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μLF-100
Ultrasonic Liquid Flow Meter

SERIAL NUMBER_____

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Installation, Operation and Maintenance Manual

TM-68028 REV. A

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Virtually every major commercial, government, and scientific organization is making use of our products, expertise and extensive technical support. This is a culmination of years of refinement in our flow meter and calibrator designs that has resulted in the technological leadership in the flow measurements field that we enjoy.

We are proud of our quality products, our courteous service and welcome you, as a valued customer, to our growing family.

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TM-68028 REVISIONS

REVISION	ECO NUMBER	DATE	APPROVAL
A			

Introduction

Thank you for purchasing our μLF-100 Ultrasonic Liquid Flow Meter. Before you operate this product, please read this instruction manual thoroughly; it describes the procedures necessary for handling the product properly and delivering best possible performance.

Safety precautions

The safety precautions to ensure safe operation of this ultrasonic liquid flow meter are described below.

1. The power supply voltage for this flow meter is DC 12-30 V, but the pulse voltage of approx. 150 V is output from the converter to drive the detector. Therefore, there is a risk of electrical shock if you touch the terminal while the power to the converter is turned on.

Contents

1. General description

When an ultrasonic wave is propagated into a liquid flowing in a pipe, the apparent propagation velocity changes in accordance with the liquid flow velocity. Making use of this principle, the Flow Technology μLF-100 Ultrasonic Liquid Flow Meter measures the liquid flow velocity in the pipeline, converts it into the flow rate and outputs it in the form of an electrical signal.

The μLF-100 offers many advantages over other flow technologies, including no pressure loss, a wide measurement range, and excellent repeatability. The sensor is a robust, molded mounting fixture designed to insert in small, 6 mm or 3 mm O.D. PFA lines.

2 Features

- Zero pressure drop
- Wide measurement range.
- No moving parts
    - Eliminates wear and fatigue
    - Calibration accuracy is maintained.
    - Results in low cost of ownership.
- Excellent repeatability of +/-0.2%
- Fast response time
- Simple configuration

3. Principle of measurement

The propagation velocity C of an ultrasonic wave in stationary liquid is constant if the composition and the temperature of the liquid are constant. However, when the liquid flows, the apparent propagation velocity changes in accordance with the flow direction and flow velocity.

For example, if the flow direction and the propagation direction of an ultrasonic wave are the same, the propagation velocity increases proportional to the flow velocity, and if they are opposite, the propagation velocity decreases proportional to the flow velocity.

As shown in the figure below, for a case in which two ultrasonic sensors (detectors) of the toroidal shape are attached to the pipe wall and the ultrasonic pulses are transmitted and received repeatedly and alternately, the relationship between propagation time t1 in the same direction with the liquid flow, propagation time t2 in the opposite direction and flow velocity V of the liquid can be shown in Eq. (3) below:

$$t1 = \frac{L}{C+V} \quad \cdots\cdots(1)$$

$$t2 = \frac{L}{C-V} \quad \cdots\cdots(2)$$

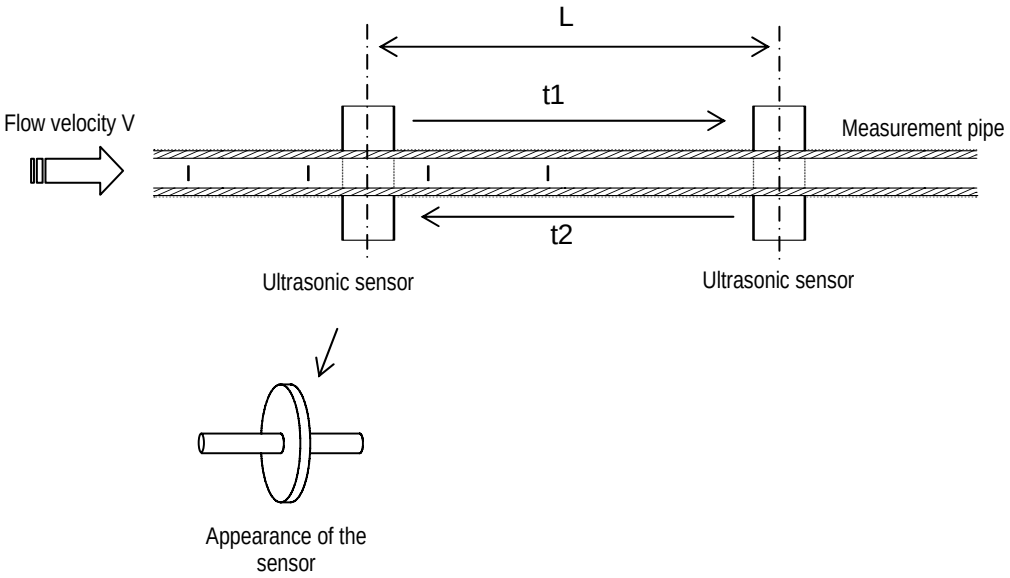
From Eqs. (1) and (2) above,

$$V = \frac{L}{2}\left(\frac{1}{t1} - \frac{1}{t2}\right) \quad \cdots\cdots(3)$$

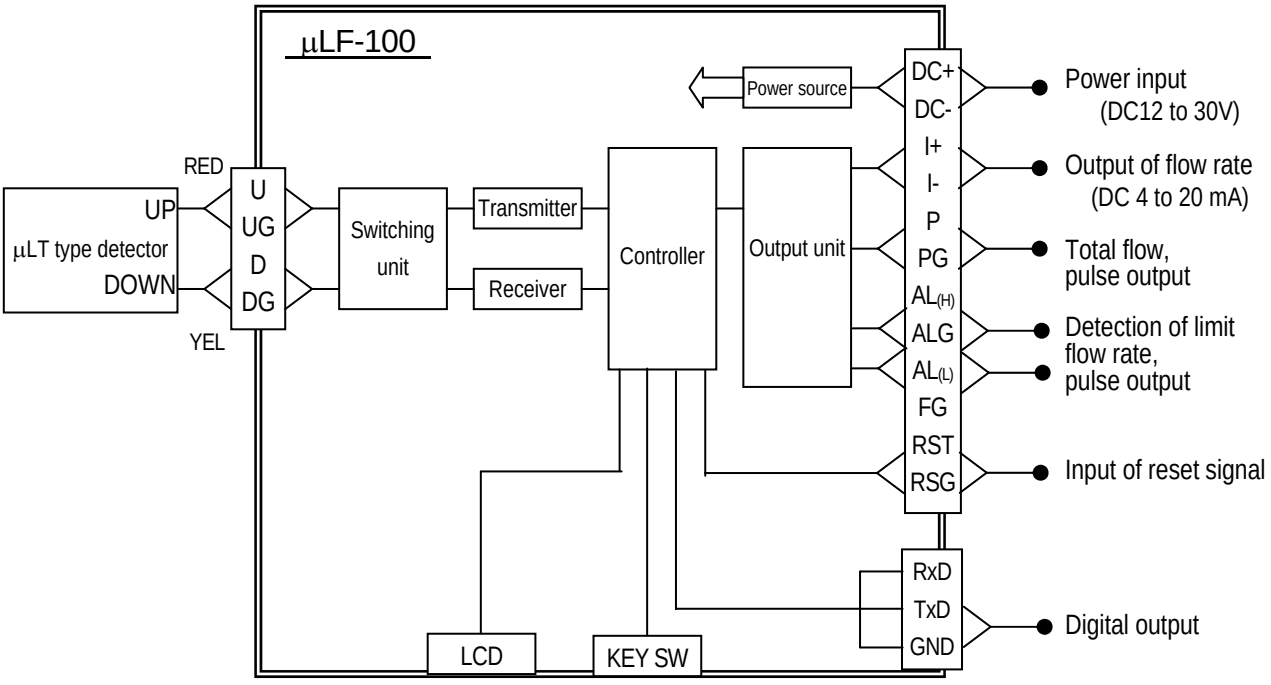
where V = Flow velocity (m/s),
L = Distance between the detectors (ultrasonic wave propagation distance) (m) and
C = Propagation velocity of ultrasonic wave in the stationary liquid (m/s).

