



**Liquid Vortex Flow Meter
with Temperature Correction
(With Display)**

FML300-D SERIES

INSTRUCTION MANUAL

KOFLOC Corp.

Foreword

Thank you for your selection of the liquid vortex flow meter with temperature correction FML300-D Series. Prior to using your new equipment, please read this manual thoroughly to ensure it is used in the correct way. Please note that this manual is subject to change without notice.

Please read this manual thoroughly prior to installing and using the product. This way it is possible to ensure the performance and safety of the product and prevent possible accidents and damage to the product due to incorrect use.

When the product has failed or is considered to require readjustment, please contact our sales office. Our experienced technical staff will give you appropriate advice. Please follow the instructions given.

Please note that if you repair/modify the product yourself, not only serious accidents may occur, but our warranty will become void.

The contents of the manual are subject to change without notice for improvement. Prior to shipment, every care has been taken in preparing this manual not to mention the product itself, but if you notice any imperfections, errors or omission, please contact KOFLOC.

■ Contact

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■ Warning symbols



Ignoring this symbol and handling the product incorrectly may result in loss of life or serious injury.

Ignoring this symbol and handling the product incorrectly may result in personal injury or damage to property.

■ Product Warranty

Contents of warranty

(1) Warranty period

The warranty period shall be one (1) year after the shipment from KOFLOC.

(2) Warranty scope

If the product fails during the warranty period due to reasons attributable to KOFLOC, we shall provide a substitute or repair the failed product free of charge in our factory.

Please note that the warranty scope is limited to the product itself and KOFLOC shall not be held responsible whatsoever for customer's damage that may arise from failure of the KOFLOC product regardless of the magnitude of such damage.

(3) Out of warranty

Even if the product fails during the warranty period, failures due to the following reasons are not covered by this warranty:

- a) Failures due to incorrect use or unauthorized repair or modification.
(Failures due to difference between the manufacturing specifications and the conditions of use are also included.)
- b) Failures due to dropping or other mishandling of the product after purchase.
- c) Failures due to fire or natural disasters such as earthquake, flood damage and lightning strike or failures caused by riot/war.
- d) Failures due to intrusion of foreign matter inside the piping.
- e) Failures due to problems specific to combination with built-in equipment.
- f) Failures due to causes that are considered to be outside of KOFLOC responsibility.
- g) Damages that could have been avoided if the user's machinery for which KOFLOC product was used had been equipped with the functions, structure and safety measures that are commonly provided in the industry.

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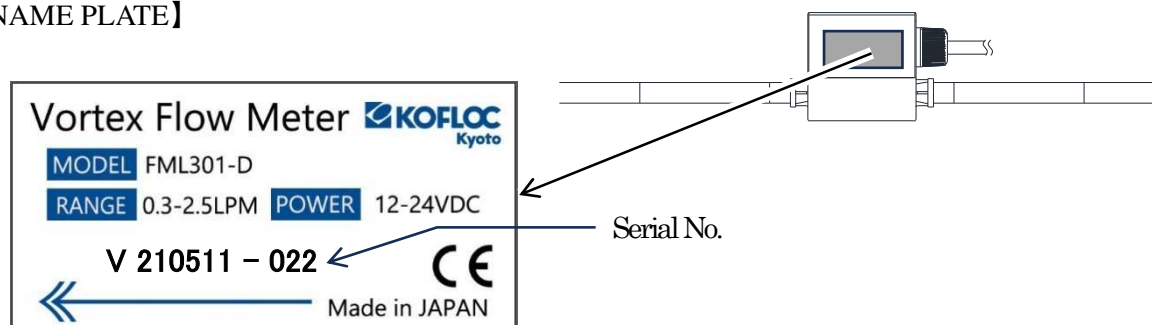
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1. Precautions for Use

1.1 Nameplate and model

Every product ordered by you has been assembled and adjusted according to your specifications. The flow rate range, output spec. and other data are shown on the nameplate on the side face of the case. Please make sure they meet your ordered specifications.

【NAME PLATE】



【MODEL】

Model		FML 30		— I / P	— D	—		—			Connection type※	
Rated flow rate range												
Symbol	Description										Symbol	Description
301	0.3~2.5L/min.										O	Tube end
302	0.4~4L/min.										X	Special spec.
303	2.0~16L/min.										Cable length※	
304	5.0~50L/min.										Symbol	Description
305	10~100L/min.										O	3m
306	25~250L/min										X	Special spec.

