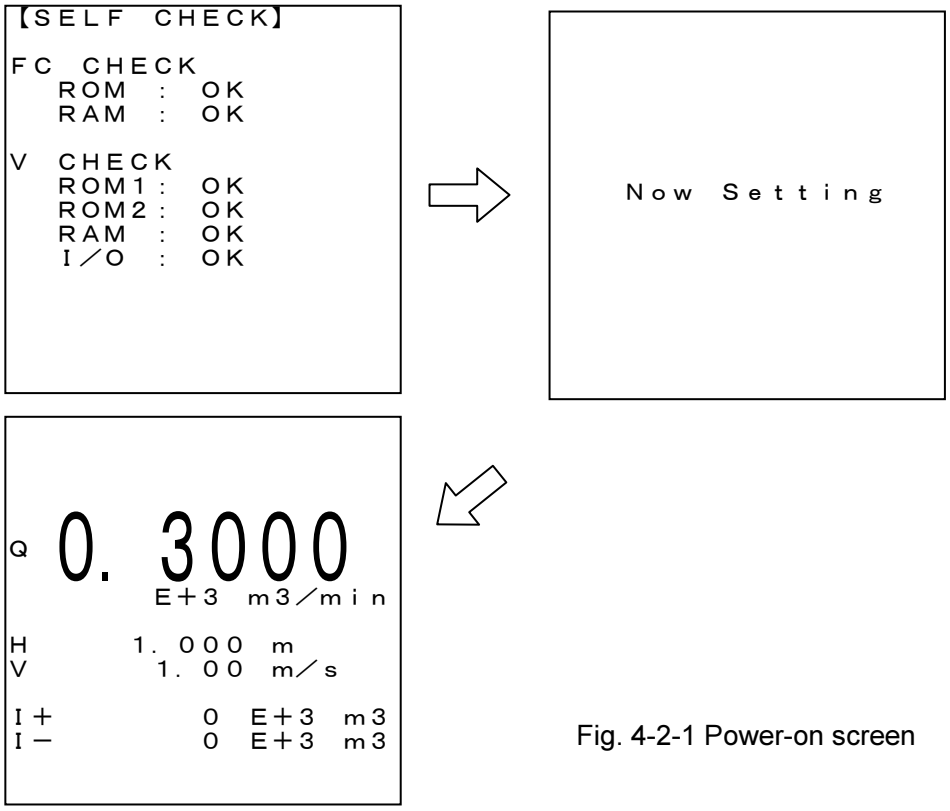


Fig. 4-2-1 Power-on screen

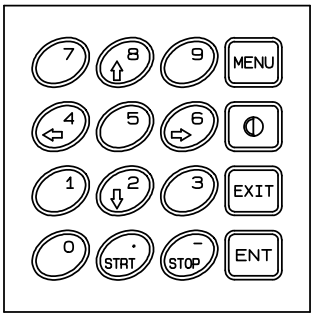
(2) Deactivation

・Turn the power switch off.

Even when the equipment is switched off, setting data necessary for measurement is held in the internal nonvolatile memory.

4.3 Keyboard

For easy explanation, the buttons on the keyboard (below left) are described according to the diagram on the right:



⇒

〈7〉	〈8/↑〉	〈9〉	〈MENU〉
〈4/←〉	〈5〉	〈6/→〉	〈●○〉
〈1〉	〈2/↓〉	〈3〉	〈EXIT〉
〈0〉	〈. /STRT〉	〈− /STOP〉	〈ENT〉

Fig. 4-3-1 Keyboard

The keys have the following basic functions.

Table 4-3-1 Basic key functions

(*1)(*2)	Measurement Screen	Information Screen	Menu Screen		Manual Gain Setting Screen
			Choice Selection	Numeric Input	
<MENU>	Change to the information screen. Measurement continues.	Invalid	Return to the measurement screen.	←	・Return to the measurement screen. ・Update <ENT> items.
<●○>	See <4/←> and <6/→>.	Invalid	←	←	←
<EXIT>	Invalid	Return to the measurement screen.	・Return to the measurement screen or the previous screen, according to the screen instruction. ・Unless specified otherwise, return to the previous step: - If pressed before <ENT> (Choice Selection), return to the previously selected choice. - If back at the previous choice, return to the previous screen. ・Return to the previous screen.	・Return to the previous step: - If pressed before <ENT> (Numeric Input), equivalent to the backspace key. - If all digits have been deleted (Numeric Input), return to the previously set numeric value. - If back at the previous numeric value, return to the previous screen. ・Return to the previous screen.	・Return to the previous step: - If pressed before <ENT> (Gain Setting), return to the previously set gain. - If back at the previous gain, return to the previous screen. ・Return to the previous screen.
<ENT>	Invalid	Change to the menu screen.	Confirm choice and proceed to the next step.	←	←
Keys <0> to <9>, <./STRT>, <-/STOP>, when used as numeric input keys	Invalid	←	←	Numeric handling	Invalid
Keys <0> to <9>, <./STRT>, <-/STOP>, when not used as numeric input keys					
<./STRT>	Integration ON: Reset the integrated value and start integration. Invalid during integration. Integration OFF: Invalid	Invalid	←	. (Decimal point)	Invalid
<-/STOP>	Integration ON: Stop integration. Invalid when integration is not taking place. Integration OFF: Invalid	Invalid	←	- (Negative sign)	Invalid
<8/↑>	Invalid	Invalid	Return to the previous item, OR Select the previous parameter.	8	Gain increase
<2/↓>	Invalid	Invalid	Advance to the next item, OR Select the next parameter.	2	Gain decrease

	<4/←>	Reduce contrast using <●○> + <4/←>.(*3)	Invalid	Return to the previous menu.	4	Invalid
	<6/→>	Increase contrast using <●○> + <6/→>.(*3)	Invalid	Advance to the next menu.	6	Invalid

(*1) During the operation described at the top of the column, the key at the start of each line has the function explained here.
(*2) The keys operate repeatedly.
(*3) <●○> + <4/←> means pressing the <4/←> key while holding down the <●○> key.

4.4 Screen Types

There are three types of screen: measurement, menu, and information. Fig. 4-4-1 shows how to navigate between them.
In the measurement screen, press the <MENU> key to change to the information screen, where the software version and other information is displayed.
In the information screen, press the <ENT> key to change to the menu screen [MEAS].
In the menu screen, press the <6/→> or <4/←> key to switch the display between the [MEAS] and [CHECK] screens.
In the menu screen, press the <MENU> or <EXIT> key to return to the measurement screen.

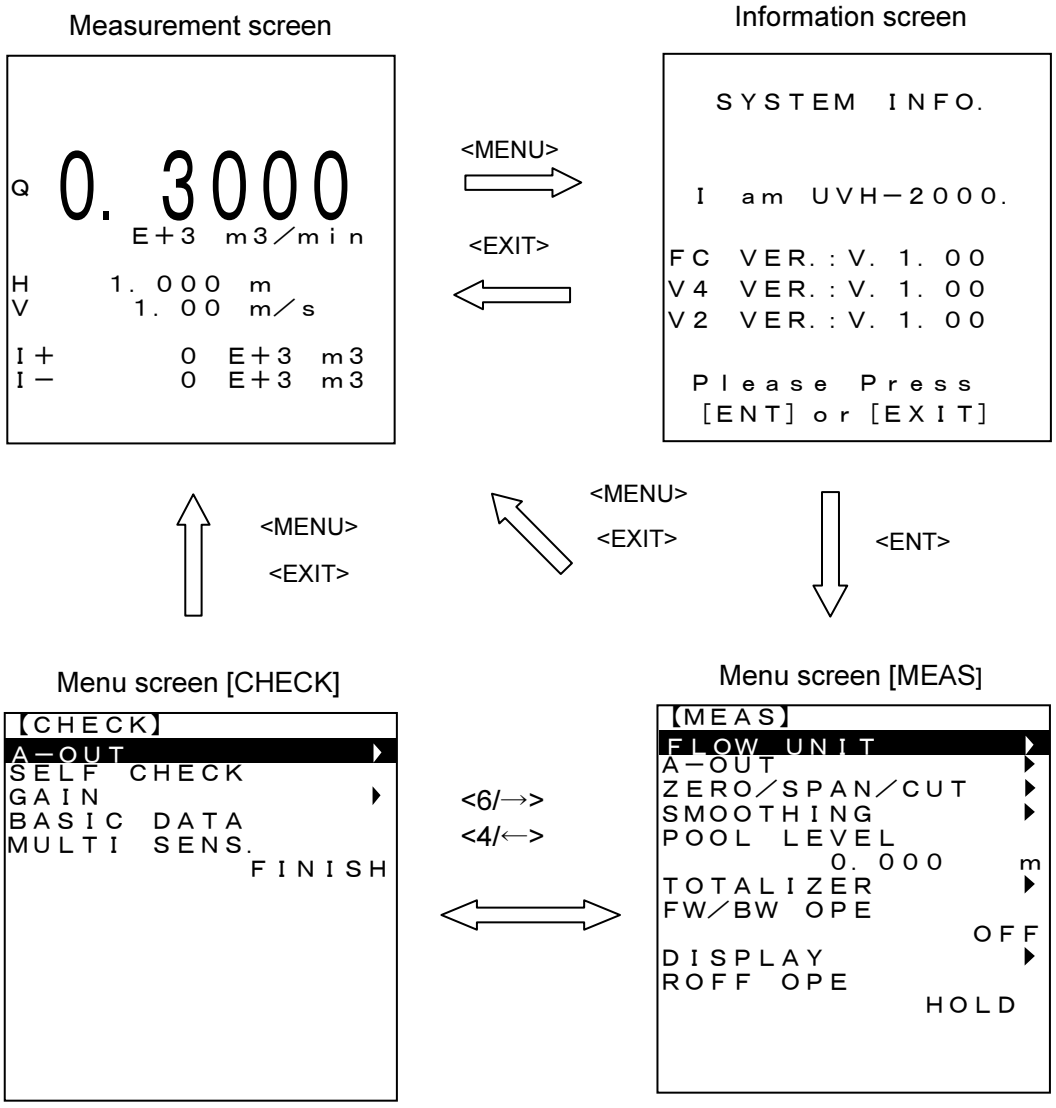
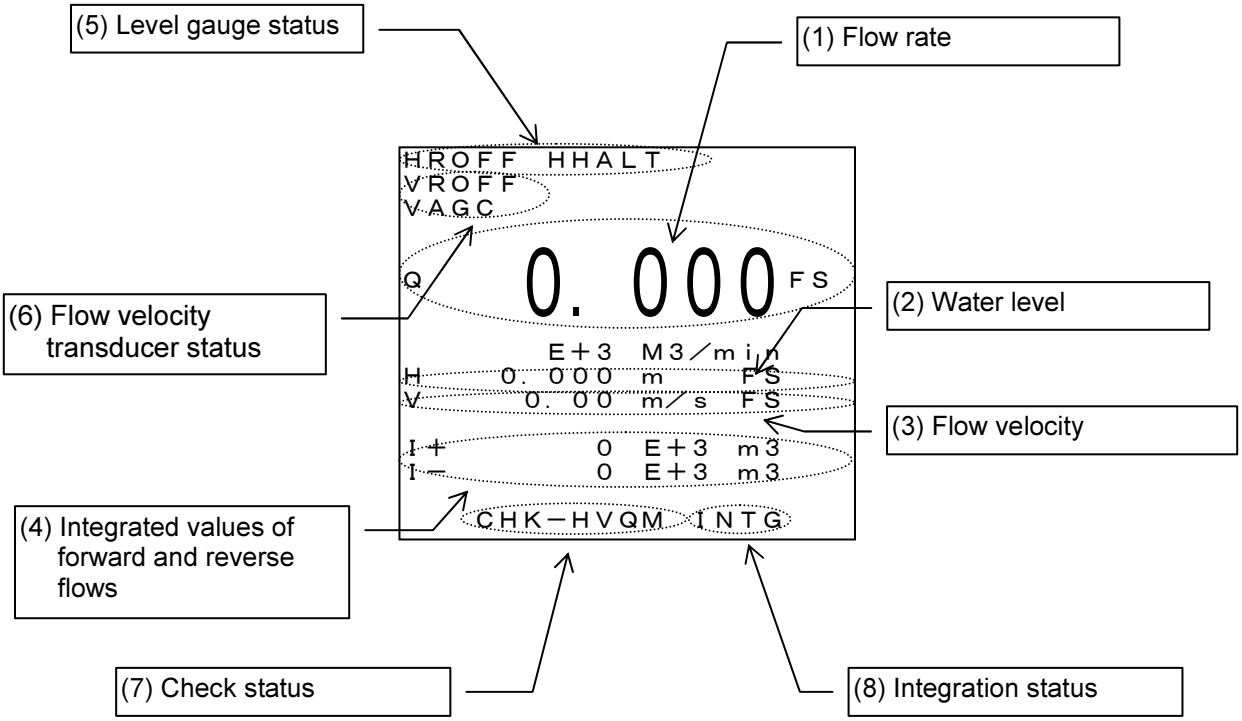


Fig. 4-4-1 Measurement, information and menu screens

4.5 Measurement Screen

During measurement, the following screen is displayed.
The screen here is an example for explanation.



(1) Flow rate
The unit and multiplier are as set on the [MEAS]→[FLOW UNIT] screen.
FS (Full Scale) is displayed when the value has exceeded the MAX FLOW value set on the [MEAS]→[A-OUT] screen.
The number of decimal places is as set at MAX FLOW above.