The equipment obtains the flow velocity based on the arithmetic expression shown above (propagation time inverse number difference computing type).

As Eq. (3) above shows, the difference in the inverse of the propagation time is proportional to the flow velocity.



4. General block diagram



5. Specifications

5.1 Converter

(1) General specifications

Type:	μLF-100
Measuring method:	Ultrasonic pulse propagation time inverse number difference computing type
Computing type:	Digital computing by μCPU
Measuring objects:	Water, various types of chemicals
Measurement accuracy:	±2% RD (1.6 to 33ft/sec: 0.5-10 m/s)
Repeatability:	±0.2%
Flow velocity resolution:	5 mm/s
Flow rate setting range:	In the range of 1.6 to 33ft/sec: 0.5-10 m/s (analog output full-scale setting)
Flow rate measurement range:	In the range of 0 to 33ft/sec : 0-10 m/s
Construction:	equivalent to IP50
Material:	Glass fiber-filled Noryl resin
Temperature range:	50˚ to 122˚ F (10˚ to 50˚ C)
Humidity range:	No dew condensation
Power supply:	12-30 VDC
Power consumption:	3.6 VA or under
Weight:	Approx. 330 g

(2) Output unit

Instantaneous flow rate:	Electric current output: DC 4-20 mA/0 to +FS (load resistance: 450 Ω or under) Output time constant: 0-20 seconds (1-second step) Low cut: 0-10% (1% step)
Total flow:	Pulse output: Open collector (Rated DC 30 V, 0.25 A) Pulse width: 1.6 msec or 50 msec Low cut: 0-10% (1% step)
Alarm:	2 ch (Upper limit alarm output, lower limit alarm output) Open collector (Rated DC 30 V, 0.25 A, 2 ch)
Digital output:	9600 bps, 8-bit, non-parity, stop bit 1)

(3) Display function

Display:	LCD display (16 characters × 2 lines)
Parameters displayed	Instantaneous flow rate, flow velocity, total flow (display by selection)

(4) Setting function

Setting items: Analog output FS flow rate, digital output, unit of flow rate, pulse rate, damping time, low cut, upper and lower limit flow rates, others.

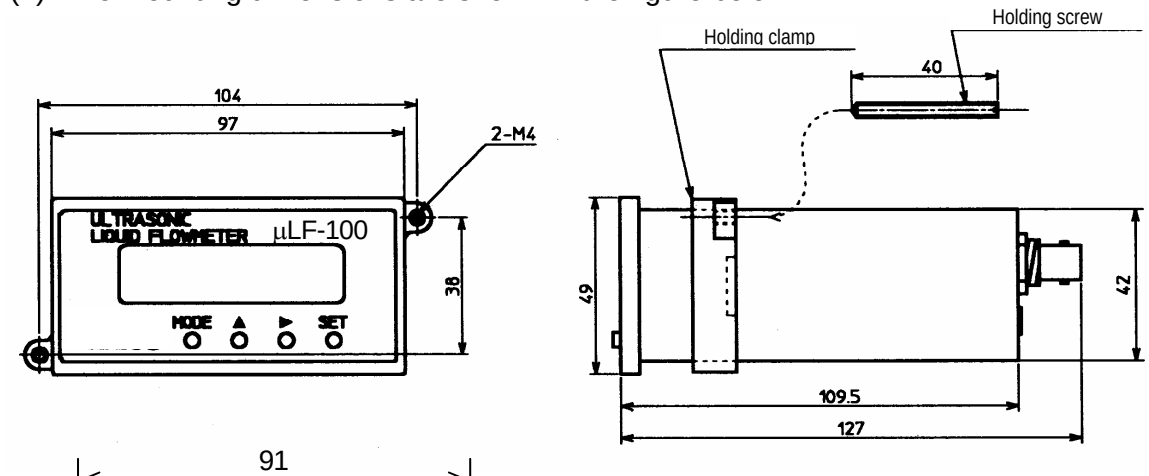
5.2 Detection unit

Material of the measurement pipe:	PFA
Material of the case:	Polypropylene
Operating temperature range:	50˚ to 158˚ F, (10˚ to 70˚ C)
Cable:	5 m (1.5C-QEV)
Weight:	Approx. 250-300 g (varies diameter of the measurement pipe)

6. Installation of the converter

6.1 Installation (main body of the converter)

(1) Attach the converter using the attached holding clamp and holding screws.
(2) The mounting dimensions are shown in the figure below.



Dimensions of the mounting hole

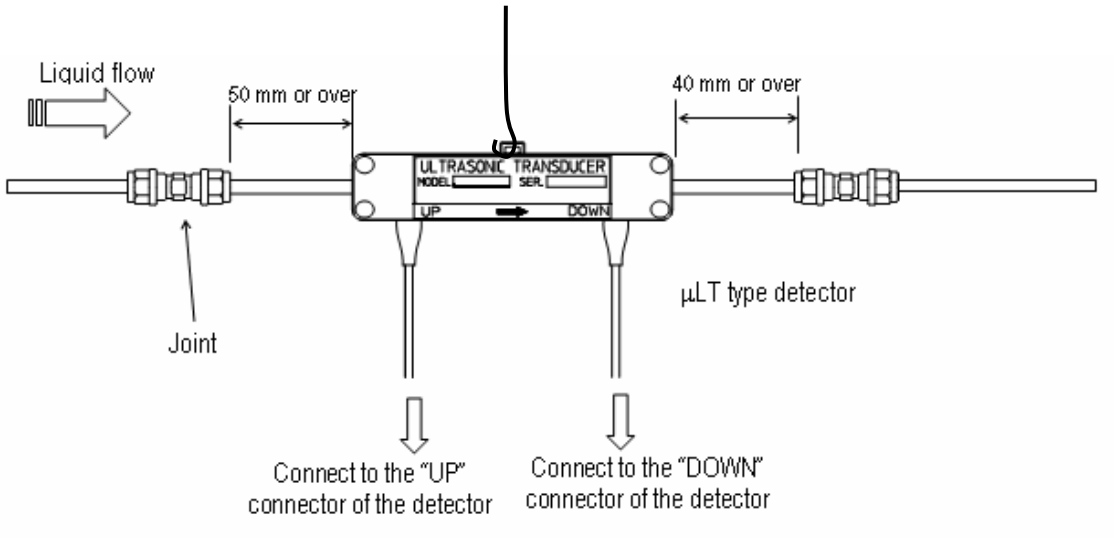
7. Installation of the detector

Please use joints when installing the detector.