※Not printed on the nameplate

1.2 Storage of the product



When disposing of the product, follow the local ordinance.

When the product is received, store it as described below until it is put in use:

- (1) Store the product in the package in which it was received from KOFLOC.
- (2) Store the product in a place free of rain and water.
- (3) Store the product in a place free of vibration and impact.
- (4) Store the product in a place of normal temperature and normal humidity (25°C, 65%RH).
- (5) Store the product in a place free of dust and corrosive gases.
- (6) Store the product free of a strong electric/magnetic field.

To store the product that has been used and has remaining measuring fluid in the tube, wash it out completely before storing the product.

1.3 Handling

- (1) Use the meter with measuring tube filled with fluid to measure.
- (2) Do not apply a water pressure exceeding the proof pressure nor wash with counter flow. Such action may damage the sensor and cause troubles.
- (3) Do not use the meter in a place under direct sunlight, or hot/humid place.
- (4) Note that if fluid to measure inside the tube freezes, the sensor may be damaged.
If there is a possibility of freezing, provide heat insulation measures.
- (5) FML300 Series is made of resin including the thread part. When installing it, be careful not to apply an unnecessarily strong force.
- (6) Do not hold the output cable when moving the meter. Such action may break the meter.
- (7) Do not conduct insulation resistance/withstand voltage tests. Such tests may damage the meter.
- (8) To maintain the accuracy, warm up the meter (about 10 minutes after power on).

1.4 Installation and piping



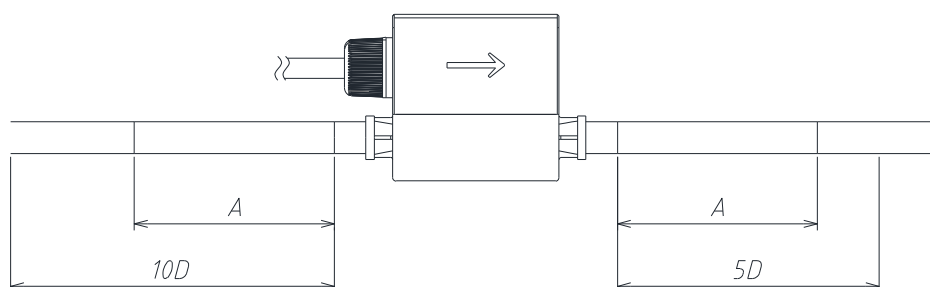
Make sure that the connections of piping are not leaking. Using unsafe liquid without such check may possibly result in serious accidents.



When washing the tube of the product, be careful not to damage the inside. Scratches are a cause of deterioration of accuracy.

Take the following precautions to use the product safely and accurately over a long period of time:

- (1) Fluid to measure is liquid. Use industrial water equivalent to pure water/tap water.
- (2) Do not use the meter in a place under direct sunlight, or hot/humid place.
- (3) Install the meter in a place free of corrosive gases.
- (4) This product is of splash-proof structure, but avoid rain and water.
- (5) Install the meter in a place free of vibration and impact.
- (6) When laying piping, do not hold the cover, but hold down the body part.
- (7) The meter may be installed in any posture. Match the direction of flow with the arrow shown on the side of the main unit.
- (8) To eliminate influence of turbulence and pulsating current, provide straight pipe as long as possible. The recommended dimensions of straight pipe are as shown below.



(Unit: mm)

Model	FML301	FML302	FML303	FML304	FML305	FML306
D (ID of tube)	6.35	6.35	9.50	15.88	22.20	33.70
A (product tube length)	60.0	60.0	60.0	60.0	50.0	85.0
IN side required straight pipe length: 10D	63.5	63.5	95.0	158.8	222.0	337.0
OUT side required straight pipe length: 5D	31.8	31.8	47.5	79.4	111.0	168.5