(2) Water level
This is displayed only when LEVEL DISPLAY on the [MEAS]→[DISPLAY] screen is ON.
The unit is fixed at m (meter).
FS (Full Scale) is displayed when the value has exceeded the MAX LEVEL value set on the [MEAS]→[A-OUT] screen.
The number of decimal places is as set at MAX LEVEL above.

*If the optional ultrasonic level gauge is used, MAX LEVEL cannot be changed.

(3) Flow velocity
This is displayed only when VEL. DISPLAY on the [MEAS]→[DISPLAY] screen is ON.
The unit is fixed at m/s (meter/second).

FS (Full Scale) is displayed when the value has exceeded the MAX VEL. value set on the [MEAS]→[A-OUT] screen.
The number of decimal places is as set at MAX VEL. above.

(4) Integrated values of forward and reverse flows
This is displayed when FUNCTION on the [MEAS]→[TOTALIZER] screen is ON.
The unit of integration for forward current (I+) and reverse current (I-) are as set at UNIT on the [MEAS]→[TOTALIZER] screen.
Integration starts when the <./STRT> key is pressed and stops when the <-/STOP> key is pressed or the set integration time has passed. The integrated value is reset at the start of integration.

(5) Level gauge status
The following statuses are displayed:

Display	Meaning	Water Level Analog Output	HERR Relay Output
None	Normal	Water level converted into 4 - 20 mA	Open
HROFF(*1)	The input terminal signal of the level gauge has exceeded 20 mA. The level gauge has received no echoes. (with optional ultrasonic level gauge)	Last obtained value converted into 4 - 20 mA	Closed
HHALT	The input terminal signal of the level gauge has fallen below 4 mA.	Last obtained value converted into 4 - 20 mA	Closed

(*1) The status may differ depending on the level gauge.

(6) Flow velocity transducer status

The following statuses are displayed:

Display	Meaning	Flow Velocity Analog Output	VERR Relay Output
None	Normal	Flow velocity converted into 4 - 20 mA	Open
VROFF	One or some flow velocity transducer receive no echoes.	Flow velocity converted into 4 - 20 mA	Closed
	All transducer receive no echoes.	Last obtained value converted into 4 - 20 mA	

Display	Meaning
VAGC	VAGC: AGC is ON.

(7) Check status

The following statuses are displayed:

Display	Meaning			
	H Check	V Check	Q Check	Measurement Path Check
None				
CHK-H	○			
CHK-V		○		
CHK-Q			○	
CHK-HV	○	○		
CHK-HQ	○		○	
CHK-VQ		○	○	
CHK-HVQ	○	○	○	
CHK-M				○
CHK-HM	○			○
CHK-VM		○		○
CHK-QM			○	○
CHK-HVM	○	○		○
CHK-HQM	○		○	○
CHK-VQM		○	○	○
CHK-HVQM	○	○	○	○

○: Active function

See the [CHECK] screen for the check function and the [MULTI SENS.] screen for the measurement path switching check function.

(8) Integration status

When INTG is displayed, integration is in progress.

4.6 Information Screen

When the <MENU> key is pressed in the measurement screen, the information screen displays the software version and other information as follows:

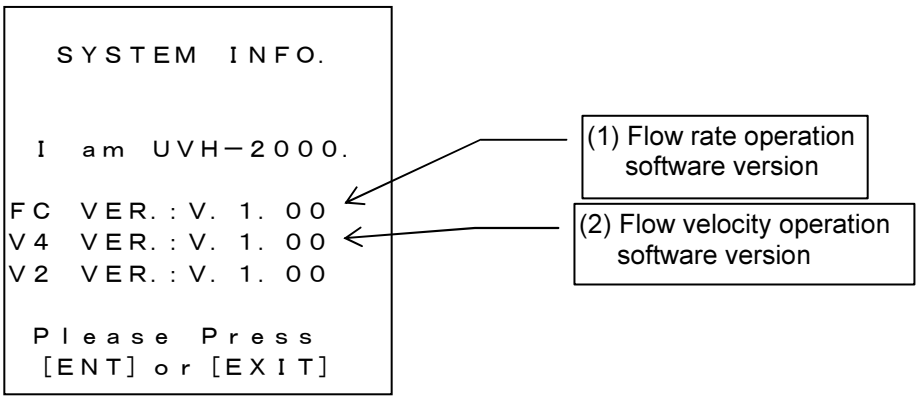


Fig. 4-6 Information screen

In this screen, press the <ENT> key to change the display to the menu screen. Press the <EXIT> key to return to the measurement screen.

4.7 Menu Screen

(1) Item selection

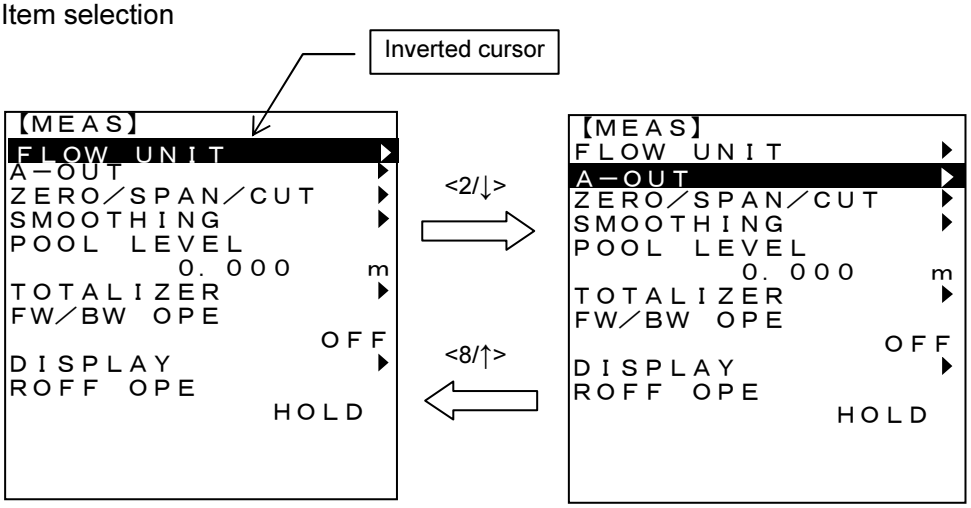


Fig. 4-7-1 Item selection

To select an item, move the color-inverted cursor using the <8/↑> or <2/↓> key and press the <ENT> key.
If available, a submenu is displayed. Otherwise, an underscore cursor flashes at the current setting.

Note: ▸ at right indicates that a submenu is available.

(2) Changing settings

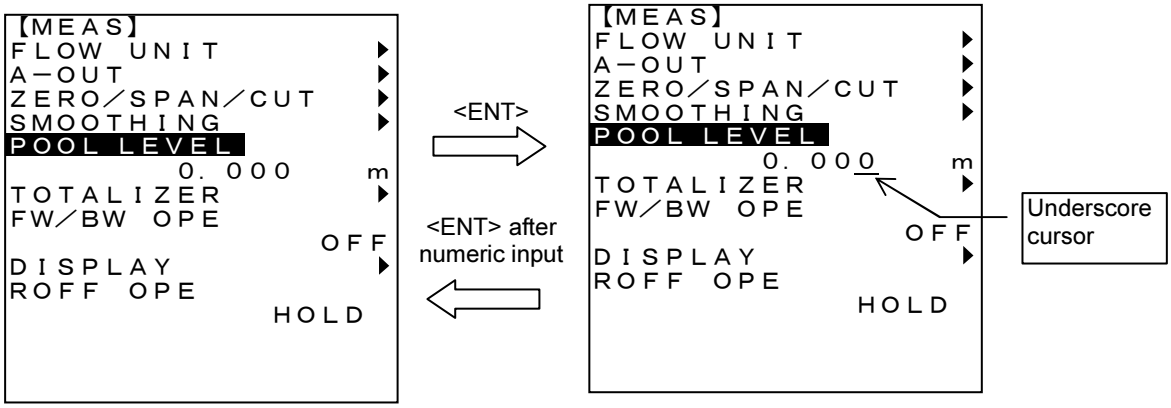


Fig. 4-7-2 Changing settings

Select an item using the <8/↑> or <2/↓> key and press the <ENT> key. The underscore cursor flashes to indicate that the setting can be changed.
When the underscore cursor is flashing, change the setting using the <8/↑> or <2/↓> key or the <0> to <9>, <./STRT>, and <-/STOP> keys.
To confirm the changed setting, press the <ENT> key. To discard the input value, press the <EXIT> key.

Example of Setting Change by Input

Example: to change the setting of POOL LEVEL.
1. Move the cursor to POOL LEVEL with the <8/↑> or <2/↓> key. (Fig. 4-7-3)
2. Press the <ENT> key to enable a setting change. (Fig. 4-7-4)
3. Enter a numeric value using the <0> to <9>, <./STRT>, and <-/STOP> keys. (Fig. 4-7-5)
4. Press the <ENT> key to confirm the change.

This completes the setting change.

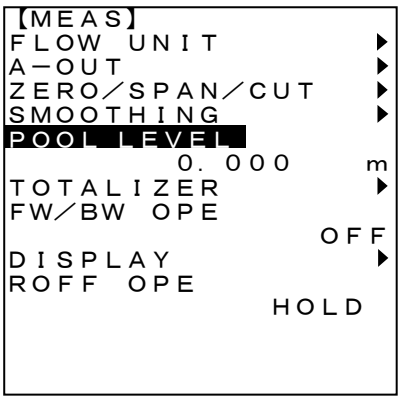


Fig. 4-7-3 Selection of POOL LEVEL

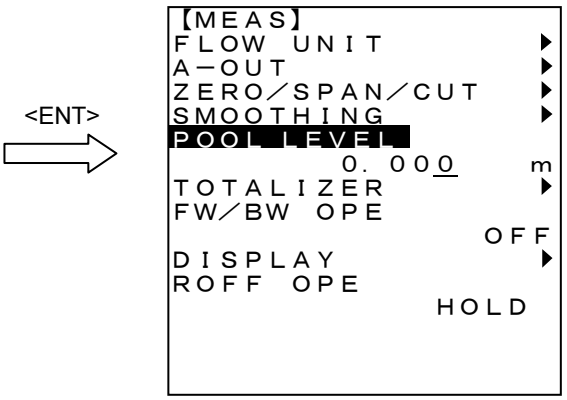


Fig. 4-7-4 Enabling input

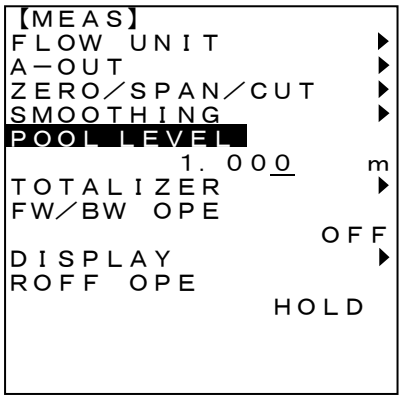
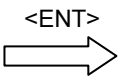


Fig. 4-7-5 Changing setting (a value of 1.000 is entered)



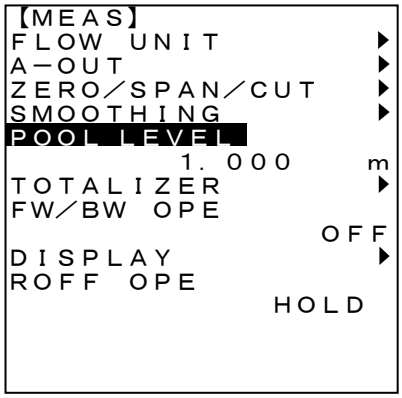


Fig. 4-7-6 Confirmation of change

Example of Input Value Correction

Example: to correct input data for POOL LEVEL.
1. Press the <EXIT> key to discard input. (Fig. 4-7-8)
2. Enter a numeric value using the <0> to <9>, <./STRT>, and <-/STOP> keys, and press the <ENT> key to confirm the input value. (Fig. 4-7-9, Fig. 4-7-10)

This completes correction of the input value.