Install the detector so that the “UP” indication on the nameplate is on the upstream side and the “DOWN” is on the downstream side.

You may cut the tube of the detector if necessary, but be sure to secure a length of 50 mm or over at the upstream side and 40 mm or over at the downstream side (if the tube is cut shorter than the above, measurement is still possible, but the level of accuracy may drop). Also, ensure that the piping for this portion is straight.

Use a hook to suspend, or a fixture to support the detector, so that no load is applied to the piping and joints.



8. Connection

8.1 Connection of the converter and the detector

Signal	BNC connector		Remarks
	Number	Name	
Upstream	1	UP	To the upstream side of the detector
Downstream	2	DOWN	To the downstream side of the detector

8.2 Connection of the power supply and the input and output signals

Signal		12-P connector		Remarks
Name	Polarity	Number	Name	
Power input	+	1	DC+	DC 12–30 V
	–	2	DC–	(Use a power supply of 3.6 VA or over)
Flow rate output	+	3	I+	DC 4–20 mA
	–	4	I–	Load resistance: 450 Ω or under
Integrated pulse output	+	5	P	Open collector output
	–	6	PG	Rating: DC 30 V, 0.25 A or under
Alarm output	+	7	AL(H)	Open collector output
	–	8	ALG	Rating: DC 30 V, 0.25 A or under
	+	9	AL(L)	
Frame ground		10	FG	
Integrated reset signal output	+	11	RESET	DC 5–30 V
	–	12	RESTG	

(Notes)

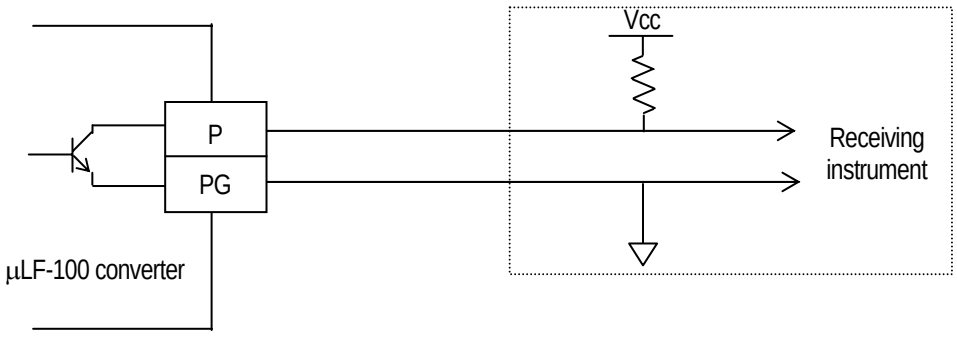
1. This converter has no power switch. When power is supplied, the converter is activated; be sure to make the necessary connections before supplying power to the converter.
2. For connections to the converter, please observe the procedures shown below.

   Be sure to confirm that the voltage of the power supply is identical to the one displayed on the nameplate. If the wrong supply voltage is used, the unit may not operate properly or may become damaged. (12-30 VDC)
3. The sensor is equipped with a 5-m cable.

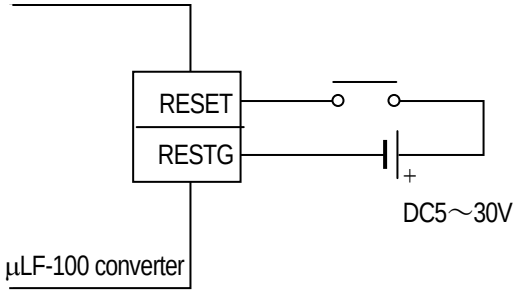
♦ Example of connecting the outputs

Open collector output

(The figure below shows the integrated pulse output,
but the connection procedure is the same for the alarm output.)



♦ Example of connecting the integrated reset signal input



- Concerning the alarm output

  Normally, terminals AL (H) and AL (L) at the back are in the OFF position.

  When the measured flow rate value reaches the upper alarm limit, terminal AL (H) is turned on, likewise, when the measured flow rate value drops below the lower alarm limit, terminal AL (L) is turned on.

  When you set the received wave abnormal alarm to the “ON” position, both terminals AL (H) and AL (L) are turned on when the E mark lights up on the display.

Example of operations

Setting example	Measurement status		Alarm output	
	Status display	Indicated flow rate	AL(H)	AL(L)
Signal Error: On	E	(HOLD status)	ON	ON
Upper Limit: On 200 mL/min	H	200 mL/min or over	ON	OFF
Lower Limit: On 100 mL/min	None	200 to 100 mL/min	OFF	OFF
	L	100 mL/min or under	OFF	ON

8.3 Digital output

This converter is equipped with an RS-232C output terminal so that, using the dedicated cable (optional), the measured data can be uploaded to a personal computer.

The output data is as follows:

E, 12.34, mL/m, 567890, XmL, L
① ② ③ ④ ⑤ ⑥

① Error handling information (space or E)
② Flow rate value (same format as the flow rate value display)
③ Unit of flow rate value (selected unit)
④ Integrated value (same format as the integrated value display)
⑤ Integrated value weighting (weighting selected on the integrated value display)
⑥ Alarm contact (space, H, L, E, *)

The data format is shown below:

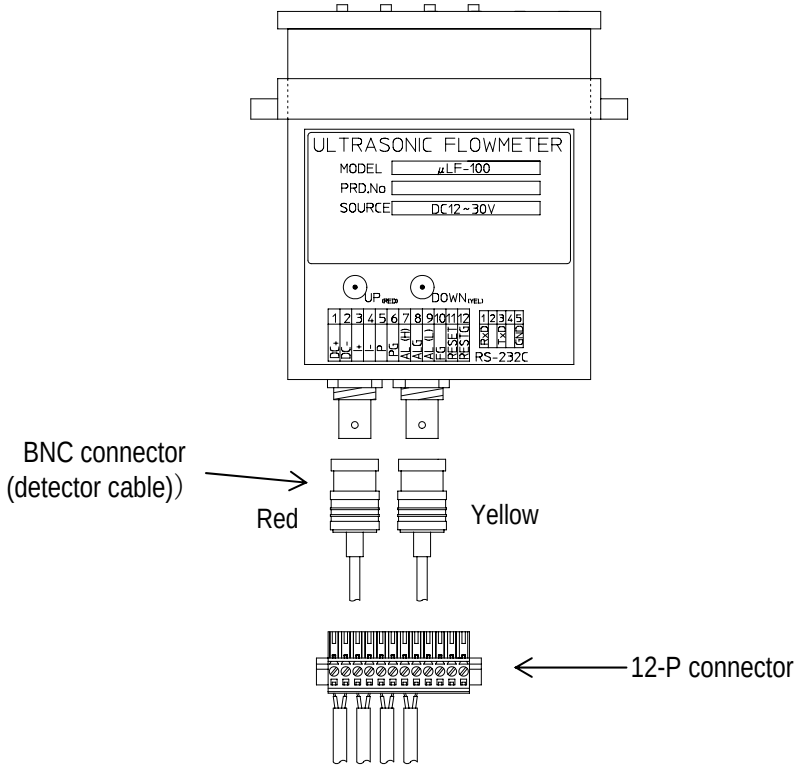
Transmission speed	9600 bps
Transmission rate	Once/time constant
Output time constant	1-120 s
Data bit length	8 bits
Stop bit length	1 bit
Parity	None
Data format	ASCII
Output items	Set flow rate, flow velocity

* For details of the RS-232C dedicated cable, please consult our sales department.