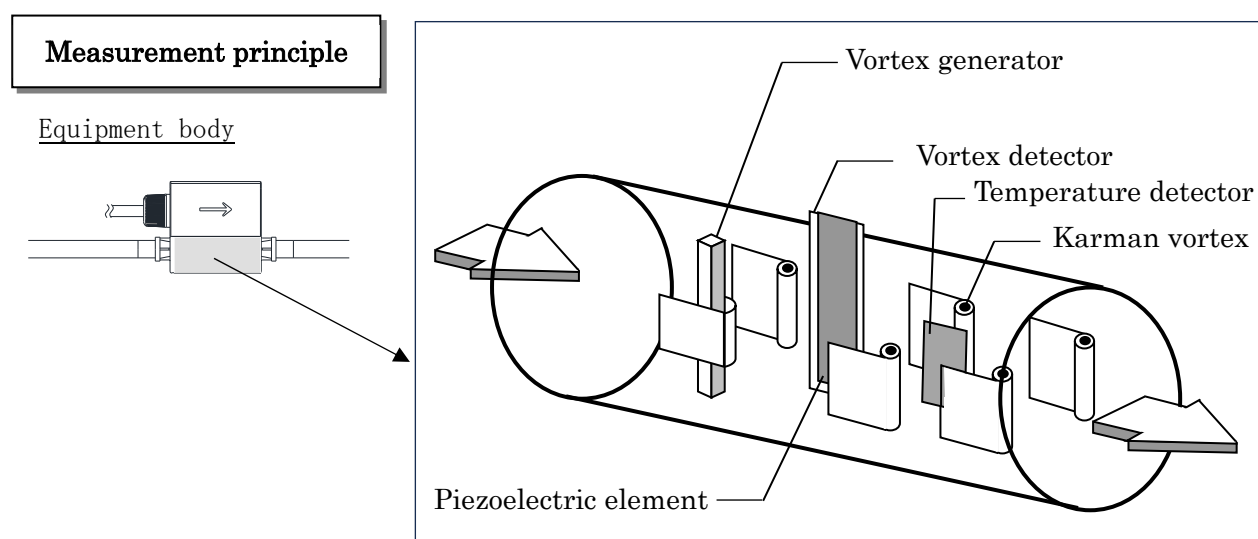
2. Overview of the Product

The liquid vortex flow meter with temperature correction FML300 Series is a device that measures the velocity (vortex) of liquid (water) that flows in the tube and detects a vortex frequency proportional to the velocity and then outputs appropriate values via a processing circuit.

The flow passage of the product is made of New PFA to realize high mechanical strength and chemical resistance.

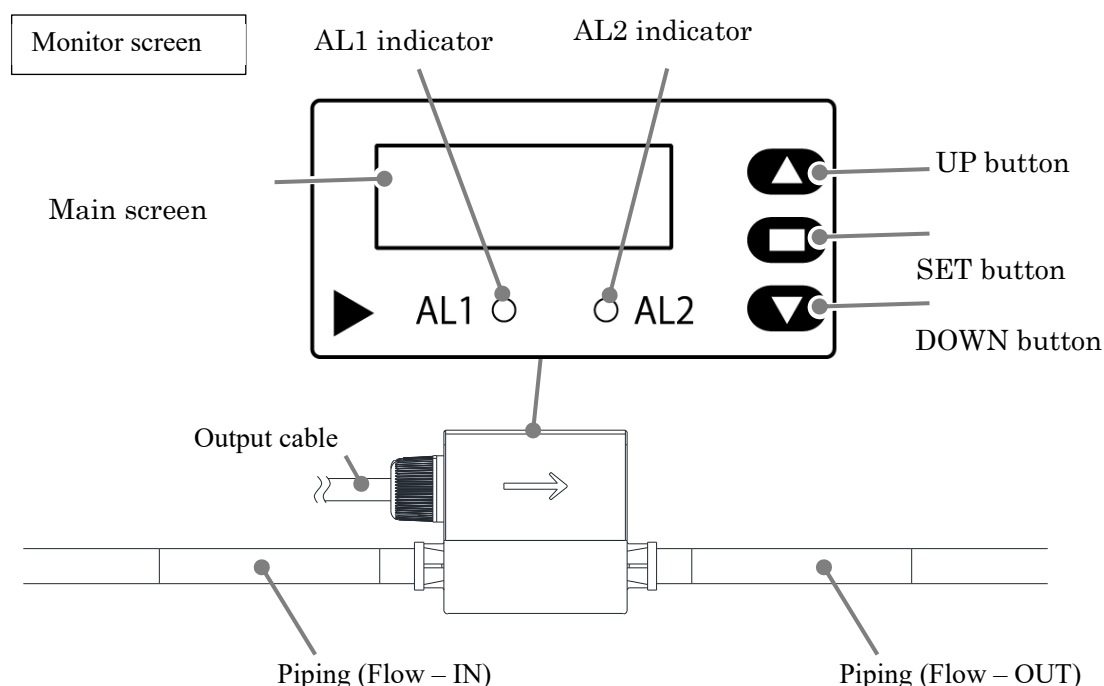
Also, a simple structure with little liquid accumulation realizes a maintenance free feature requiring no periodical maintenance and inspection.