Note: When input is discarded with the <EXIT> key, the previously existing value is displayed. (Fig. 4-7-11, Fig. 4-7-12)

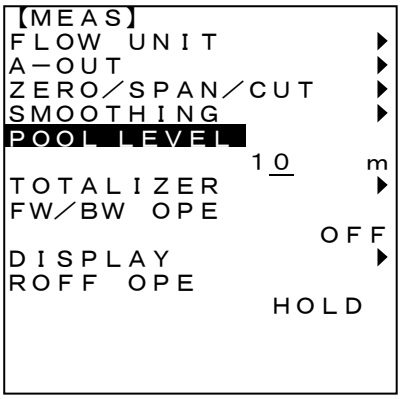


Fig. 4-7-7 Using the numeric keys, "10" is input

<EXIT>

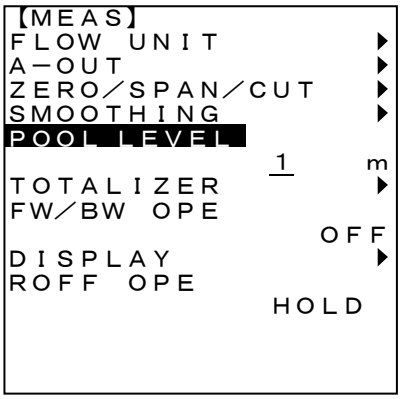


Fig. 4-7-8 Input discarded by pressing <EXIT>

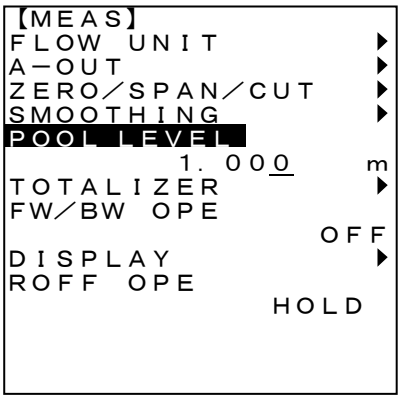


Fig. 4-7-9 Using the numeric keys, "1.000" is input

<ENT>

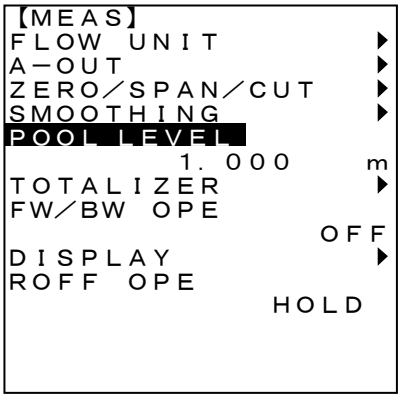


Fig. 4-7-10 Input confirmed by pressing <ENT>

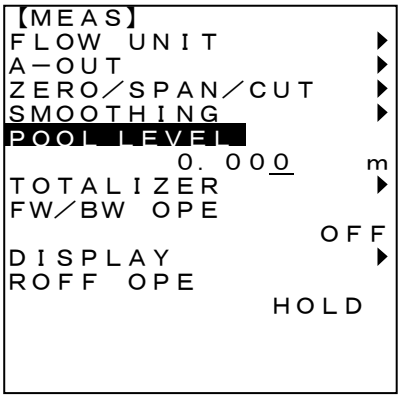


Fig. 4-7-11 Previous setting restored by discarding input value using <EXIT> key

<EXIT>

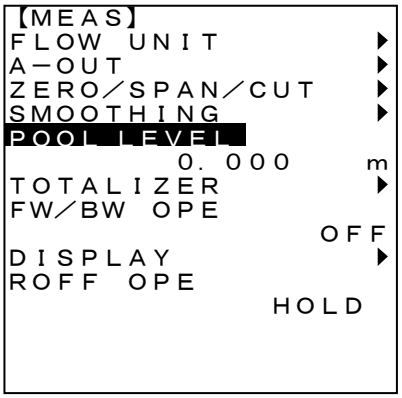


Fig. 4-7-12 After exit from input mode

Example of Setting Change by Selection

Example: to change the setting of FW/BW OPE.
1. Move the cursor to FW/BW OPE with the <8/↑> or <2/↓> key and press the <ENT> key. (Fig. 4-7-13)
2. Change the setting with the <8/↑> or <2/↓> key. (Fig. 4-7-14)
3. Press the <ENT> key to confirm the change (Fig. 4-7-15), or
4. Press the <EXIT> key to discard the input. (Fig. 4-7-16)

This completes the setting change by selection.

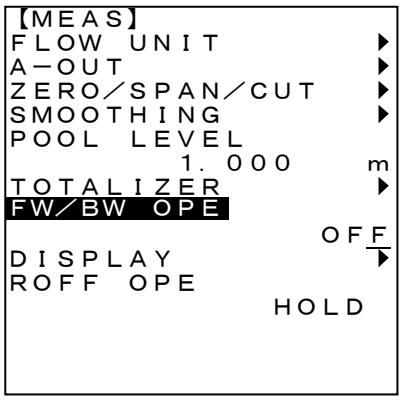


Fig. 4-7-13 Selection of FW/BW OPE

<8/↑>
<2/↓>

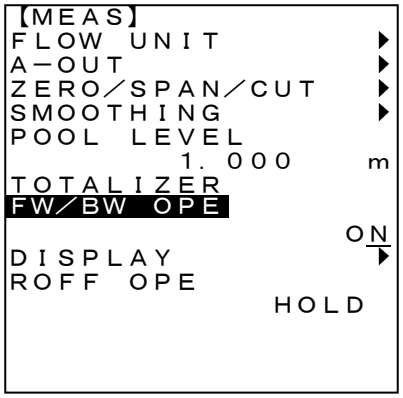


Fig. 4-7-14 Setting changed using <8/↑> or <2/↓> key

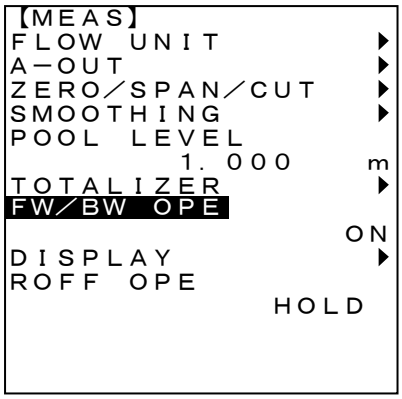


Fig. 4-7-15 Setting change confirmed by pressing <ENT>, or

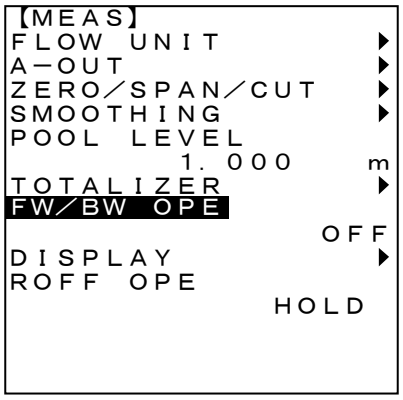
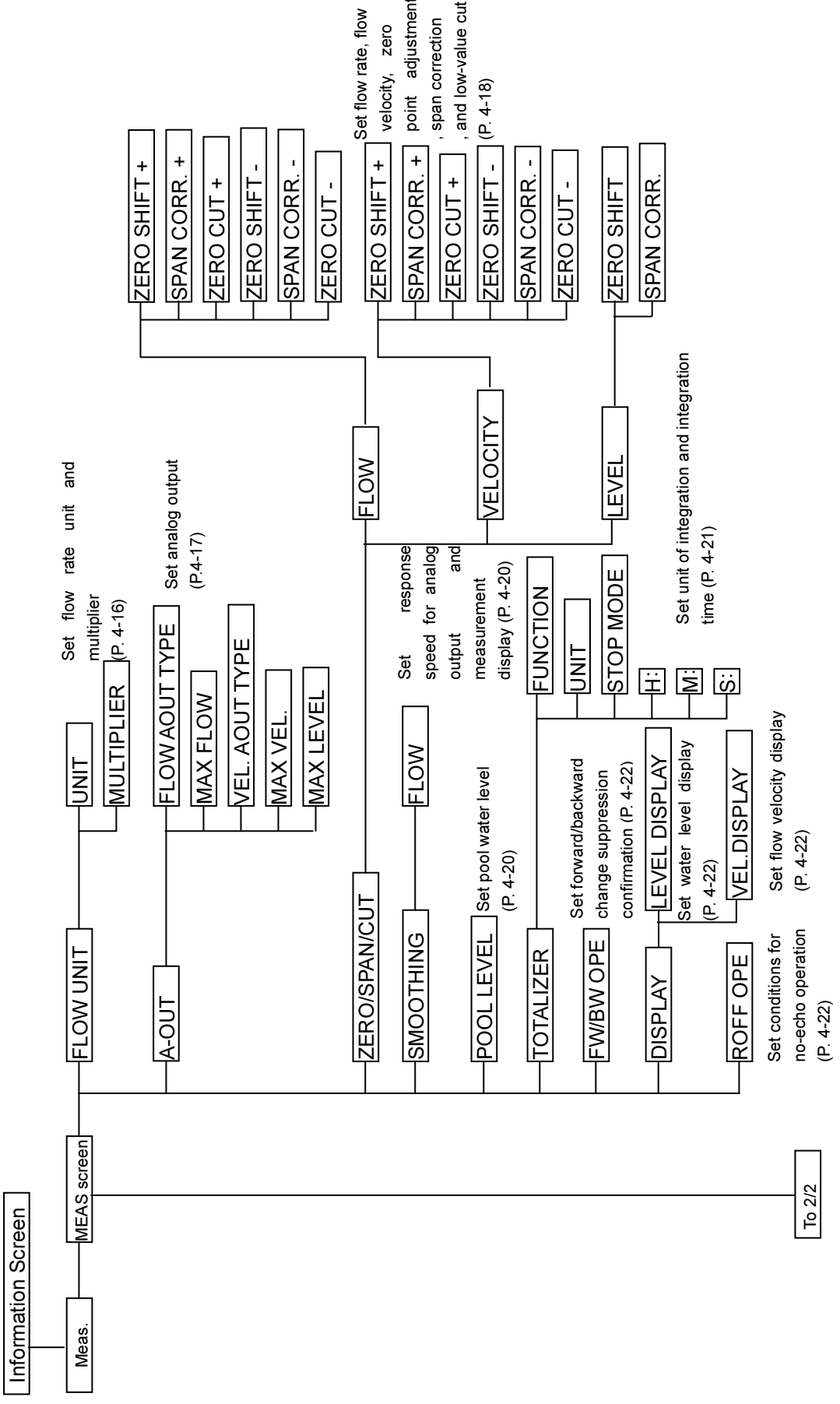


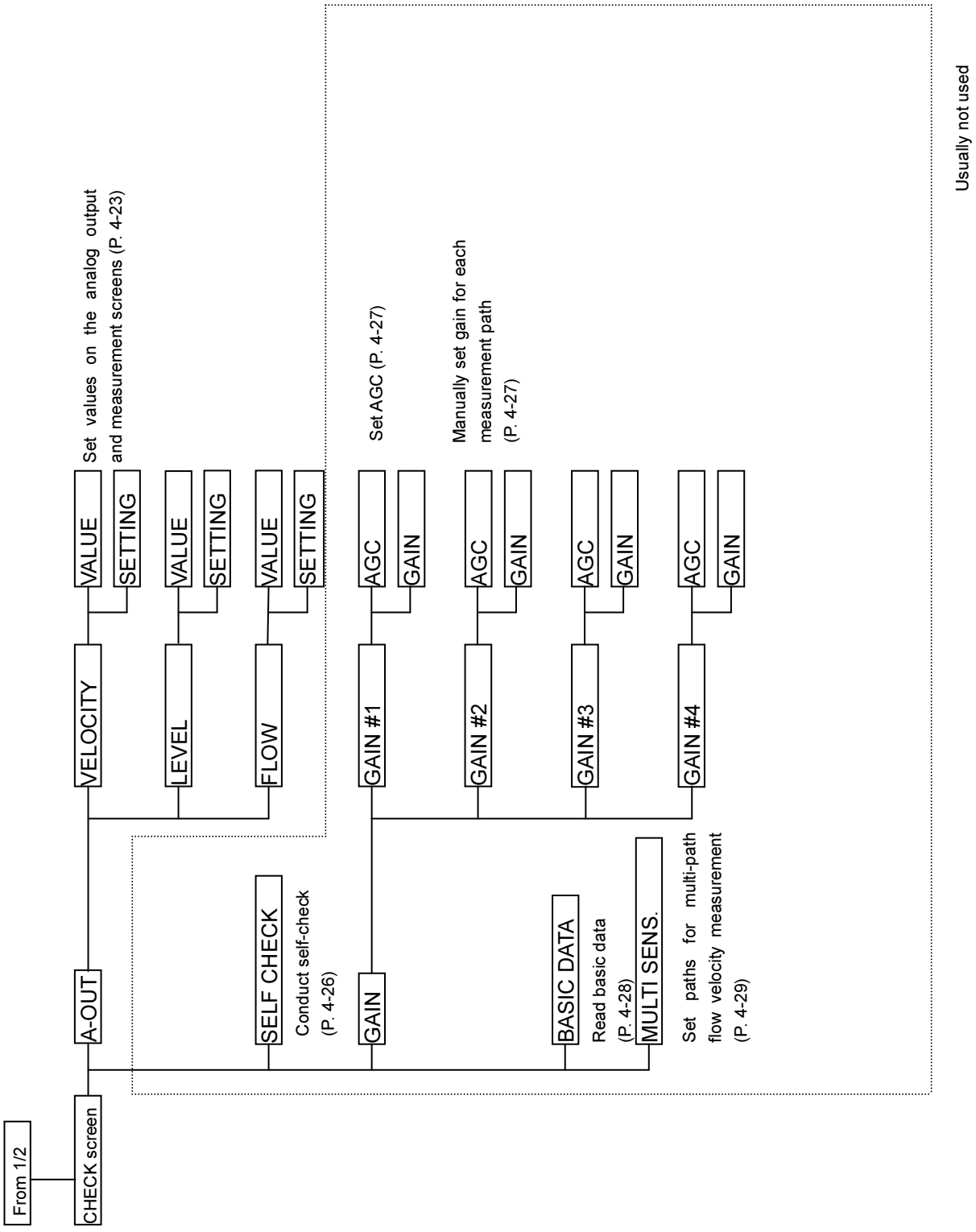
Fig. 4-7-16 Input discarded by pressing <EXIT>

4.8 Menu Configuration (1/2)

.



Menu Configuration (2/2)



4.9 Settings of [MEAS]

On the [MEAS] screen, the following parameters can be set.