8.4 Procedures for connecting the power supply and the input and output signals

- 12-P connector (power supply and input and output terminals)
  (1) Peel the insulation off the wire leaving approx. 5 mm of exposed conductor
  (2) Remove the connector from the main body of the converter. Insert the exposed conductors into the pins and tighten the fastening screws.
  (When inserting the exposed conductors into the pins, refer to the pin numbers indicated on the side of the connector and those shown in the previous page.)
  (3) Attach the connector to the main body of the converter.

- BNC connector (detector)
  Hold the connector by its resin part, and push it into the converter. When you remove the connector, hold the connector by its resin part and pull it out of the converter.



* For details of the connecting cable for RS-232C output (digital output), please consult our sales department.

9. Power ON and Power OFF

9.1 Power ON

This converter has no power switch. When power is supplied, the converter is activated; be sure to check the connections before supplying power to the converter.

9.2 Power OFF

When the power supply is disconnected, the signal converter retains its configuration

10. Setting and changing the parameters

10.1 Basic operations

To make entries, either enter the values or select the values.

Use the **[↑]** key to move to the next optional item or to increase the numerical value.

Use the **[→]** key to move to the next optional item, to move the cursor, or to decrease the numerical value.

Use the **[SET]** key to set the numerical data or the data of the selected optional item.

Use the **[MODE]** key to move to the previous screen or to display the initial value.

10.2 Explanation of the menu screen

```
Menu
1 Measure
2 Setting
3 Confirm
4 Adjustment
```

1. Measure
   Displays the various measured values.
   (Refer to 10.3 Explanation of the measurement screen.)

2. Setting
   Sets or changes the parameters.
   (Refer to 10.4 Explanation of the parameter setting and changing screen.)

3. Confirm
   Confirms the set parameters.
   (Refer to 10.5 Explanation of the set parameter confirmation screen.)

4. Adjustment
   This option is used mainly by our service personnel to make various kinds of internal adjustments.
   (Refer to 10.6 Explanation of the adjustment screen.)

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

10.3 Explanation of the measurement screen

```
  Select
1 Flow Rate
2 Velocity
3 Total Flow
4 Flow & Total
```

1. Flow Rate
   Displays the instantaneous flow rate.

2. Velocity
   Displays the cross-sectional average flow velocity.

3. Total Flow
   Displays the total flow.

4. Flow & Total
   Displays the instantaneous flow rate and the total flow.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

(1) Display of the instantaneous flow rate

```
Flow Rate
□□□□□□  ■■■■■
```

□ ····· The measured flow rate (instantaneous flow rate) is displayed.
■ ····· The unit of flow rate is displayed.

Pressing the **[MODE]** key moves to the previous screen.

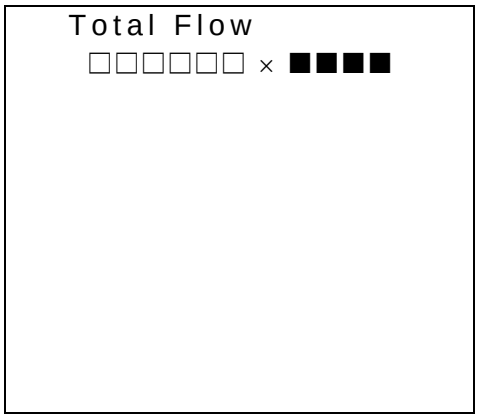
(2) Display of the cross-sectional average flow velocity

```
Velocity
  □□□□□   m/s
```

□ ····· The measured flow velocity (cross-sectional average flow velocity) is displayed.

Pressing the **[MODE]** key moves to the previous screen.

(3) Display of the total flow

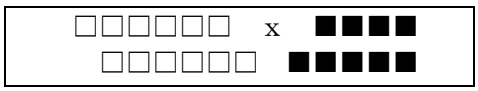


□ ····· The total count value is displayed.
■ ····· The pulse rate is displayed.

Pressing the **[MODE]** key moves to the previous screen.

*) The display consists of the following: Total flow = total count value × pulse rate.
*) If the unit of flow rate is set to m/s or cm/s, this screen is not displayed.
*) If the Pulse Output is set to None, this screen is not displayed.

(4) Display of the instantaneous flow rate & total flow



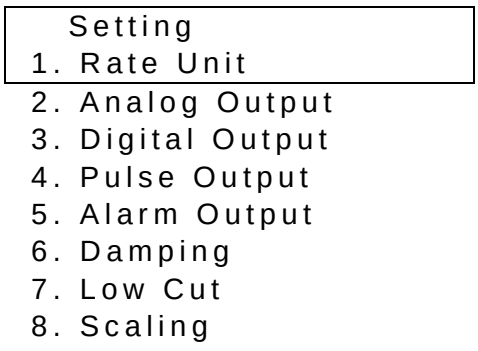
Upper line:
□ ····· The total count value is displayed.
■ ····· The pulse rate is displayed.
Lower line:
□ ····· The measured flow rate (instantaneous flow rate) is displayed.
■ ····· The unit of flow rate is displayed.

Pressing the **[MODE]** key moves to the previous screen.

*) If the unit of flow rate is set to m/s or cm/s, this screen is not displayed.
*) If the Pulse Output is set to None, this screen is not displayed.

10.4 Explanation of the parameter setting screen

The setting items to be displayed on this screen vary depending on the measurement unit and/or the flow rate conversion method. (Refer to the attached Sheet 1.)



1. Rate Unit
   Sets the unit of flow rate.

2. Analog Output
   Sets ON/OFF of the analog output and the maximum flow rate.

3. Digital Output
   Sets the presence/absence of RS-232C output.

4. Pulse Output
   Sets the pulse width and pulse rate of the total flow.

5. Alarm Output
   Sets the received wave abnormal alarm, the upper limit and lower limit of the flow rate.

6. Damping
   Sets the averaging time of the flow rate output.

7. Low Cut
   Sets the low cut range of the total flow and the instantaneous flow rate.

8. Scaling
   Makes fine adjustments to the flow rate output.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

(1) Setting the unit of flow rate

```
1. Rate Unit
  1 L/h
  2 L/min
  3 mL/min
  4 mL/sec
  5 m/sec
  6 cm/sec
```

Select the unit of flow rate.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
When you press the **[SET]** key once, the cursor disappears.
When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.
Pressing the **[MODE]** key moves to the previous screen.