Furthermore, fluid temperature correction by means of a built-in temperature sensor enables highly accurate flow rate measurement in a wide range of fluid temperature.



2.1 Component parts

2.1.1 FML-300 and operation screen



2.2 Specifications of the Product

Series	FML					
Model	301-D	302-D	303-D	304-D	305-D	306-D
Fluid	Pure water and chemicals					
Connection (inch)	I.D. 1/4” O.D. 3/8”	I.D. 1/4” O.D. 3/8”	I.D. 3/8” O.D. 1/2”	I.D. 5/8” O.D. 3/4”	I.D. 7/8” O.D. 1”	I.D. 1(21/64)” O.D.1(1/2)”
Max.operating pressure@25℃	1MPa			0.75MPa	0.65MPa	
Material in contact with liquid	New PFA					
Flow rate range	0.3～2.5L/min	0.4～4.0L/min	2.0～16L/min	5.0～50L/min	10～100L/min	25～250L/min
Full scale (F.S.)	2.5L/min	4.0L/min	16L/min	50L/min	100L/min	250L/min
Measuring max. flow rate	110%F.S.					
Output1※1	① Instantaneous flow rate output : 4-20mA output (0-100%F.S.), ② Instantaneous flow rate output : Pulse output (1kHz @F.S., Duty:50%)					
Output2※2	③ Temperature output : 4-20mA output (0℃-100℃)※3 ④ Integrated output : Pulse output (Unit: 10mL/P, width:5ms)			③ Temperature output : 4-20mA output (0℃-100℃)※3 ④ Integrated output : Pulse output (Unit: :100mL/P, width: 5ms)		
Flow rate accuracy※4	±2.0%F.S. (Fluid temperature: 15℃ to 60℃)				±3.0%F.S. (Fluid temp.: 15℃ to 60℃)	
Reproducibility	±0.5%F.S.					
Temperature accuracy	±2℃ ±0.15×ΔT℃ ΔT : ambient temp. – fluid temp.					
Fluid temperature	0 to 90℃ (no freezing, no boiling)					
Ambient temperature	0 to 50℃ (no freezing)					
Ambient humidity	95%RH max.					
Storage temperature	-10 to 70℃ (no freezing)					
Power supply voltage	12 to 24VDC ±10% Current consumption 80mA max.					
Display	OLED display (luminescent) : white, AL1,AL2 (red LED) , flow rate/temperature/integrated value indication※5					
Alarm output※6 AL1, AL2	Set by flow rate value/temperature value. NPN open collector output Independent 2 outputs (Condition: Measured value ≥ set value, measured value ≤ set value, set value ≤ measured value ≤ set value)					
Cover material	PPS (Color: black)					
Protection structure	Equivalent to IP65 (Drip-proof & dust-proof spec.)					
Cable	4-pair (8-core) shielded wire, length 3m, finished OD 5.0mm Conductor: Tin plated annealed stranded wire AWG26(30/0.08TA) Insulator: Lead-free heat resistant semirigid vinyl chloride mixture Insulator OD 0.79mm Sheath: Lead-free heat resistant vinyl chloride mixture Black (Matted)					
Applicable standard	RoHS2 10 Substance、CE					
Weight (cable included)	Approx. 202g	Approx. 202g	Approx. 202g	Approx. 217g	Approx. 242g	Approx. 365g

※1 The output of either ① or ② only is selectable. Select the output by operation on the display.

※2 The output of either ③ or ④ only is selectable. Select the output by operation on the display.

※3 The output is valid only when liquid is let flow.

※4 Accuracy at ambient temperature 25°C.

※5 Select instantaneous flow rate indication, temperature indication and integrated value indication by operation on the display.

※6 Set by operation on the display.

3. Connection Specifications

This chapter describes how to install the equipment.



WARNING

Prior to turning on the power, make sure that wiring has been laid correctly. Incorrect wiring is a cause of breakage, malfunction or fire.