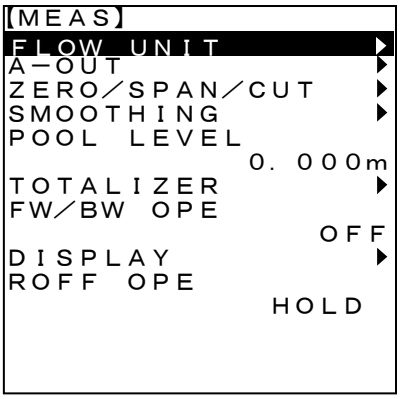


Fig. 4-9-1 MEAS setting

Setting List
The table below lists the setting items.

Setting Item	Description
FLOW UNIT	Set the unit of flow.
A-OUT	Set analog output.
ZERO/SPAN/CUT	Set zero adjustment, span correction, and low value cut.
SMOOTHING	Set a response speed for output and display.
POOL LEVEL	Set the standing water level.
TOTALIZER	Set integration.
FW/BW OPE	Set forward/reverse frequent change suppression.
DISPLAY	Set flow velocity and water level display.
ROFF OPE	Set conditions for no-echo processing.

For items displaying this mark, the arrow keys (↑, ↓) are enabled.
For items displaying this mark, the numeric keys are enabled.

4.9.1 FLOW UNIT setting

Select FLOW UNIT on the [MEAS] screen.

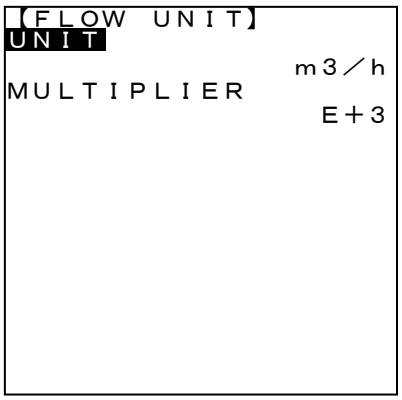


Fig. 4-9-2 FLOW UNIT setting screen

(1) UNIT
Set the unit of flow rate.
Settings:
m3/D, m3/h, m3/min, m3/s, L/D, L/h, L/min, L/s
Note: m3 represents m^3.

(2) MULTIPLIER
Select a multiplier for the unit of flow rate.
Settings:
E-6, E-3, E+0, E+3, E+6, E+9
Note: E-6 represents 10^{-6}.

4.9.2 A-OUT setting

Select A-OUT on the [MEAS] screen.

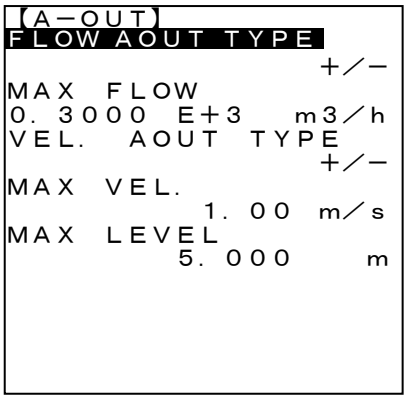


Fig. 4-9-3 A-OUT setting screen

(1) FLOW AOUT TYPE ⇅

Set an analog output pattern for flow rate.

Settings:(*1)(*2)

+, +/-

(2) MAX FLOW 123

Set the maximum flow rate. If the measured value exceeds the maximum value, the analog output becomes 20 mA.

Note: The number of decimal places entered here is reflected in the measured value. If “1.000” is entered, for example, the number of decimal places in the measured value will be three. The unit is as set at FLOW UNIT.

Setting range:

0.0001 to 999999

(3) VEL. AOUT TYPE ⇅

Set an analog output pattern for flow velocity.

Settings:(*1)(*2)

+, +/-

(4) MAX VEL. 123

Set the maximum flow velocity. If the measured value exceeds the maximum value, the analog output becomes 20 mA. The unit is m/s.

Setting range:

0.0001 to 5.000

(5) MAX LEVEL(*3) 123

Set the maximum water level. If the measured value exceeds the maximum value, the analog output becomes 20 mA. The unit is m.

Setting range:

0.001 to 5.000

(*1) When + is set, output for forward current is from 4 to 20 mA but output for reverse current is always 4 mA. When +/- is set, output is from 4 to 20 mA for both forward and reverse currents.

(*2) For details about these settings, see Table 7-2.

(*3) Some product specifications may not allow this setting.

4.9.3 ZERO/SPAN/CUT setting

Select ZERO/SPAN/CUT on the [MEAS] screen.

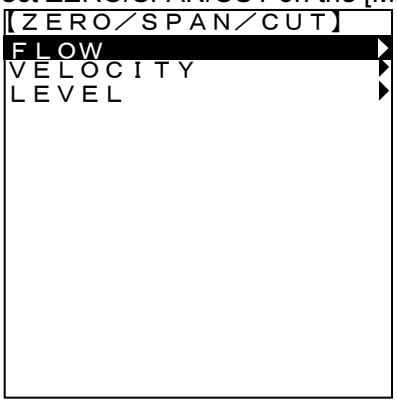


Fig. 4-9-4 ZERO/SPAN/CUT setting screen

Select flow rate, flow velocity, or water level on this screen.

4.9.4 Setting zero point adjustment, span correction, and low value cut for flow rate

Select FLOW on the [ZERO/SPAN/CUT] screen.

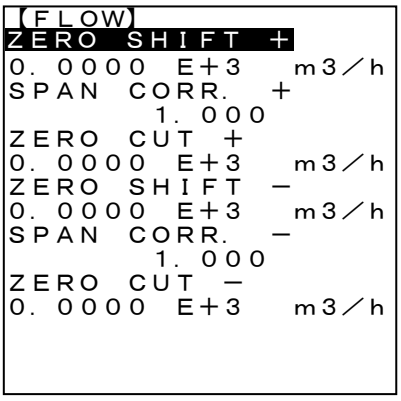


Fig. 4-9-5 FLOW setting screen

(1) ZERO SHIFT +

Set a zero point adjustment value for the flow rate of forward current. The unit is as set at FLOW UNIT.

Setting range:(*1)

-99999 to 999999

(2) SPAN CORR. +

Set a span correction value for the flow rate of forward current.

Setting range:

0.100 to 2.000

(3) ZERO CUT +

Set a low value cut limit for the flow rate of forward current. The unit is as set at FLOW UNIT.

Setting range:(*1)

0.0000 to 999999

(4) ZERO SHIFT -

Set a zero point adjustment value for the flow rate of reverse current. The unit is as set at FLOW UNIT.

Setting range:(*1)

-99999 to 999999

(5) SPAN CORR. -

Set a span correction value for the flow rate of reverse current.

Setting range:

0.100 to 2.000

(6) ZERO CUT -

Set a low value cut limit for the flow rate of reverse current. The unit is as set at FLOW UNIT.

Setting range:(*1)

-99999 to 0.0000

(*1) The number of effective digits, including a sign and a decimal point, is 5.

4.9.5 Setting zero point adjustment, span correction, and low value cut for flow velocity

Select VELOCITY on the [ZERO/SPAN/CUT] screen.

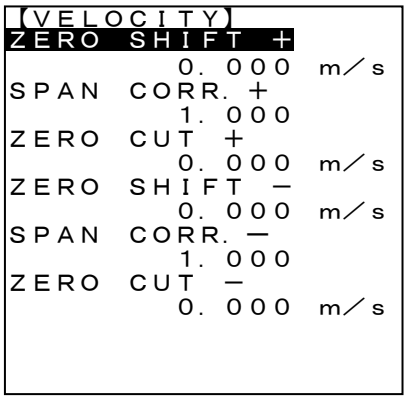


Fig. 4-9-6 VELOCITY setting screen

(1) ZERO SHIFT + (123)

Set a zero point adjustment value for the flow velocity of forward current. The unit is m/s.

Setting range:

-5.000 to 5.000

(2) SPAN CORR. + (123)

Set a span correction value for the flow velocity of forward current.

Setting range:

0.100 to 2.000

(3) ZERO CUT + (123)

Set a low value cut limit for the flow velocity of forward current. The unit is m/s.

Setting range:

0.000 to 5.000

(4) ZERO SHIFT - (123)

Set a zero point adjustment value for the flow velocity of reverse current. The unit is m/s.

Setting range:

-5.000 to 5.000

(5) SPAN CORR. - (123)

Set a span correction value for the flow velocity of reverse current.

Setting range:

0.100 to 2.000

(6) ZERO CUT - (123)

Set a low value cut limit for the flow velocity of reverse current. The unit is m/s.

Setting range:

-5.000 to 0.000

Note: The relationships between zero point adjustment value, span correction value, and low value cut limit are as follows:

$$\begin{aligned} y &= \alpha_+ x + \beta_+ \quad (\alpha_+ x + \beta_+ \geq \gamma_+) \\ &= \alpha_- x + \beta_- \quad (\alpha_- x + \beta_- \geq \gamma_-) \\ &= 0 \quad \text{(Other)} \end{aligned}$$

where x: Value before zero point adjustment, span correction, or low value cut

y: Value after zero point adjustment, span correction, or low value cut

α_+, β_+, γ_+: Span correction value, zero point adjustment value, and low value cut limit for forward current

α_-, β_-, γ_-: Span correction value, zero point adjustment value, and low value cut limit for reverse current

4.9.6 Setting zero point adjustment and span correction for water level

Select LEVEL on the [ZERO/SPAN/CUT] screen.

Fig. 4-9-7 LEVEL setting screen

(1) ZERO SHIFT (123)

Set a zero point adjustment value for water level. The unit is meter(s).

Setting range:

-5.000 to 5.000

(2) SPAN CORR. (123)

Set a span correction value for water level.

Setting range:

0.100 to 2.000

4.9.7 SMOOTHING setting

Select SMOOTHING on the [MEAS] screen.

Fig. 4-9-8 SMOOTHING setting screen

FLOW (123)

Set a response speed for flow rate output and display. The unit is second(s).

Setting range:

0 to 120

4.9.8 POOL LEVEL setting

Select POOL LEVEL on the [MEAS] screen.

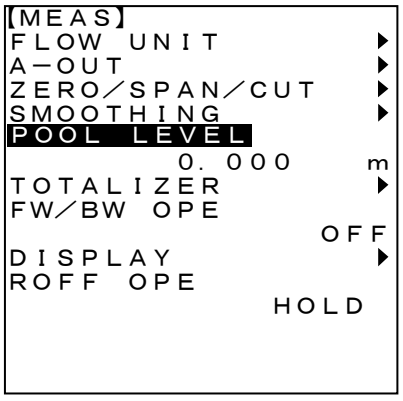


Fig. 4-9-9 POOL LEVEL setting screen

POOL LEVEL (123)

Set a level for standing water. If the water level falls below this setting, the flow rate becomes 0. The unit is meter(s).

Setting range:

0.000 to 5.000

4.9.9 TOTALIZER setting

Select TOTALIZER on the [MEAS] screen.

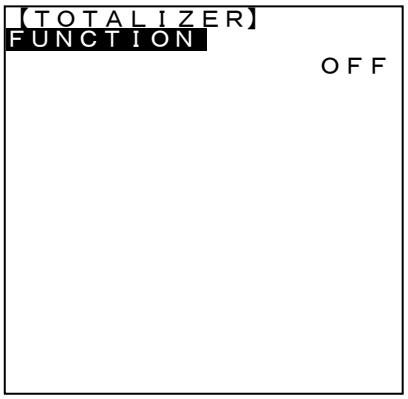


Fig. 4-9-10 TOTALIZER setting screen

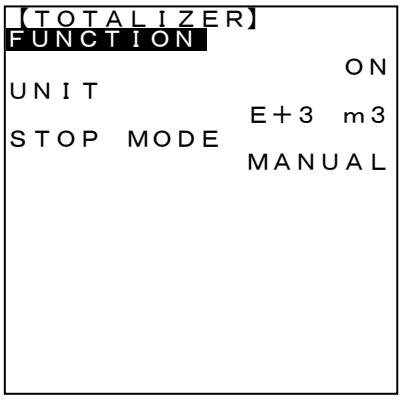


Fig. 4-9-11 FUNCTION: ON

(1) FUNCTION

Set the integration function (totalizer) to ON or OFF. The output of integrated pulse is also depended by this switch

Settings:

ON, OFF

When the function is set to ON, the UNIT setting screen appears.

(2) UNIT

Set the unit of integration and a multiplier.

Settings:

E+3 m3, E+2 m3, E+1 m3, m3, E-1 m3, E-2 m3, E-3 m3

Note: E+3 represents 10^{+3} and m3 represents m^3.

(3) STOP MODE

Set the stop method for the integration function.

Settings:

MANUAL, TIMER

When TIMER is set, the time setting screen appears.

(4) H:

Set the integration function stop time. The unit is hour(s).

Setting range:

0 to 99

(5) M:

Set the integration function stop time. The unit is minute(s).

Setting range:

0 to 59

(6) S:

Set the integration function stop time. The unit is second(s).

Setting range:

0 to 59

Note: H:, M:, S: are displayed only when STOP MODE is set to TIMER.

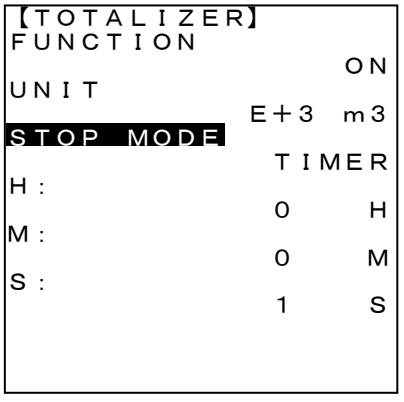


Fig. 4-9-12 STOP MODE: TIMER

4.9.10 FW/BW OPE setting

Set FW/BW OPE on the [MEAS] screen.