*) When you select m/sec or cm/sec, you cannot enter the pulse setting.

(2) Setting the analog output

```
2.Analog Output
  1.Off
  2.On
```

Set the presence/absence of the analog output.
1. Off····Cancels the analog output.
2. On····Sets the analog output.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

Setting the maximum flow rate value (full-span setting for the analog output)

```
Full Scale
  □□□□□□  mL/min
```

□ ····· Enter the maximum flow rate (FS) for the analog output.

Setting range: 0-999999

Analog output: 4-20 mA/0-FS

Pressing the **[↑]** key changes the numerical value of the cursor location.

Pressing the **[→]** key moves the cursor.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

*) The maximum flow rate you can set is in the range of 1.6 to 33ft/sec (0.5-10 m/s) in terms of the flow velocity. If you set the maximum flow rate outside this range, an error message is displayed when you return to the menu screen. (Refer to 11.2 Setting error.)

(3) Setting the digital output

```
3.Digital Output
   1.Off
   2.On
```

Set the presence/absence of the digital output.

1. Off ··· Cancels the digital output.
2. On ··· Sets the digital output.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

Pressing the **[SET]** key moves to the selected optional item.

Pressing the **[MODE]** key moves to the previous screen.

(4) Selecting the integration function and setting the pulse width

```
4.Pulse Output
  1 None
  2 High Mode
  3 Low Mode
```

Select the integration function and set the integrated pulse output width.

1. None
   No flow integration or integrated pulse output.
2. High Mode
   High speed pulse: Pulse width 1.6 ms
   Setting range: 1 P/s - 300 P/s
3. Low Mode
   Low speed pulse: Pulse width 50 ms
   Setting range: 1 P/h - 10 P/s

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the pulse rate setting screen.
Pressing the **[MODE]** key moves to the previous screen.

*) When you select m/sec or cm/sec for the unit of flow rate, and when you set the analog output to OFF, you cannot select “High Mode” or “Low Mode”.

Setting the integrated pulse rate

```
Pulse Rate
1 1mL
2 10mL
3 0.1L
4 1L
```

Select the pulse rate of the total flow (flow rate per pulse).

Pressing the **[↑]** key moves to the next optional item.
When you press the **[SET]** key once, the cursor disappears.
When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.
Pressing the **[MODE]** key moves to the previous screen.

*) If the Pulse Output is set to None, this screen is skipped.
*) If you set the pulse rate outside the setting range, an error message is displayed immediately after you enter the value. (Refer to 11.2 Setting error.)

(5) Setting the flow alarm

```
5.Alarm Output
1 Signal Error
2 Upper Limit
3 Lower Limit
```

Set the received wave abnormal alarm, the upper limit flow rate and lower limit flow rate.

1. Signal Error ····· Sets the received wave abnormal alarm.
2. Upper Limit ····· Sets the upper limit flow rate alarm.
3. Lower Limit ····· Sets the lower limit flow rate alarm.

With the received wave abnormal alarm, upper limit alarm, or lower limit alarm set, if the received wave is abnormal or if the measured value has reached the set value, the ON signal (open collector) is output to the connector terminal at the back.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

Setting the received wave abnormal alarm

```
Signal Error
  1.Off
  2.On
```

Set the received wave abnormal alarm.

1. Off……Cancels the alarm.
2. On……Sets the alarm.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

Setting the upper limit alarm

```
Upper Limit
  1.Off
  2.On
```

Set the upper limit alarm.

1. Off····Cancels the alarm.
2. On····Sets the alarm.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

Setting the upper limit value

```
Upper Limit
   □□□□□□ mL/min
```

□□□□□□……Enter the upper limit flow rate value.

Setting range: 0-999999

(The unit of flow rate is the one that has been set at 1. Rate Unit.)

When the flow rate exceeds the upper limit value, the alarm is activated.

Pressing the **[↑]** key changes the numerical value of the cursor location.

Pressing the **[→]** key moves the cursor.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

*) If you enter an upper limit value outside the setting range, an error message is displayed immediately after you enter the value. (Refer to 11.2 Setting error.)

Setting the lower limit alarm

```
Lower Limit
  1.Off
  2.On
```

Set the lower limit alarm.

1. Off·····Cancels the alarm.
2. On·····Sets the alarm.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

Pressing the **[SET]** key moves to the selected optional item.

Pressing the **[MODE]** key moves to the previous screen.

Setting the lower limit value

```
Lower Limit
□□□□□□ mL/min
```

□□□□□□·····Enter the lower limit value.

Setting range: 0-999999

(The unit of flow rate is the one that has been set at 1. Rate Unit.)

When the flow rate drops below the lower limit value, the alarm is activated.

Pressing the **[↑]** key changes the numerical value of the cursor location.

Pressing the **[→]** key moves the cursor.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

*) If you enter a lower limit value outside the setting range, an error message is displayed immediately after you enter the value. (Refer to 11.2 Setting error.)

(6) Setting the averaging time

```
6.Damping
  □□ Sec
```

The flow rate output is smoothed (90% response of primary delay).

Setting range: 0-20 sec.

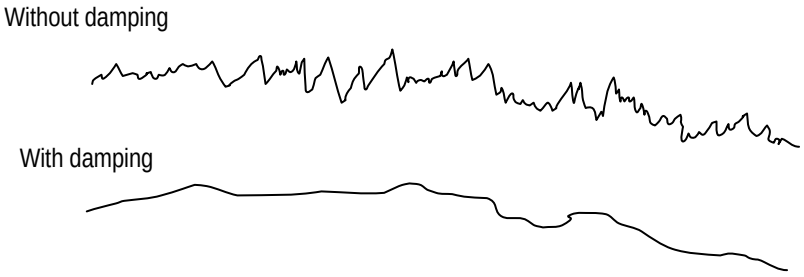
Pressing the **[↑]** key increases the numerical value.

Pressing the **[→]** key decreases the numerical value.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.



(7) Setting the low cut range

```
7.Low Cut
  1 Total Flow
  2 Flow Rate
```

Set a low flow cut-off range that forces an almost zero flow rate to 0.

1. Sets the total low flow cutoff range.
2. Sets the instantaneous low flow cutoff range.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

Setting the total flow low cut

```
Total Flow Cut
□□□□.□□ mL/min
```

Enter the total low flow cutoff range.
A flow rate of □□□□.□□ or lower is regarded as 0.
Setting range: 0-9999.99

Pressing the **[↑]** key changes the numerical value of the cursor location.
Pressing the **[→]** key moves the cursor.
When you press the **[SET]** key once, the cursor disappears.
When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.
Pressing the **[MODE]** key moves to the previous screen.

Setting the flow rate low cut

```
Flow Rate Cut
□□□□.□□ mL/min
```

Enter the low cutoff range for the instantaneous flow rate.
A flow rate of □□□□.□□ or lower is regarded as 0.