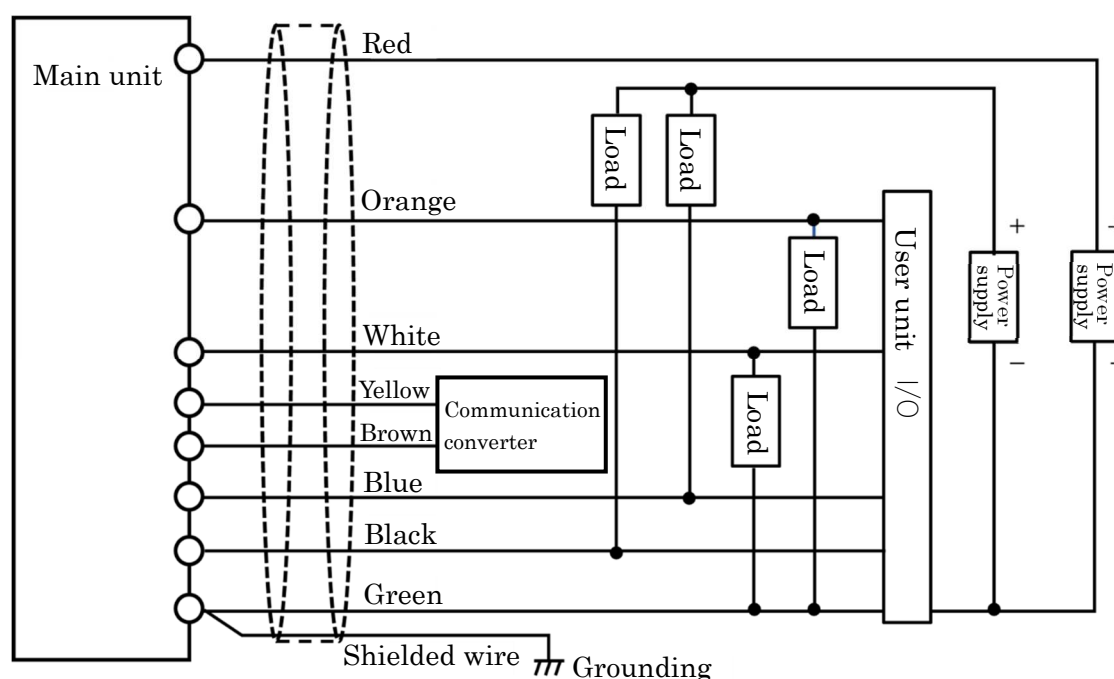
3.1 Connection example 1 <Factory setting>

OUT1 : Instantaneous flow rate output [FLOW 4-20mA]

OUT2 : Temperature output [TEMP.OUT] selected

Wire color	IN/OUT	Signal name	Description	Remarks
Red	IN	VIN	12V, 24V power supply	12VDC, 24VDC $\pm 10\%$ (Current consumption: 140mA max.)
Green		GND	0V power supply	
Orange	OUT	OUT1	Flow rate output	4-20mA output (0L/min.-F.S.L/min.) Allowable load resistance: 24VDC input 250 Ω – 500 Ω 12VDC input 250 Ω max.
Blue	OUT	AL1	Contact output	NPN open collector output Max. 30VDC/80mA
White	OUT	OUT2	Temperature output	4-20mA output (0 $^{\circ}$ C - 100 $^{\circ}$ C) Allowable load resistance: 24VDC input 250 Ω – 500 Ω 12VDC input 250 Ω max.
Black	OUT	AL2	Contact output	NPN open collector output Max. 30VDC/80mA
Yellow	—	TR(-)	Serial communication function(RS485)	Modbus RTU supported Transmission method: 2-wire, half duplex
Brown	—	TR(+)		
FG	—	Shield	Shielded wire	Connect to frame ground (FG).