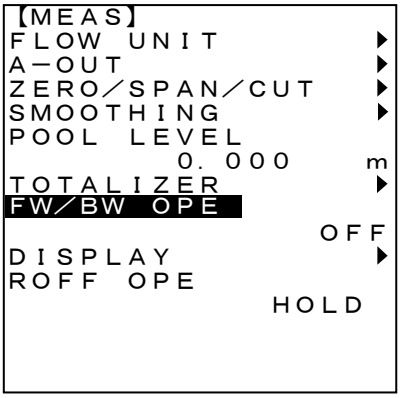


Fig. 4-9-13 FW/BW OPE setting screen

FW/BW OPE

Set forward/reverse frequent change suppression. This is to avoid complicated changes in directional contact (QBW) when the flow rate is near zero and the current flow frequently changes direction.

Settings:

ON: Function enabled

OFF: Function not enabled

4.9.11 DISPLAY setting

Select DISPLAY on the [MEAS] screen.

Fig. 4-9-14 DISPLAY setting screen

(1) LEVEL DISPLAY

Set whether to display the water level on the measurement screen.

Settings:

ON: Display

OFF: No display

(2) VEL.DISPLAY

Set whether to display the flow velocity on the measurement screen.

Settings:

ON: Display

OFF: No display

4.9.12 ROFF OPE setting

Set ROFF OPE on the [MEAS] screen.

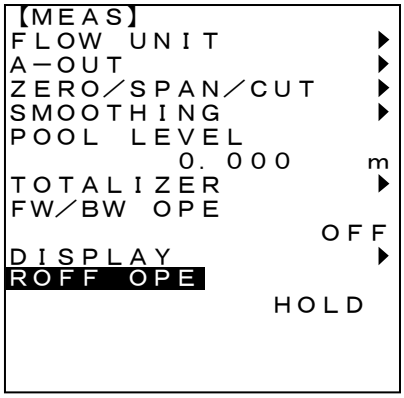


Fig. 4-9-15 ROFF OPE setting screen

ROFF OPE

Set flow rate display and output for no-echo processing.

Settings:

0%, 100%, HOLD

Note: In a no-echo state, the level gauge and flow velocity transducer receive no echoes.

4.10 Settings of [CHECK]

On the [CHECK] screen, the following parameters can be set.

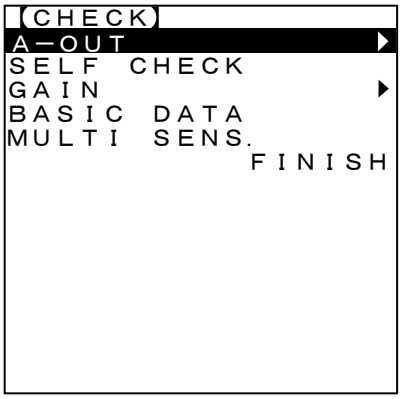


Fig. 4-10-1 CHECK screen

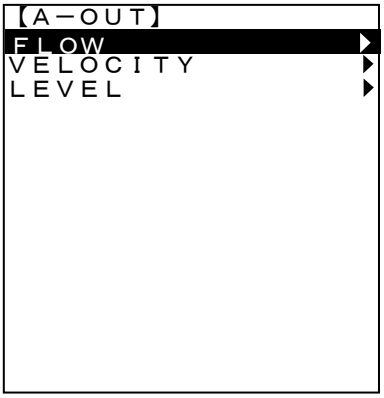
Setting List
The table below lists the setting items.

Setting Item	Description
A-OUT	Temporarily fix value display and analog output.
SELF CHECK	Carry out self-check.
GAIN	Set gain.
BASIC DATA	Display basic data.
MULTI SENS.	Temporarily fix sensors.

For items displaying this mark, the arrow keys (↑, ↓) are enabled.
For items displaying this mark, the numeric keys are enabled.

4.10.1 A-OUT setting

Select A-OUT on the [CHECK] screen.



Select flow rate, flow velocity, or water level on this screen.

Fig. 4-10-2 A-OUT setting screen

4.10.2 Flow rate analog output check

Select FLOW on the [A-OUT] screen.

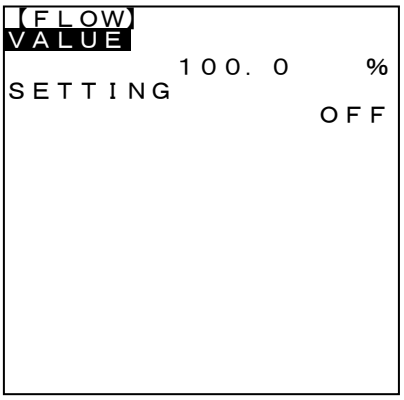


Fig. 4-10-3 FLOW setting

(1) VALUE

Fix flow rate at an arbitrary value.

Specify the flow rate as a percentage of the value set at MAX FLOW on the [MEAS]→[A-OUT] screen.

Note: 0%→4 mA, 100%→20 mA

Setting range:

-100.0 to 100.0

(2) SETTING

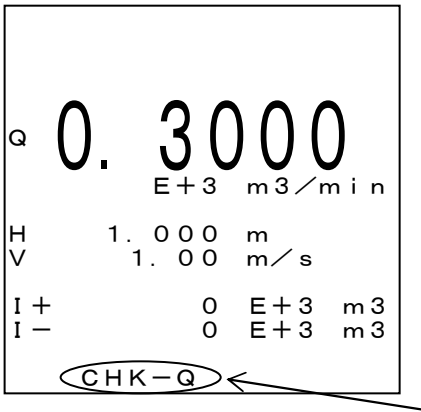
Set whether to fix the flow rate value.

Settings:

ON, OFF

Returning to the measurement screen with SETTING set to ON outputs an analog value proportional to the setting of VALUE.

To clear the setting, select this menu again, set SETTING to OFF, and return to the measurement screen.



If flow rate analog output is set as a check item, the measurement screen displays CHK-Q.

Fig. 4-10-4 Measurement screen at arbitrary fixed flow rate

4.10.3 Flow velocity analog output check

Select VELOCITY on the [A-OUT] screen.

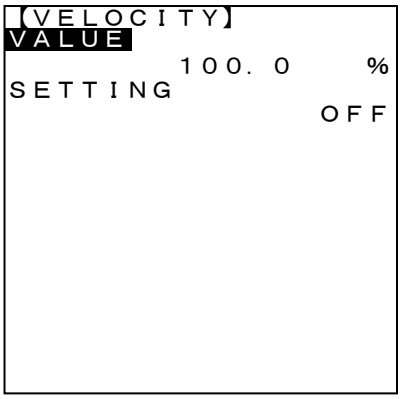


Fig. 4-10-5 VELOCITY setting screen

(1) VALUE

Fix flow velocity at an arbitrary value.

Specify the flow velocity as a percentage of the value set at MAX VEL. on the [MEAS]→[A-OUT] screen.

Setting range:

-100.0 to 100.0

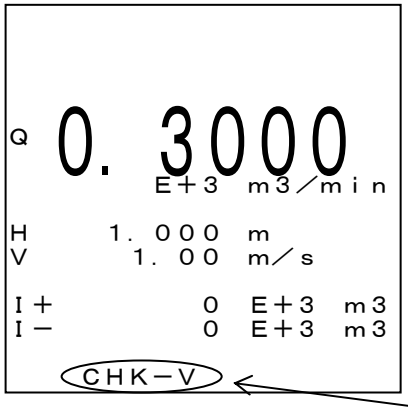
(2) SETTING

Set whether to fix the flow velocity.

Settings:

ON, OFF

Returning to the measurement screen with SETTING set to ON outputs an analog value proportional to the setting of VALUE.



If flow velocity analog output is set as a check item, the measurement screen displays CHK-V.

Fig. 4-10-6 Measurement screen with arbitrary fixed flow velocity

4.10.4 Water level analog output check

Select LEVEL on the [A-OUT] screen.

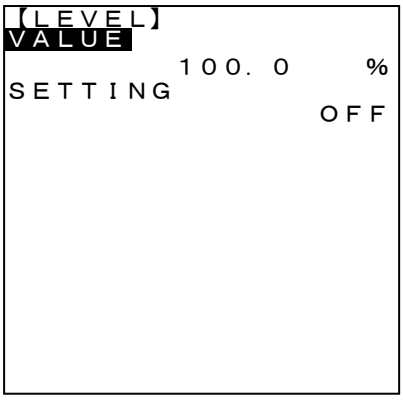


Fig. 4-10-7 LEVEL setting screen

(1) VALUE (123)

Fix water level at an arbitrary value.

Specify the water level as a percentage of the value set at MAX LEVEL on the [MEAS]→[A-OUT] screen.

Setting range:
0.0 to 100.0

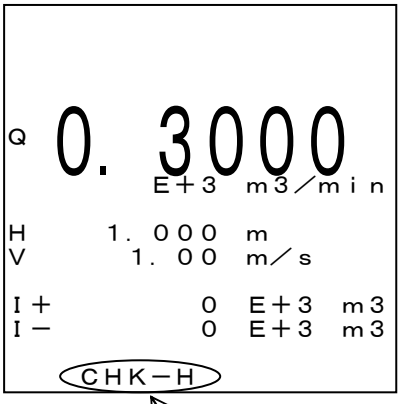
(2) SETTING (↑↓)

Set whether to fix the water level.

Settings:
ON, OFF

Returning to the measurement screen with SETTING set to ON outputs an analog value proportional to the setting of VALUE.

Note: If flow rate, flow velocity, and water level analog output are all set as check items, CHK-HVQ is displayed.



If water level analog output is set as a check item, the measurement screen displays CHK-H.

Fig. 4-10-8 Measurement screen with arbitrary fixed water level

4.10.5 SELF CHECK

Select SELF CHECK on the [CHECK] screen. <Usually not used>

Fig. 4-10-9 SELF CHECK screen

SELF CHECK (⇅)

Execute flowmeter self-check.

Select SELF CHECK and press the <ENT> key to display a self-check result as shown in Fig. 4-10-10.

Note: This data is used for troubleshooting in case of an equipment abnormality.

If the self-check result is NG, contact a TOKYO KEIKI office.

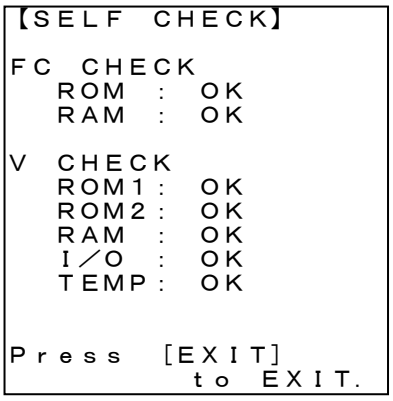


Fig. 4-10-10 Self-check result screen (Example)

4.10.6 GAIN setting

Select GAIN on the [CHECK] screen. <Usually not used>

Fig. 4-10-11 GAIN setting screen

(1) GAIN

Select GAIN and press the <ENT> key to display the GAIN setting screen shown in Fig. 4-10-12.

Note: Do not change the gain, or normal measurement may become impossible. An oscilloscope is necessary for gain adjustment.

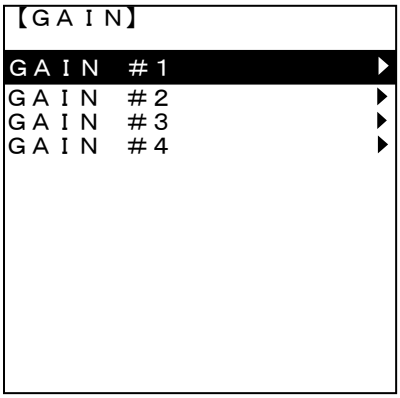


Fig. 4-10-12 GAIN screen

(2) GAIN #1 to #4

Select a sensor number to change its gain. Then press the <ENT> key to display the AGC and GAIN setting screen shown in Fig. 4-10-13. (#2 to #4 are displayed only when necessary.)

Fig. 4-10-13 AGC OFF

(3) AGC

Select whether the gain is to be set automatically or manually.

Settings:

ON, OFF

When AGC (Auto Gain Control) is ON, the gain is adjusted automatically during measurement. When AGC is OFF, GAIN is displayed for manual numeric input.

The same operation applies to sensors #2 to #4.

Note: The automatic gain control function keeps the receiver output level constant even when the receiving sensitivity fluctuates over a long period. Do not use this function if bubbles or other factors cause short-term fluctuations in receiving sensitivity.

Fig. 4-10-14 GAIN manual setting screen

(4) GAIN

When AGC is OFF, enter a gain value manually. Fig. 4-10-14 shows the setting screen. Note that the arrow keys, not the numeric keys, are enabled.
This operation also applies to #2 to #4.

4.10.7 BASIC DATA

Select BASIC DATA on the [CHECK] screen. <Usually not used>

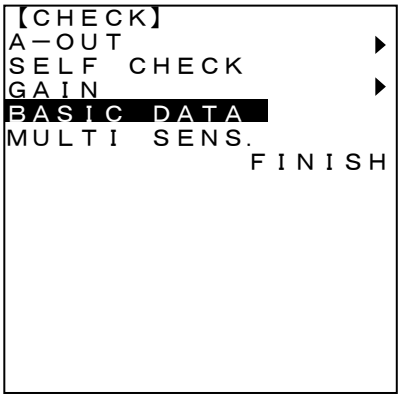


Fig. 4-10-15 BASIC DATA selection screen

Select BASIC DATA and press the <ENT> key to read basic data.
Fig. 4-10-16 shows the basic data display screen.
Press the <EXIT> key on the basic data display screen to return to the [CHECK] screen.