(The flow rate is displayed as 0 on the LCD; for the output, refer to the figure shown below.)

Setting range: 0-9999.99

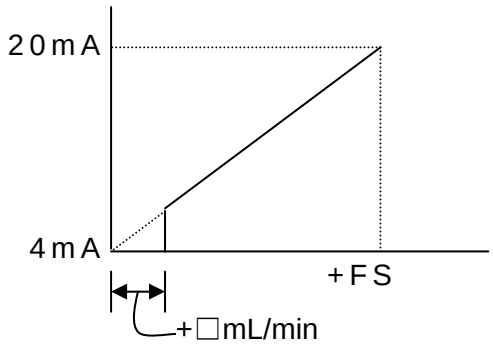
Pressing the **[↑]** key changes the numerical value of the cursor location.

Pressing the **[→]** key moves the cursor.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.



A flow rate output of □□□□.□□ mL/min or lower is regarded as 4 mA.
Note: The reverse flow rate is also regarded as 4 mA.

(8) Setting the scaling

8.Scaling □.□□□

Enter the scaling value.

Flow rate output = Measured flow rate × Scaling set value

Normally, set to 1.000 (without fine adjustments)

Setting range: 0.500-5.000

Pressing the **[↑]** key changes the numerical value of the cursor location.

Pressing the **[→]** key moves the cursor.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

10.5 Explanation of the set parameter confirmation screen

Pressing the **[↑]** key or **[→]** key switches the confirmation screen, and the set values you entered in 10.4 are displayed.

Pressing the **[MODE]** key returns to the menu screen.

10.6 Explanation of the adjustment screen

Selecting the adjustment mode

```
Mode Select
  1 User Mode
  2 Eng. Mode
```

There are two types of adjustment modes:
User Mode: Select this mode.
Eng. Mode: To be used by our service personnel.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key fixes the selection and moves to the next screen.
Pressing the **[MODE]** key moves to the previous screen.

Entering the password

```
User Mode
  Password □□□
```

Initial value: 999

Enter the password to access the Adjustment menu.

Pressing the **[↑]** key changes the numerical value of the cursor location.
Pressing the **[→]** key moves the cursor.
When you press the **[SET]** key once, the cursor disappears.
When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.
Pressing the **[MODE]** key moves to the previous screen.

```
  Adjustment
1. Flow Clear
2. Zero Adj.
3. LCD Contrast
4. Gain Control
5. AMP Control
6. Ja./English
7. Pwd Change
```

1. Flow Clear
   Clears the total flow display (it becomes 0).
2. Zero Adj.
   Makes the zero-adjustment of the flow rate of a static state.
3. LCD Contrast
   Adjusts the display intensity of the LCD.
4. Gain Control
   Adjusts the AMP gain of the ultrasonic receiver signal.
5. AMP Control
   Adjusts the previous AGC AMP gain.
6. Ja./English
   Selects the language (Japanese or English) used for the menu on the LCD. (Normally, English is used.)
7. Pwd Change
   Changes the password to access the Adjustment menu.

Pressing the **[↑]** key moves to the next optional item.
Pressing the **[→]** key moves to the next optional item.
Pressing the **[SET]** key moves to the selected optional item.
Pressing the **[MODE]** key moves to the previous screen.

(1) Clearing the total flow value

1. Flow Clear 1 No 2 Yes

Select whether or not to clear the displayed total flow value to zero.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

(2) Zero adjustment of the flow rate

2. Zero Adj. 1 Auto 2 Manual

Select whether or not to make the zero adjustment of the flow rate.

1. Auto·····Executes the zero adjustment automatically

When Auto is selected, the flow rate value at that time is automatically adjusted to zero; therefore, before making the adjustment, be sure that there is no residual flow flowing through the meter.

It takes about 10 seconds for the adjustment; the message "Now Adjusting" is displayed while the zero adjustment is being executed.

2. Manual ···Executes the zero adjustment manually

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

When you select "Manual", the next screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

□□□. □□ mL/min ±□□. □□ mL/min

Zero adjustment of the flow rate (manual)

On the upper line of the LCD, the measured value (difference at the zero point) is displayed.

Enter the adjustment value on the lower line of the LCD. The corrected flow rate value is displayed on the upper line.

Pressing the **[↑]** key increases the numerical value.

Pressing the **[→]** key decreases the numerical value.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

(3) LCD contrast adjustment

```
3. LCD Contrast
  □□
```

Adjustment of the LCD display intensity

Adjustment range: 0-10

Pressing the **[↑]** key increases the numerical value and the display becomes darker.

Pressing the **[→]** key decreases the numerical value and the display becomes lighter.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

Pressing the **[MODE]** key moves to the previous screen.

(4) Gain adjustment of the ultrasonic receiver signal

```
4. Gain Control
   1 Auto
   2 Manual
```

Gain adjustment of the ultrasonic receiver signal

1. Auto (Automatic gain control)

The gain adjustment is executed automatically. We recommend that you select this option.

2. Manual

The gain adjustment of the received wave is executed manually.

This function is used mainly by our service personnel.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

When you select “Manual”, the next screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

```
Manual Gain
  □□    ■■■V
```

Adjustment of the received wave gain (manual)

This screen is to be used mainly for maintenance purposes.

Adjustment range: 00-50

Pressing the **[↑]** key increases the numerical value and the gain increases.

Pressing the **[→]** key decreases the numerical value and the gain decreases.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

Pressing the **[MODE]** key moves to the previous screen.

(5) Gain adjustment of the first-stage AMP

```
5. AMP Control
   □. □ V
```

Initial value: 1.0 V

This function is used for cases in which the received signal is excessive and it is necessary to prevent saturation of the received wave or the signal is too weak and it is necessary to increase the signal level.

This function is used mainly by our service personnel.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

Pressing the **[↑]** key increases the numerical value and the gain increases.

Pressing the **[→]** key decreases the numerical value and the gain decreases.

Pressing the **[MODE]** key moves to the previous screen.

(6) Selection of the language used for display

```
6. Ja./English
  1 Japanese
  2 English
```

Select the language to be used for display.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

Pressing the **[SET]** key fixes the selection and moves to the previous screen.

Pressing the **[MODE]** key moves to the previous screen.

(7) Password change

```
7. Pwd Change
   □□□
```

Change the password.

□□□ ····· Enter the password to be changed.

Setting range: 0-999

Pressing the **[↑]** key changes the numerical value.

Pressing the **[→]** key moves the cursor.

When you press the [**SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the previous screen is displayed.

Pressing the **[MODE]** key moves to the previous screen.

New Passwd:□□□
1 No
2 Yes

Set the new password.

□□□ ····· The new password is displayed.

Pressing the **[↑]** key moves to the next optional item.

Pressing the **[→]** key moves to the next optional item.

When you press the **[SET]** key once, the cursor disappears.

When you press the **[SET]** key the second time, the setting is fixed and the "Adjustment, 7. Password" screen is displayed.