■ Connection example 1 diagram



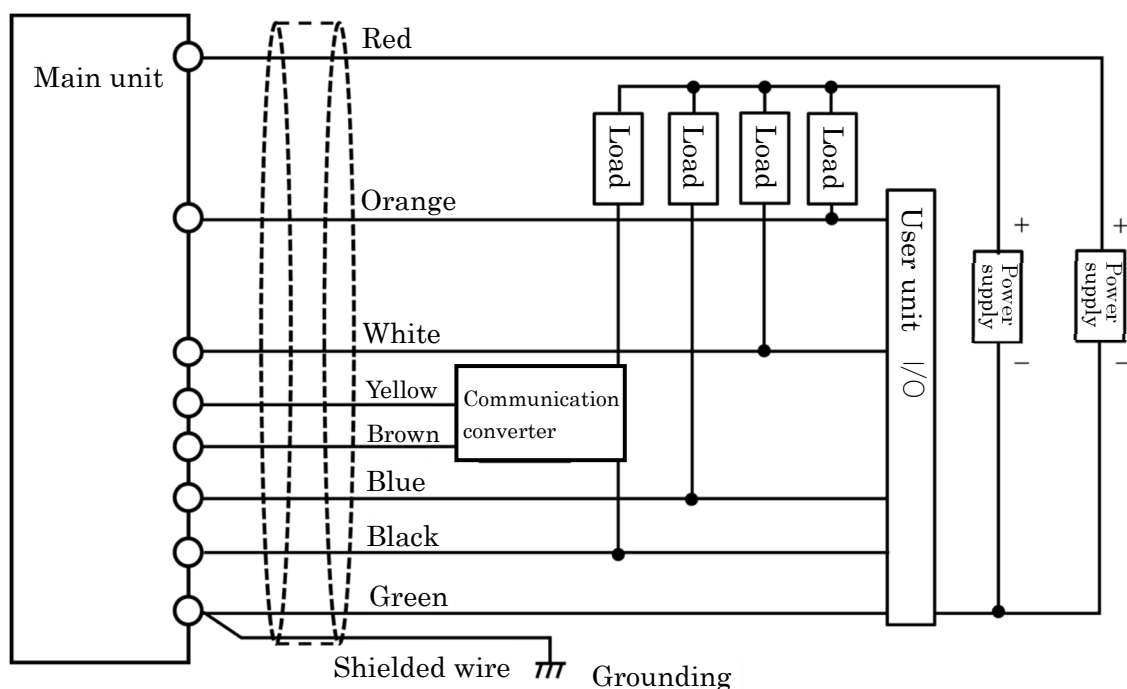
※The shielded wire has been connected to GND inside the product.

3.2 Connection example 2

OUT1 : Instantaneous flow rate output [FLOW PULSE], OUT2 : Integrated output [PULSE OUT] selected

Wire color	IN/OUT	Signal name	Description	Remarks
Red	IN	VIN	12V, 24V power supply	12VDC, 24VDC $\pm 10\%$ (Current consumption: 140mA max.)
Green		GND	0V power supply	
Orange	OUT	OUT1	Flow rate output	Pulse output (1kHz @F.S. Duty:50%) NPN open collector output Max. 30VDC/80mA
Blue	OUT	AL1	Contact output	NPN open collector output Max. 30VDC/80mA
White	OUT	OUT2	Integrated output (Pulse output)	Pulse unit 10mL/P, width 5ms (301-D, 302-D, 303-D) Pulse unit 100mL/P, width 5ms (304-D, 305-D, 306-D) NPN open collector output Max. 30VDC/80mA
Black	OUT	AL2	Contact output	NPN open collector output Max. 30VDC/80mA
Yellow	—	TR(-)	Serial communication function(RS485)	Modbus RTU supported Transmission method: 2-wire, half duplex
Brown	—	TR(+)		
FG	—	Shield	Shielded wire	Connect to frame ground (FG).

■ Connection example 2 diagram

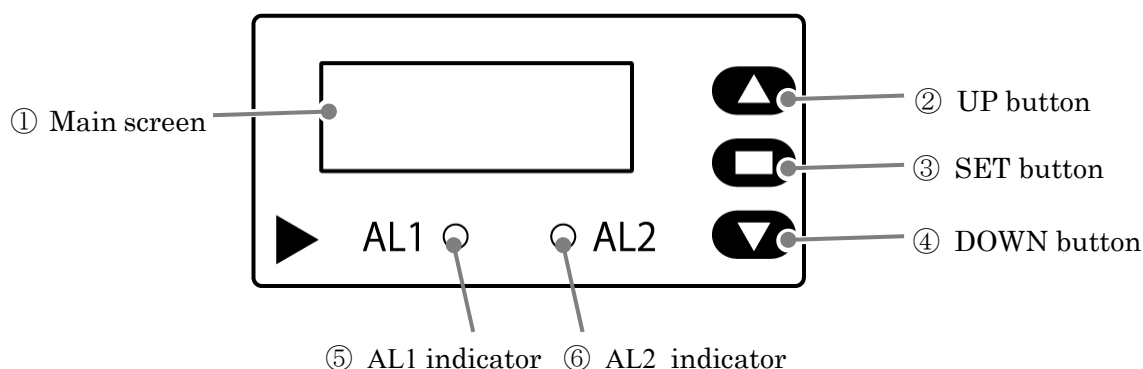


※The shielded wire has been connected to GND inside the product.