Note: This data is used for troubleshooting in case of an equipment abnormality.

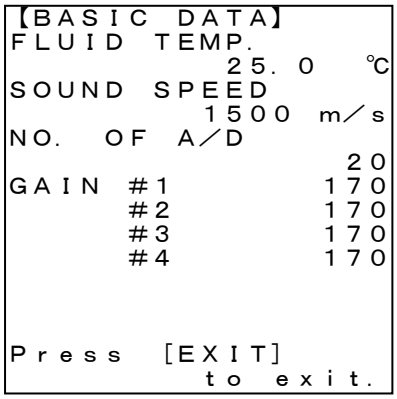


Fig. 4-10-16 BASIC DATA display screen (Example)

4.10.8 MULTI SENS. setting

Select MULTI SENS. on the [CHECK] screen. <Usually not used>

Fig. 4-10-17 MULTI SENS. setting screen

MULTI SENS.

Select the sensor switching check function.

Settings:

FINISH, SENS.1, SENS.2, SENS.3, SENS.4

FINISH:

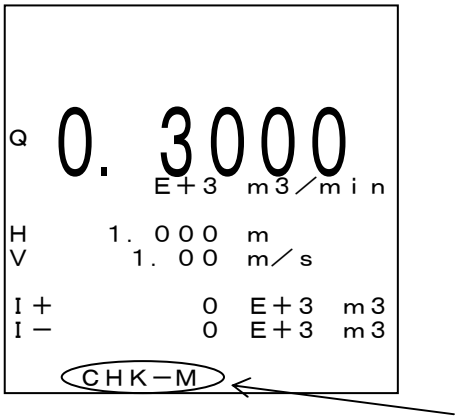
Terminate the sensor switching check function.

SENS.1 to SENS.4:

Fix the selected sensor and enable the sensor switching check function. If this function is enabled, the measurement screen displays CHK-M. (Fig. 4-10-18)

Note: The flow rate and flow velocity displayed are derived from a fixed sensor and are different from the actual values.

The selection items may differ depending on product specifications.



If the sensor switching check function is enabled, the measurement screen displays CHK-M.

Fig. 4-10-18 Sensor switching check function enable screen

How to Change Settings

1. Changing the unit of flow rate

Move to [MEAS]->[FLOW UNIT] and change the values of UNIT and MULTIPLIER.

2. Changing the flow rate analog output pattern

Move to [MEAS]->[A-OUT] and change the value of FLOW AOUT TYPE.

3. Changing the maximum flow rate

Move to [MEAS]->[A-OUT] and change the value of MAX FLOW.

4. Changing the flow velocity analog output pattern

Move to [MEAS]->[A-OUT] and change the value of VEL. AOUT TYPE.

5. Changing the maximum flow velocity

Move to [MEAS]->[A-OUT] and change the value of MAX VEL.

6. Changing the maximum water level

Move to [MEAS]->[A-OUT] and change the value of MAX LEVEL.

Note: This may not be available, depending on product specifications.

7. Changing the zero point adjustment value for flow rate

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of ZERO SHIFT +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of ZERO SHIFT -.

8. Changing the span correction value for flow rate

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of SPAN CORR. +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of SPAN CORR. -.

9. Changing the low value cut limit for flow rate

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of ZERO CUT +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[FLOW] and change the value of ZERO CUT -.

10. Changing the zero point adjustment value for flow velocity

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of ZERO SHIFT +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of ZERO SHIFT -.

11. Changing the span correction value for flow velocity

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of SPAN CORR. +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of SPAN CORR. -.

12. Changing the low value cut limit for flow velocity

Forward current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of ZERO CUT +.

Reverse current:

Move to [MEAS]->[ZERO/SPAN/CUT]->[VELOCITY] and change the value of ZERO CUT -.

13. Changing the zero point adjustment value for water level

Move to [MEAS]->[ZERO/SPAN/CUT]->[LEVEL] and change the value of ZERO SHIFT.

14. Changing the span correction value for water level

Move to [MEAS]->[ZERO/SPAN/CUT]->[LEVEL] and change the value of SPAN CORR.

15. Changing the response speed for flow rate analog output

Move to [MEAS]->[SMOOTHING] and change the value of FLOW.

16. Setting the standing water level

Change the POOL LEVEL value on the [MEAS] screen.

17. Setting the integration function

Move to [MEAS]->[TOTALIZER] and change the value of FUNCTION.

18. Changing the unit of integration

Move to [MEAS]->[TOTALIZER] and set FUNCTION to ON to enable the integration function.

Then change the value of UNIT.

Note: This cannot be set when the integration function is Invalid.

19. Changing the integration function stop method

Move to [MEAS]->[TOTALIZER] and set FUNCTION to ON to enable the integration function. Then change the value of STOP MODE.

Note: This cannot be set when the integration function is Invalid.

20. Changing the integration function stop time

Move to [MEAS]->[TOTALIZER], set FUNCTION to ON, and change STOP MODE to TIMER. Change the values of H:, M:, and S:.

Note: This cannot be set when the integration function is Invalid.

21. Suppressing fluctuation of directional contact (QBW) when flow rate is near zero

Change the value of FW/BW OPE on the [MEAS] screen.

22. Setting water level display on the measurement screen

Move to [MEAS]->[DISPLAY] and change the value of LEVEL DISPLAY.

23. Setting flow velocity display on the measurement screen

Move to [MEAS]->[DISPLAY] and change the value of VEL. DISPLAY.

24. Changing settings for no-echo processing

Change the value of ROFF OPE on the [MEAS] screen.

25. Fixing analog output at an arbitrary value

○ Flow rate

Move to [CHECK]->[A-OUT]->[FLOW], change the output value at VALUE, set SETTING to ON, and return to the measurement screen.

○ Flow velocity

Move to [CHECK]->[A-OUT]->[VELOCITY], change the output value at VALUE, set SETTING to ON, and return to the measurement screen.

○ Water level

Move to [CHECK]->[A-OUT]->[LEVEL], change the output value at VALUE, set SETTING to ON, and return to the measurement screen.

Note: After checking, be sure to set SETTING to OFF to ensure correct measurement.

Chapter 5 Installation

When installing the Ultrasonic Doppler Flowmeter UVH-2000, consider the following points to obtain the best performance from the equipment.

5.1 Installation of Main Unit

5.1.1 Selection of installation place

Select an installation place by considering the following conditions:

1) Ambient temperature of -10 to +50°C, not near a heating element or under direct sunlight
2) No dust or corrosive atmosphere
3) Easy maintenance and inspection
4) Maximum cable length between the main unit and the detection unit:
   Ultrasonic level gauge: 150 m
   Optional Radar Level Gauge MRG-10 or MRF-10: 300 m
5) No risk of induction problems from power equipment and wiring

5.1.2 Installation

1) Install the main unit securely on a vertical wall with four M10 bolts.
2) Reserve a working area for maintenance and inspection.

5.2 Installation of Detector

5.2.1 Flow velocity detector

(1) Selection of installation place

To suppress measurement errors attributable to disorder in flow velocity distribution and to ensure the performance of the flowmeter, a straight water channel, as specified in Table 7.1, is necessary at the upstream and downstream positions of the flow velocity detector. For other information, consult TOKYO KEIKI or representative.

(2) Installation

For bottom use of sensor SE204020B, the mounting bracket should generally be attached to the bottom of the channel with an anchor bolt or by other means if the channel is closed. Depending on the channel shape and environmental conditions, a different installation method may be adopted. For details, consult TOKYO KEIKI or representative.

5.2.2 Water level detector

(1) Selection of installation place

To suppress measurement errors and ensure the performance of the flowmeter, note that the following conditions need to be satisfied when considering the mounting position of the water level detector. For details, consult TOKYO KEIKI or representative.

1) Upstream of the flow velocity transducer
2) Not near a heating element or under direct sunlight

(2) Installation

Secure the water level detector after attaching the mounting bracket with an anchor bolt or by other means.

5.3 Wiring

The devices are connected through the terminal board of the main unit. Connect them as follows:

1) Ensure that the coaxial cable between the main unit and the detector is separated from the power cables, and route it away from power equipment.
2) For wiring between the main unit and external equipment, see Figs. 5-1 and 5-2 and Table 5-1.
3) Be sure to use an instrument power supply and avoid sharing a power supply for power equipment.
4) Use power and signal cables whose nominal cross sections are 0.75 to 2 mm^2.
5) Use conduits pipe for wiring. Lead the power and signal cables of the main unit through the skin top at the bottom of the main unit, so that the end of conduit comes very close to the bottom of the main unit.
6) Ground the casing of the main unit through terminal A as shown below. (Class-D ground)
7) Do not connect anything to a terminal represented by ⊘.
8) Do not jumper the MRG+ and M-U+ terminals. Doing so may damage the built-in power supply.
9) Do not connect a power supply directly to the M-U+ or UL- terminal. Doing so may damage the internal circuit.

> **Warning**
> ・For wiring, stop measurements and turn the power off.
> Risk of electric shock.
> ・Connect cables correctly.
> A wiring error may damage this equipment or other equipment connected to it.

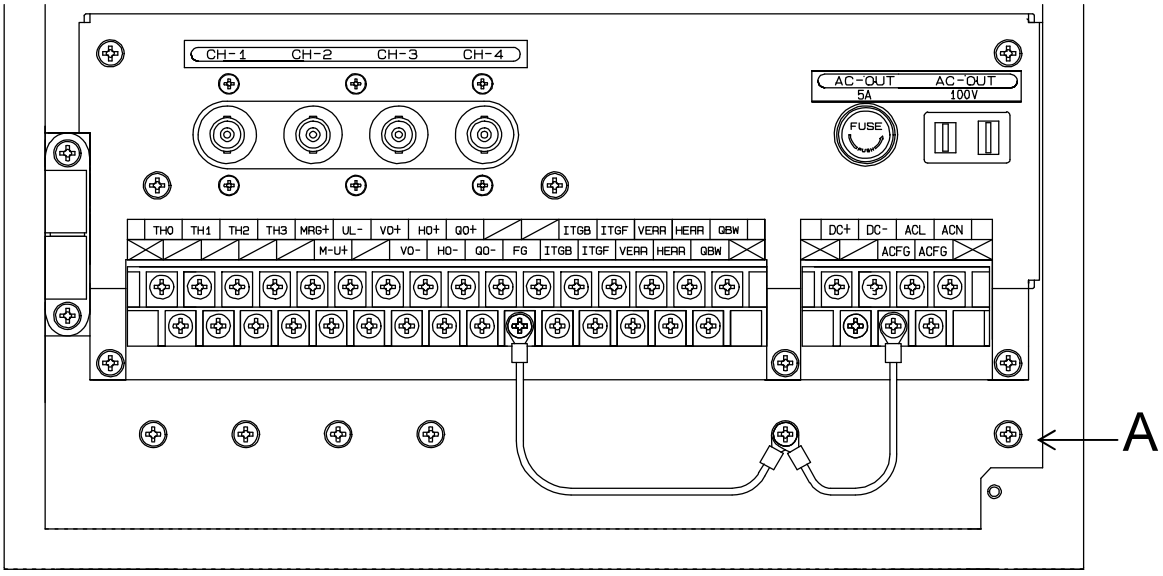


Fig. 5-1 External connection terminals of the main unit (100 VAC power supply)

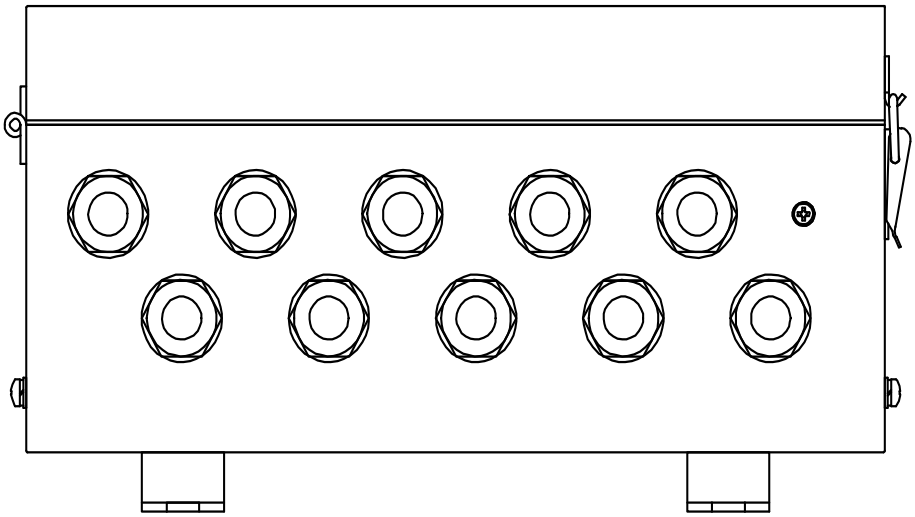


Fig. 5-2 Lower part of the casing of the main unit

Table 5-1 External connection terminals of the main unit

Functions may be limited by specifications or settings.