Pressing the **[MODE]** key moves to the "Adjustment, 7. Password" screen.

10.7 Settings prior to shipment

This converter has been set as follows prior to shipment.

To reset the parameters and return to the values set at the factory prior to shipment (initial values), turn off the power supply and, while pressing the [MODE] key, turn on the power.

Setting item	Initial set value	User set value
1. Rate Unit	3 mL/min	
2. Analog Output	1 Off	
3. Digital Output	1 Off	
4. Pulse Output	1 None	
5. Alarm Output	——	
Signal Error	1 Off	
Upper Limit	1 Off	
Lower Limit	1 Off	
6. Damping	10 Sec	
7. Low Cut	——	
Total Flow Cut	0000.00	
Flow Rate Cut	0000.00	
8. Scaling	1.000	

Password	999	

10.8 Linearization correction

This flow meter has a linearization correction function.

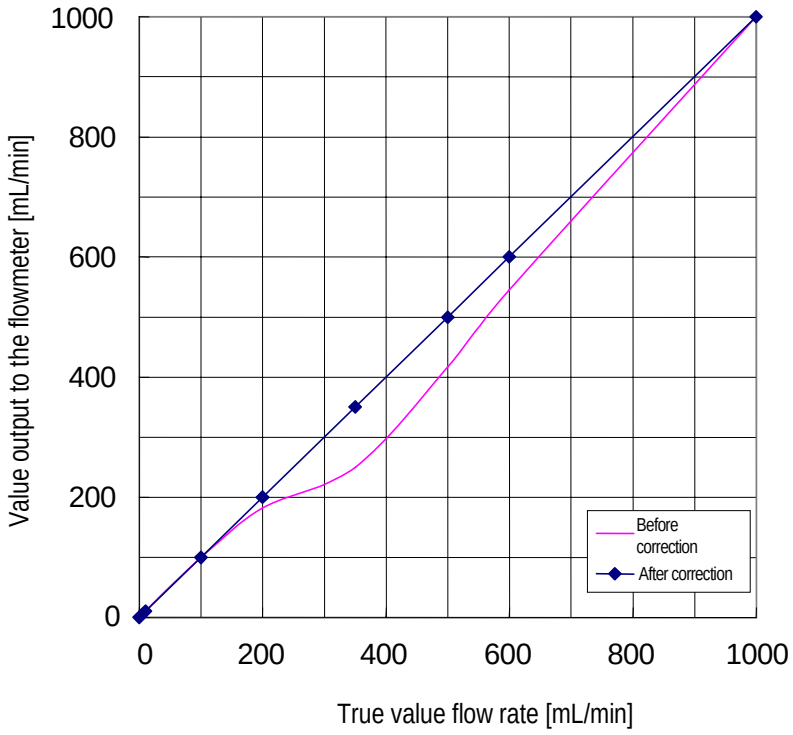
Up to a maximum of 15 correction points can be set; specify these points at an appropriate proportion to the full scale. Any correction factor can be set to each correction point. (The correction factor between correction points is linearly interpolated.)

Setting the linearization is executed using a telecommunications cable and dedicated software (both optional). For more details, please consult our sales department.

♦ Example of usage

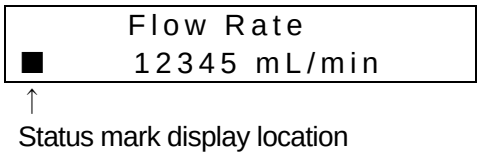
For a case in which the full-scale set value is 1,000 mL/min and the number of correction points is 8:

Correction point (%)	Correction factor
0	1
1	0.9
10	1
20	1.1
35	1.4
50	1.2
60	1.1
100	1



11. Status display

11.1 Measurement status



Status mark display location

The following status marks may be displayed during measurement:

E: This status mark is displayed when no received wave signals are sent to the unit due to a break in the sensor cable or for other reasons, or when there is no liquid in the measurement pipe. In such a situation, measurement becomes impossible and the value from immediately before the measurement process stopped is retained for output.

*: This status mark is displayed when the liquid starts to flow, when the flow turbulence is significant, or when air bubbles are entrained. Also, it may be displayed when the unit is subjected to noise, but even if this status mark is displayed from time to time, the unit is still capable of taking normal measurements.

#: This status mark is displayed when the measured flow rate exceeds the analog output range. Even if this status mark is displayed, the unit still takes normal measurements. The analog output range is from –25% (0 mA) to 125% (24 mA) of FS.

L: This status mark is displayed when the measured flow rate drops below the lower limit alarm. Even if this status mark is displayed, the unit still takes normal measurements.

H: This status mark is displayed when the measured flow rate exceeds the upper limit alarm. Even if this status mark is displayed, the unit still takes normal measurements.

11.2 Setting error

Maximum flow rate setting error

Setting Range Error

This error message is displayed when the setting of the maximum flow rate for 4-20 mA output is outside the setting range.

The setting range is 0.5-10 m/s in terms of the flow velocity.

When you press any key, the error message disappears. Check the maximum flow rate and the unit of flow rate for the correct setting range, and re-set the maximum flow rate.

Integrated pulse setting error

Pulse Rate Error

This error message is displayed when the integrated pulse setting is outside the setting range.

When you press any key, the error message disappears. Check the maximum flow rate and the integrated pulse setting range, and re-set the integrated pulse setting.

Alarm setting error

5.Alarm Output Setting Error

This error message is displayed when both the upper limit alarm and the lower limit alarm are turned on and,

Upper limit alarm set value < lower limit alarm set value,
Full scale < upper limit alarm set value, or
Full scale < lower limit alarm set value.

When you press any key, the error message disappears. Check the setting ranges of the upper limit alarm and the lower limit alarm, and re-set the alarms.

11.3 Flow rate range exceeded

Flow Rate Flow Limit Over

This error message is displayed when the measured flow rate exceeds ±10 m/s in terms of the flow velocity.

The count of the total flow is stopped.

When the measured flow rate returns to within ±10 m/s, the normal flow rate display resumes.

12. Maintenance and inspection

12.1 Inspection items

1. Converter housing ····· Confirm that the panel is closed firmly. Also, confirm that there is no humidity or water droplets visible when you open the lid.
2. Detector ····· Confirm that the detector is not deformed or significantly stained.
3. Cables ····· Confirm that the cables are attached firmly to the converter's connectors and that they are not corroded.
4. Power supply voltage····· Confirm that the power supply voltage is within the rated value.
5. Operations ····· Confirm that the unit outputs "zero" when the flow is stopped and that the received wave signal during measurement is normal and there is no abnormality in the output signal.