(1) Input and output terminals

Terminal	Function	Terminal	Function
TH0	Water temperature detection terminal 0	HO-	Water level analog output (-) terminal
TH1	Water temperature detection terminal 1	QO+	Flow rate analog output (+) terminal
TH2	Water temperature detection terminal 2	QO-	Flow rate analog output (-) terminal
TH3	Water temperature detection terminal 3	FG	Ground terminal(*2)
MRG+	Level gauge analog input terminal(*1)	ITGB	Integrated pulse contact output terminal (Reverse flow)
M-U+	Level gauge analog input terminal(*1)	ITGF	Integrated pulse contact output terminal (Forward flow)
UL-	Level gauge analog input terminal(*1)	VERR	Flow velocity transducer error output contact terminal
VO+	Flow velocity analog output (+) terminal	HERR	Level gauge error output contact terminal
VO-	Flow velocity analog output (-) terminal	QBW	Reverse current output contact terminal
HO+	Water level analog output (+) terminal		

(*2) This is connected to the housing through a power cable with a ground wire.

(*1) Details of level gauge analog input terminals

Level gauge	Terminal			Remarks
	MRG+	M-U+	UL-	
Optional ultrasonic level gauge (built in)		Connect the analog output terminal (+) of the optional level gauge.	Connect the analog output terminal (-) of the optional level gauge.	These terminals are connected at product assembly. Do not disconnect them.
MRG-10 MRF-10	Connect the positive (+) terminal of the level gauge.	Connect the negative (-) terminal of the level gauge.		These terminals are connected at installation. Within the current loop, do not add resistance greater than 300Ω.
Two-wire level gauge (with internal power supply of flowmeter)	Connect the positive (+) terminal of the level gauge.	Connect the negative (-) terminal of the level gauge.		These are current input terminals. Do not connect a voltage source between them.
Two-wire level gauge (with external power supply)		Connect the output terminal (-) of the level gauge.	Connect the output terminal (-) of the power supply.	These are current input terminals. Do not connect a voltage source between them. Create a loop as shown in Fig. 5-3.

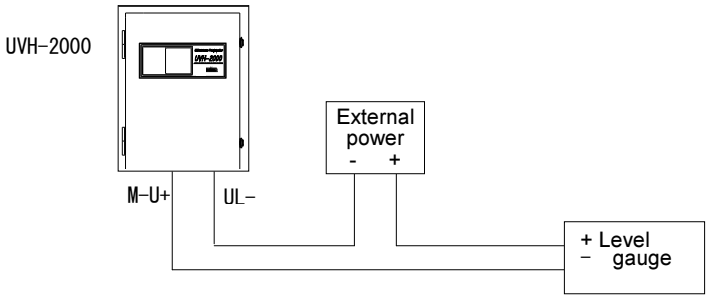


Fig. 5-3 External power supply connection diagram

(2) Power supply terminals

Terminal	Function
DC+	Positive DC terminal
DC-	Negative DC terminal
ACFG	Ground terminal for AC power arrester(*1)(*2)
ACL	Live AC terminal
ACN	Neutral AC terminal

(*1) Connect the ground wire of a three-core power cable.
(*2) There are two ACFG terminals but they are connected on the internal board.

Chapter 6 Maintenance and Inspection

6.1 Maintenance and Inspection of Transducer

The transducer generally requires no maintenance. However, note the following:

(1) Do not cause a shock to the transducer.
Do not hit the transducer with a hard object or put your hand or foot on it.

(2) Do not apply force to the clamping section.
The transducer is clamped at the correct position with a mounting bracket. Force may displace the transducer and disable measurement.

(3) The flow velocity transducer is designed to minimize deposition. During long-term use, however, deposits may appear or drifts (wooden pieces) may become caught. Since the sensitivity may deteriorate, inspect the transducer periodically. If there are deposits, brush them off gently.

(4) A fault will not change the appearance of the transducer except in extreme cases. Therefore, TOKYO KEIKI services the transducer based on a contract of maintenance and inspection (separate specifications). Characteristic deterioration is judged by observing received ultrasonic echoes and comparing the echoes with those obtained when the transducer is normal.

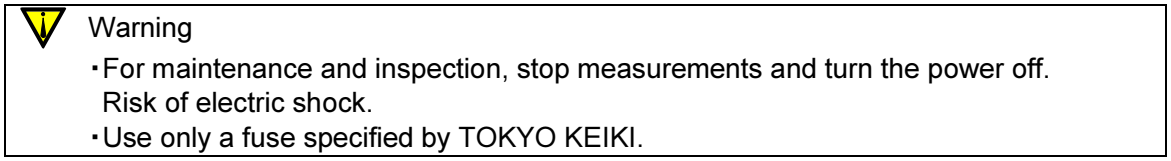
6.2 Maintenance and Inspection of Main Unit

TOKYO KEIKI's ultrasonic doppler flowmeter does not have mechanically mobile or electrically driven parts.
This product generally requires no maintenance, but take note of the following:

(1) Inspect and clean the warning label so that it is always legible. If the warning label is dirty or peeling, contact TOKYO KEIKI or representative.

(2) If a fuse blows, check that the main unit does not have a ground fault, a short circuit, or an insulation failure and that the power supply is normal. Replace the fuse only if no problem is found. If you cannot confirm that everything is normal, or if the fuse blows repeatedly, contact TOKYO KEIKI or representative.

(3) Since lightning-induced surges cause deterioration of the surge-absorbing element in the power arrester, it is recommended that you replace the element periodically. As deterioration progresses, the leakage current increases and the fuse on the power supply side blows to cut the power supply. The analog output side does not feed the current correctly to the reception gauge.



Chapter 7 General Specifications

7.1 Overall Specifications

Measurement	Application	Waste water, industrial effluents, sewage, and other liquids with a free-surface flow which contain suspended particulate matter that reflects ultrasonic waves
	Fluid temperature	0 to 40°C
	Turbidity	SS60 to 50,000 mg/L (degree) The limit of turbidity may vary with the degree of bubble mixing
	Other	Consult TOKYO KEIKI or representative in the following cases: ・Large amount of bubbles or debris on fluid surface ・Very choppy fluid surface ・Large amount of bubbles or debris in fluid ・Wood or other hard and heavy drifts in water channel ・Sediment accumulation in water channel
Applicable water channel	Channel profiles	Rectangular, circular
	Dimensions	Circular channel: ϕ 0.25 to 5 m Other channel: 0.25 to 5 m (Width of channel) The level gauge must not be submerged
	Required straight channel length	See Table 7-1
Measurement range	Flow rate	0 to full water level flow
	Water level	0 to 5 m
	Flow velocity	-5 to 5 m/s
Update period	About 100 ms	
Measurement accuracy	Flow rate	Forward flow: ±3% FS(*1) Limited to natural flows (however, max. flow limited by channel profile, max. water level, max. flow velocity, etc.) Reverse flow: Consult TOKYO KEIKI or representative
Measurement method	Flow rate	Flow velocity and water level calculation method
	Water level	Ultrasonic level gauge: Ultrasonic pulse transit time method Optional MRG-10: Microwave pulse transit time method Optional MRF-10: Microwave pulse transit time method
	Flow velocity	Ultrasonic pulse Doppler method

(*1) FS: Full scale

7.2 Main Unit Specifications

(1)

Main unit configuration	Flow velocity measurement and flow rate calculation units are integrated into one unit. Level measurement unit is externally mounted MRG-10 or MRF-10, optional ultrasonic level gauge, or another level gauge	
Water level analog input (A-IN)	Input	Water level signal from level gauge
	Devices to be connected	1) Ultrasonic level gauge 2) Optional Radar Level Gauge MRG-10 or MRF-10 3) Two-wire level gauge which operates on DC 24 V ± 20% 4) Level gauge with 4 to 20 mA current input, allowing load resistance of 350 Ω
	Input format	4 to 20 mA DC current input (insulated) (30 mA max)
	Input terminal	Termination block (M4)
Flow rate analog output (Q-OUT)	Output	Flow rate
	Output type	4 - 20 mA DC current output (insulated) Allowable load resistance: 750 Ω or less
	Response speed	10 to 120 s (90% response time)
	Output pattern	See Table 7-2 | Reverse maximum flow rate | = Forward maximum flow rate Forward/reverse flow direction determined by directional contact output (QBW)
	Output terminal	Termination block (M4)
Water level analog output (H-OUT)	Output	Water level
	Output type	4 - 20 mA DC current output (insulated) Allowable load resistance: 750 Ω or less
	Output pattern	See Table 7-2 (For + only)
Flow velocity analog output (V-OUT)	Output	Flow velocity
	Output type	4 - 20 mA DC current output (insulated) Allowable load resistance: 750 Ω or less
	Output pattern	See Table 7-2 | Reverse maximum flow velocity | = Forward maximum flow velocity Forward/reverse flow direction determined by directional contact output (QBW)
Integrated output (INTG)	Output	Integrated pulse (contact closed: about 100 ms)
	Output type	Power photo MOS relay (insulated)
	Contact capacity	AC 3 to 264 V DC 3 to 125 V 0.6 A (Derating at 40°C or more, 0.4 A @ 60°C)
	Direction of integration	Output: Independent for forward flow and reverse flow Setting: Common to forward flow and reverse flow
	Unit of integration	1000 m3(*1), 100 m3, 10 m3, 1 m3, 0.1 m3, 0.01 m3, 0.001 m3
	Output terminal	Termination block (M4)
Water level anomaly warning output(HERR)	Output	Warning when a water level outside the specified range is acquired (during warning: closed)
	Output type	Power photo MOS relay (insulated)
	Contact capacity	AC 3 to 264 V DC 3 to 125 V 0.6 A (Derating at 40°C or more, 0.4 A @ 60°C)
	Output terminal	Termination block (M4)
Flow velocity anomaly warning output(VERR)	Output	Warning when flow velocity transducer receives no choes.(VROFF state) (During warning: closed)
	Output type	Power photo MOS relay (insulated)
	Contact capacity	AC 3 to 264 V DC 3 to 125 V 0.6 A (Derating at 40°C or more, 0.4 A @ 60°C)
	Output terminal	Termination block (M4)

(*1) 1 m3 represents 1 m^3 (example).

Directionality output (QBW)	Output	Detection of forward and reverse flow (forward flow: open, reverse flow: closed)
	Output type	Power photo MOS relay (insulated)
	Contact point capacity	AC 3 to 264 V DC 3 to 125 V 0.6 A (Derating at 40°C or more, 0.4 A ＠ 60°C)
	Output terminal	Termination block (M4)
Flow velocity output	1-path measurement	Standard specifications
	2-path measurement	Optional: External measurement path switching unit not necessary
	3-path measurement	Optional: External measurement path switching unit not necessary
	4-path measurement	Optional: External measurement path switching unit not necessary

(2)

Data settings	Setting method	Flow rate calculation and flow velocity measurement units: Interactive setting with 16 keys and display Level measurement unit: ・Optional ultrasonic level gauge: Setting by trained service person only ・MRG-10: Interactive setting with 4 keys and display ・MRF-10: Interactive setting with 4 keys and display
	Settings	Analog output and others
Display	Display	16 digit × 16 line LCD display with backlight
	Display contents	Measurement data - flow data, unit of measurement, various operational displays, etc.
	Number of digits displayed	Flow rate: Dependent on the maximum setting (6 digits max. including sign and decimal point) Water level: Dependent on the maximum setting (5 digits max. including decimal point) Flow velocity: Dependent on the maximum setting (6 digits max. including sign and decimal point) Integrated value: 6 digits
Operation status display	Flow rate	Unit of flow rate (with negative sign for reverse flow)
	Integration	INTG: Integration in progress
	AGC	VAGC: AGC ON during flow velocity measurement
	No receiving echo	VROFF: No-echo processing in progress during flow velocity measurement
		HROFF: No-echo processing in progress during water level measurement
	Wire breakage, failure, etc.	HHALT: Water level equal to or lower than 0%
	Checks	CHK-Q: Flow rate analog output check CHK-V: Flow velocity analog output check CHK-H: Water level analog output check CHK-M: Measurement path switching check CHK-HVQM: Multiple checks
	Over full scale	FS: Measurement data analog output is outside displayable range

(3)

Functions	No-echo processing	Data received prior to loss of echo reception from level gauge and flow velocity transducer is retained Flow rate output can be selected as 0%, 100%, or HOLD (to retain the value obtained immediately before)
	No-echo processing start time	Flow velocity measurement: 15 s Level measurement: 3 min (Optional ultrasonic level gauge) : 1 to 120 s (MRG-10,MRF-10) : Other (Dependent on level gauge)
	Self-check	Self-check available at power-on and from the CHECK menu
	Analog output check function	Pseudo-analog output is supported Setting range: Flow rate, flow velocity: -100.0 to 100.0% of span Water level: 0.0 to 100.0% of span (1 decimal place max.)
	Low flow rate cut	Flow rates below the specified value can be eliminated (Individual setting possible for forward and reverse currents) Setting range: Forward current: 0.0000 to 999999 [Set unit of flow rate] Reverse current: -99999 to 0.0000 [Set unit of flow rate] (4 decimal places max.)
	Flow rate span correction	Span compensation possible (Individual setting possible for forward and reverse currents) Setting range: 0.100 to 2.000 (3 decimal places max.)
	Flow rate zero point adjustment	Flow rate zero offset compensation possible (Individual setting possible for forward and reverse currents) Setting range: -99999 to 999999 [Set unit of flow rate] (4 decimal places max.)
	Pool water cut	A standing water level is set and a flow rate below this setting is assumed to be zero Setting range: 0.000 to 5.000 m (3 decimal places max.)
	Automatic gain control for flow velocity measurement	An appropriate gain can be set automatically for flow velocity measurement Gain can be controlled automatically to keep the receiving sensitivity at a certain level during flow velocity measurement Note: Does not respond to momentary flow rate fluctuations A service person from TOKYO KEIKI can set this manually while checking echoes on an oscilloscope
	Basic data display	Calculated data in the main unit can be partially displayed
	Forward/reverse switching suppression	Frequent changes in directionality output for still water can be suppressed
	Measurement path switching check function	For multi-path flow velocity measurement, measurement paths can be forcibly fixed to allow individual measurement checks
	Low flow velocity cut	Flow velocities below the specified value can be eliminated (Individual setting possible for forward and reverse currents) Setting range: Forward current: 0.000 to 5.000 m/s (3 decimal places max.) Reverse current: -5.000 to 0.000 m/s (3 decimal places max.)
	Flow velocity zero point adjustment	Zero offset compensation possible only for specified flow velocity (Individual setting possible for forward and reverse currents) Setting range: -5.000 to 5.000 m/s (3 decimal places max.)
	Flow velocity span correction	Span compensation possible (Individual setting possible for forward and reverse currents) Setting range: 0.100 to 2.000 (3 decimal places max.)

	Water level zero point adjustment	Zero offset compensation possible only for specified water level Setting range: -5.000 to 5.000 m (3 decimal places max.)
	Water level span correction	Span compensation possible Setting range: 0.100 to 2.000 (3 decimal places max.)

(4)

Power supply	AC 90 to 132 V, 50/60 ± 2 Hz AC 180 to 264 V, 50/60 ± 2 Hz (must be specified) DC 19 to 29 V (must be specified) Allowable momentary power failure: 10 ms
Power consumption	AC 100 V: about 38 VA AC 220 V: about 50 VA AC 240 V: about 58 VA DC 24 V: about 24 W
Fuse rating	AC power: 2 A DC power: 3.15 A Service outlet: 5 A All fuses are of the time-lag type
Arrester	Integrated into analog input and output lines and AC power line Performance: Complies with IEC61000-4-5; confirmed not to damage the main unit circuit Test level: AC power line: Common mode: 4 kV, normal mode: 2 kV Analog output line: Common mode: 4 kV, normal mode: 2 kV (Note: The arresters do not ensure protection from all direct and induced surges. The DC power line has no arrester)

(5)

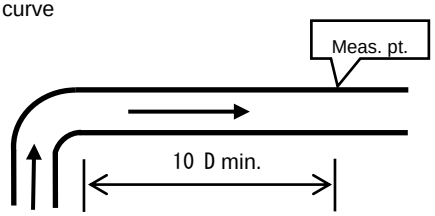
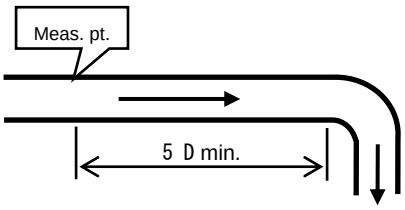
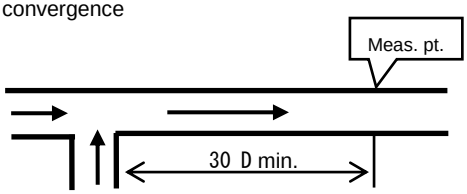
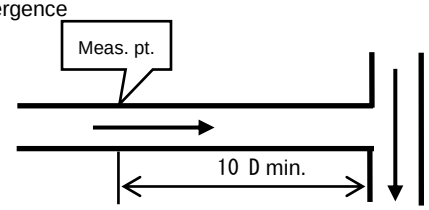
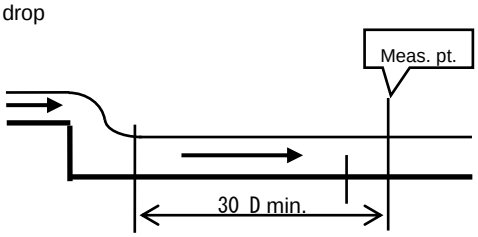
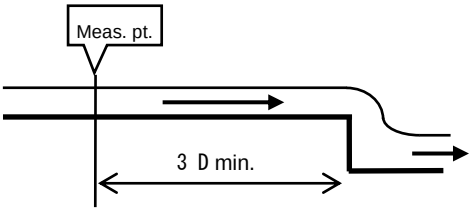
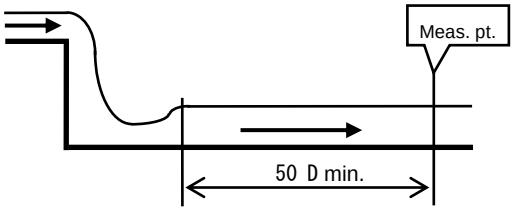
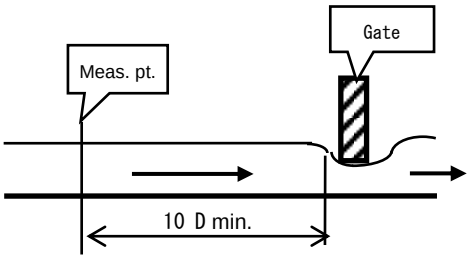
Operating temperature	-10 to 50°C
Humidity range	90% RH or less (no condensation)
Mounting method	Wall mounting
Construction	IP5X (dust-proof)
Power wiring connection port	Skin top: 10 pcs. Compatible cable: (ϕ6 to 12 mm, base hole: ϕ23.5 mm) X 5, (ϕ9 to 14 mm, base hole: ϕ23.5 mm) X 5
Casing material	Steel
Coating	Melamine resin baking
Color	Munsell 10YR9.4/0.5
Weight	With optional ultrasonic level gauge (built in): Less than 16 kg With MRG-10 or MRF-10: Less than 15 kg
Dimensions	See Fig. 7-1
Flow velocity detector	SE200020 ····· For small water channel SE204020 ····· For large conduit SE204014 ····· For small conduit SE200010 ····· For small conduit
Water level detector(*1)	ULT-140A (Measurement span: 0.3 to 5 m) ULT-130 (Measurement span: 2 to 10 m) ULT-115 (Measurement span: 5 to 20 m)

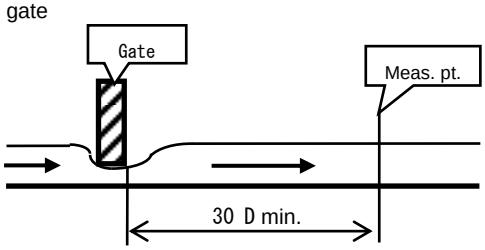
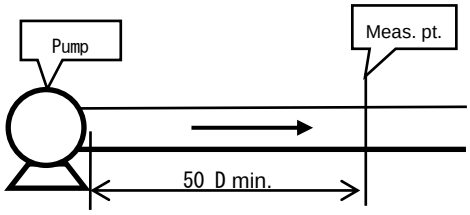
(*1) This refers to the ultrasonic level gauge.

7.3 Optional Specifications

Multi-path flow velocity measurement	This option applies to short straight channels or channels with flow velocity turbulence Flow velocity transducers can be automatically selected depending on water level Number of measurement paths: 2 to 4

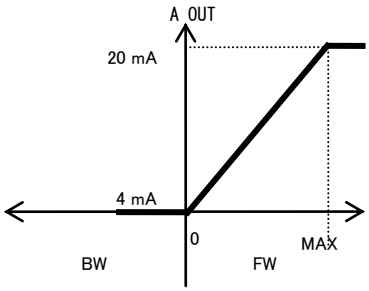
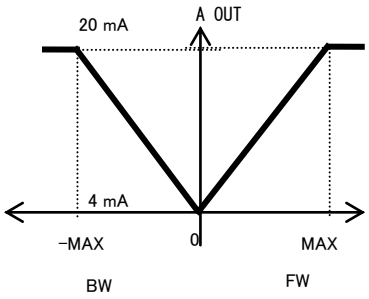
Table 7-1 Required straight channel lengths

<table>
<tr><th>Upstream Straight Channel Length</th><th>Downstream Straight Channel Length</th></tr>
<tr><td>From curve
 
</td><td>To curve
 
</td></tr>
<tr><td>From convergence
 
</td><td>To convergence
 
</td></tr>
<tr><td>From drop
 
</td><td>To drop
 
</td></tr>
<tr><td>From large drop
 
</td><td rowspan="3">To gate, dam, or reservoir
(1) Water level not affected by gate, dam, or reservoir
 

(2) Water level affected by gate, dam, or reservoir: consult TOKYO KEIKI for multi-path measurement</td></tr>
<tr><td>From gate
 
</td></tr>
<tr><td>From pump
 
</td></tr>
</table>

D: Channel diameter

Table 7-2 Analog output profile

Type	Output
+	
+/−	

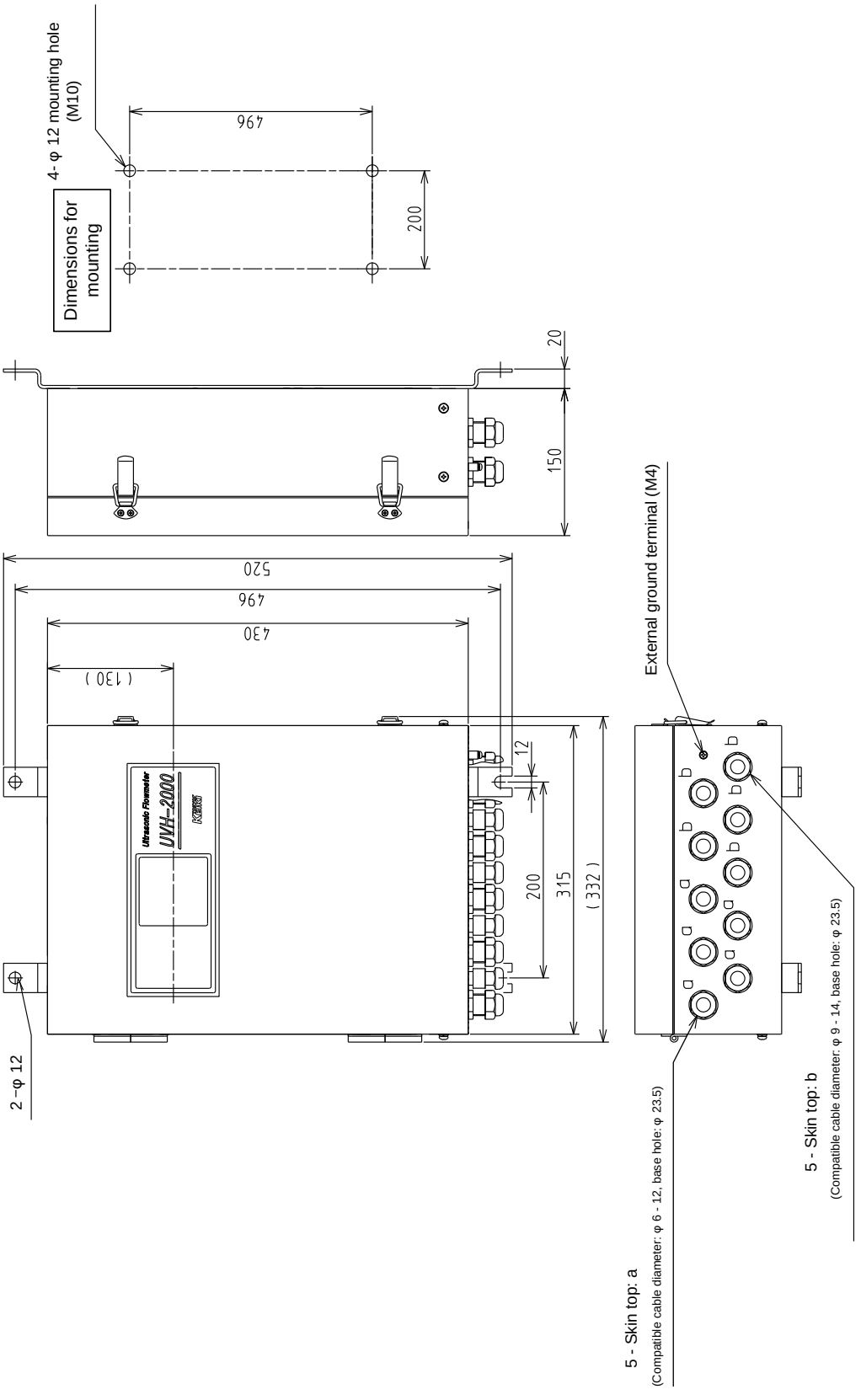


Fig. 7-1 UVH-2000 exterior dimensions

Chapter 8 Measurement Principle

Ultrasonic Doppler Flowmeter UVH-2000 measures the flow velocity of free-surface water using a flow velocity transducer (ultrasonic Doppler method) and measures the water level using a level gauge. From these data, the UVH-2000 calculates the flow rate.

In general, the flow rate Q of a conduit is the product of the flow cross sectional area A and the average flow velocity V:

$$Q = A \times V$$

The flow cross sectional area A can be calculated from the channel shape and the water level H, and the average flow velocity V is the product of the point flow velocity Vp and the point correction coefficient Kp, which is obtained experimentally using the ultrasonic Doppler method.

$$Q = A(H) \times K_p(H) \times V_p$$

H is measured with a level gauge, functions of H (A and Kp) are calculated, and the flow rate Q is obtained by calculation from the point flow velocity Vp, which is measured by the ultrasonic flow velocity transducer.

For a water channel with a turbulent flow velocity distribution, multi-path measurement (2 to 4 measurement paths) is used.

If the water level becomes lower than the detection limit of the flow velocity transducer and the flow velocity cannot be measured, the flow rate is calculated using the Manning equation.

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Operation Manual

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