Attachment

List of setting functions (English)

Item	Menu item	Number	Setting item	Input	Optional item and setting range
0	Menu	-1	Measure		
		-2	Setting		
		-3	Confirm		
		-4	Adjustment		
1	Measure	-1	Flow Rate		
		-2	Velocity		
		-3	Total Flow		
		-4	Flow & Total		
2	Setting	-1	Rate Unit	Select	L/h, L/min, mL/min, mL/sec, m/sec, cm/sec
		-2	Analog Output	Select	Off/ On
			Full Scale	Numerical value	000000 to 999999
		-3	Digital Output	Select	Off/ On
		-4	Pulse Output	Select	None/ High Mode/ Low Mode
			Pulse Rate	Select	1mL / 10mL / 0.1L / 1L
		-5	Alarm Output	Select	Signal Error/ Upper Limit/ Lower Limit
			Signal Error	Select	Off/ On
			Upper Limit	Select	Off/ On
			Upper Limit	Numerical value	000000 to 999999
			Lower Limit	Select	Off/ On
			Lower Limit	Numerical value	000000 to 999999
		-6	Damping	Numerical value	0 to 20 SEC
		-7	Low Cut	Select	Total Flow/ Flow Rate
			Total Flow Cut	Numerical value	000000.00 to 999999.99
			Flow Rate Cut	Numerical value	000000.00 to 999999.99
		-8	Scaling	Numerical value	0.500 to 5.000
3	Confirm		Measuring Pipe	Confirm	
			Full Scale	Confirm	
			Digital Output	Confirm	
			Pulse Rate	Confirm	
			Alm.Signal Err	Confirm	
			Alm.Upper Limit	Confirm	
			Alm.Lower Limit	Confirm	
			Damping	Confirm	
			Total Flow Cut	Confirm	
			Flow Rate Cut	Confirm	
			Scaling	Confirm	
			Zero Adjust	Confirm	
			Span	Confirm	
			Version	Confirm	
4	Adjustment		Mode Select	Select	User Mode/ Eng.Mode
			User Mode	Numerical value	000 to 999
			Engineer Mode	Numerical value	000000 to 999999
		-1	Flow Clear	Select	No/ Yes
		-2	Zero Adj.	Select	Auto/ Manual
			Manual Zero	Numerical value	-99.99 to +99.99
		-3	LCD Contrast	Numerical value	0 to 10
		-4	Gain Control	Select	Auto/ Manual
			Manual	Numerical value	0 to 50
		-5	AMP Control	Numerical value	0.1 to 5.0V
		-6	Ja./English	Select	Japanese/ English
		-7	Pwd Change	Select	000 to 999

Table for the full-scale setting range

- The full-scale setting range is 0.5-10 m/s in terms of the flow velocity.
- Integrated pulse setting range:

  Low speed pulse: 1 P/h - 10 P/s

  High speed pulse: 1 P/s - 300 P/s

If the full-scale set value is outside these ranges, an error occurs.

Unit of flow rate: L/h

Detector	Outside diameter [mm]	Inside diameter [mm]	Pulse mode	Full-scale setting range								
				No pulse	Low speed pulse				High speed pulse			
			Pulse rate		1mL	10mL	0.1L	1L	1mL	10mL	0.1L	1L
μLT-6P	6	4	Minimum value	23	23	23	23	23	23	36	360	Setting not possible
			Maximum value	452	36	360	452	452	452	452	452	
μLT-4P	4	3	Minimum value	13	13	13	13	13	13	36	Setting not possible	Setting not possible
			Maximum value	254	36	254	254	254	254	254		
μLT-3P	3	2	Minimum value	6	6	6	6	6	6	36	Setting not possible	Setting not possible
			Maximum value	113	36	113	113	113	113	113		
μLT-6S	6	5.6	Minimum value	45	Setting not possible	45	45	45	45	45	360	Setting not possible
			Maximum value	886		360	886	886	886	886	886	
μLT-4S	4	3.8	Minimum value	21	21	21	21	21	21	36	360	Setting not possible
			Maximum value	408	36	360	408	408	408	408	408	

Unit of flow rate: L/min

Detector	Outside diameter [mm]	Inside diameter [mm]	Pulse mode	Full-scale setting range								
				No pulse	Low speed pulse				High speed pulse			
			Pulse rate		1mL	10mL	0.1L	1L	1mL	10mL	0.1L	1L
μLT-6P	6	4	Minimum value	1	Setting not possible	1	1	1	1	1	6	Setting not possible
			Maximum value	7		6	7	7	7	7	7	
μLT-4P	4	3	Minimum value	1	Setting not possible	1	1	1	1	1	Setting not possible	Setting not possible
			Maximum value	4		4	4	4	4	4		
μLT-3P	3	2	Minimum value	1	Setting not possible	1	1	1	1	1	Setting not possible	Setting not possible
			Maximum value	1		1	1	1	1	1		
μLT-6S	6	5.6	Minimum value	1	Setting not possible	1	1	1	1	1	6	Setting not possible
			Maximum value	14		6	14	14	14	14	14	
μLT-4S	4	3.8	Minimum value	1	Setting not possible	1	1	1	1	1	6	Setting not possible
			Maximum value	6		6	6	6	6	6	6	

Unit of flow rate: mL/min

Detector	Outside diameter [mm]	Inside diameter [mm]	Pulse mode	Full-scale setting range								
				No pulse	Low speed pulse				High speed pulse			
			Pulse rate		1mL	10mL	0.1L	1L	1mL	10mL	0.1L	1L
μLT-6P	6	4	Minimum value	377	377	377	377	377	377	600	6000	Setting
			Maximum value	7539	600	6000	7539	7539	7539	7539	7539	not possible
μLT-4P	4	3	Minimum value	213	213	213	213	213	213	600	Setting	Setting
			Maximum value	4241	600	4241	4241	4241	4241	4241	not possible	not possible
μLT-3P	3	2	Minimum value	95	95	95	95	95	95	600	Setting	Setting
			Maximum value	1884	600	1884	1884	1884	1884	1884	not possible	not possible
μLT-6S	6	5.6	Minimum value	739	Setting	739	739	739	739	739	6000	Setting
			Maximum value	14778	not possible	6000	14778	14778	14778	14778	14778	not possible
μLT-4S	4	3.8	Minimum value	341	341	341	341	341	341	600	6000	Setting
			Maximum value	6804	600	6000	6804	6804	6804	6804	6804	not possible

Unit of flow rate: mL/sec

Detector	Outside diameter [mm]	Inside diameter [mm]	Pulse mode	Full-scale setting range								
				No pulse	Low speed pulse				High speed pulse			
			Pulse rate		1mL	10mL	0.1L	1L	1mL	10mL	0.1L	1L
μLT-6P	6	4	Minimum value	7	7	7	7	7	7	10	100	Setting
			Maximum value	125	10	100	125	125	125	125	125	not possible
μLT-4P	4	3	Minimum value	4	4	4	4	4	4	10	Setting	Setting
			Maximum value	70	10	70	70	70	70	70	not possible	not possible
μLT-3P	3	2	Minimum value	2	2	2	2	2	2	10	Setting	Setting
			Maximum value	31	10	31	31	31	31	31	not possible	not possible
μLT-6S	6	5.6	Minimum value	13	Setting	13	13	13	13	13	100	Setting
			Maximum value	246	not possible	100	246	246	246	246	246	not possible
μLT-4S	4	3.8	Minimum value	6	6	6	6	6	6	10	100	Setting
			Maximum value	113	10	100	113	113	113	113	113	not possible