4. Operation and Setting of the Display

This chapter describes how to operate each button of the display, their functions and how to set them.

4.1 Main screen and operation buttons



No.	Name	Function
①	Main screen	Shows an instantaneous flow rate value, temperature value and integrated value.
②	UP button	Used to select a mode.
③	SET button	Used to select a mode and accept a set value. <div>Press and hold:</div> Mainly used to display the normal screen or FUNCTION screen, or set the ALM SET value 1/2 and hysteresis width. <div>Press once:</div> Mainly used to display the next screen or select a screen.
④	DOWN button	Used to select a mode.
⑤	AL1 indicator	Lights when the AL1 contact is on and goes off when the AL1 contact is off. (LED: red)
⑥	AL2 indicator	Lights when the AL2 contact is on and goes off when the AL2 contact is off. (LED: red)

4.2 Display operation and initial parameters

The factory setting of functions is as shown below. To change the setting, follow the display operation procedures described on respective pages.

No.	Setting item	Factory setting
1	Contents change Integrated value display method	Instantaneous flow rate indication, temperature indication
2	OUT1 output change	[Flow 4-20mA] 4-20mA output (0L/min.-F.S.L/min.)
3	OUT2 output change	[Temp.OUT] 4-20mA output (0°C-100°C)
4	AL1 setting input	[NONE] No alarm output setting
5	AL2 setting input	[NONE] No alarm output setting
6	Set value check	—

References:

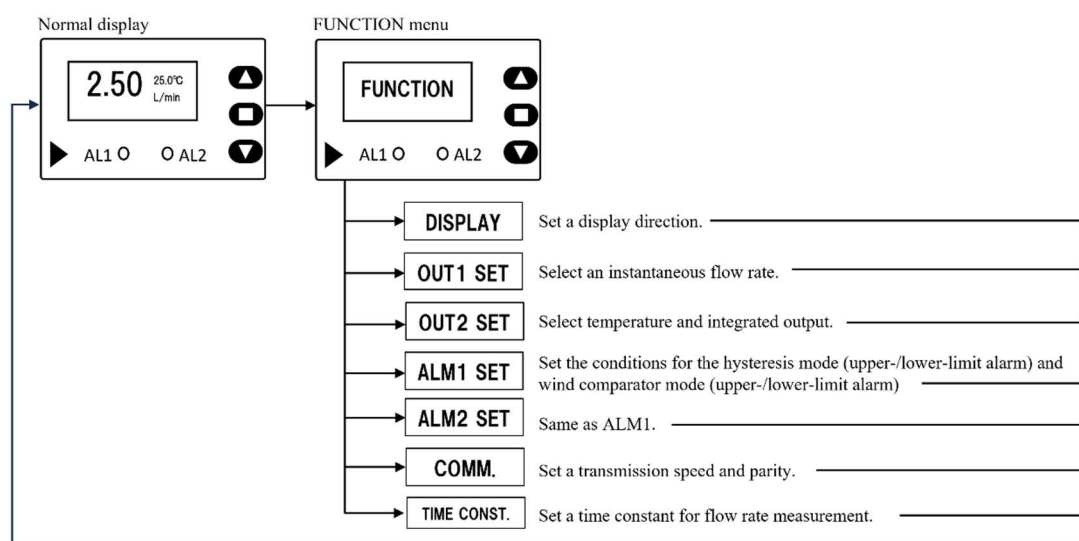
- 4.1 Main screen and operation buttons..... 11
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 - 4.3.4 Setting of OUT 2 18
 - 4.3.5 Setting of AL1 and AL2..... 19
 - 4.3.6 Setting of TIME CONST. 22
 - 4.4 Checking the set value..... 23
- * Communication setting (COMM.) is described in 6.2 Communication setting method.

4.3 Procedure to change the setting of display contents

The contents to show on the main screen and their directions can be changed and integrated values can be shown.

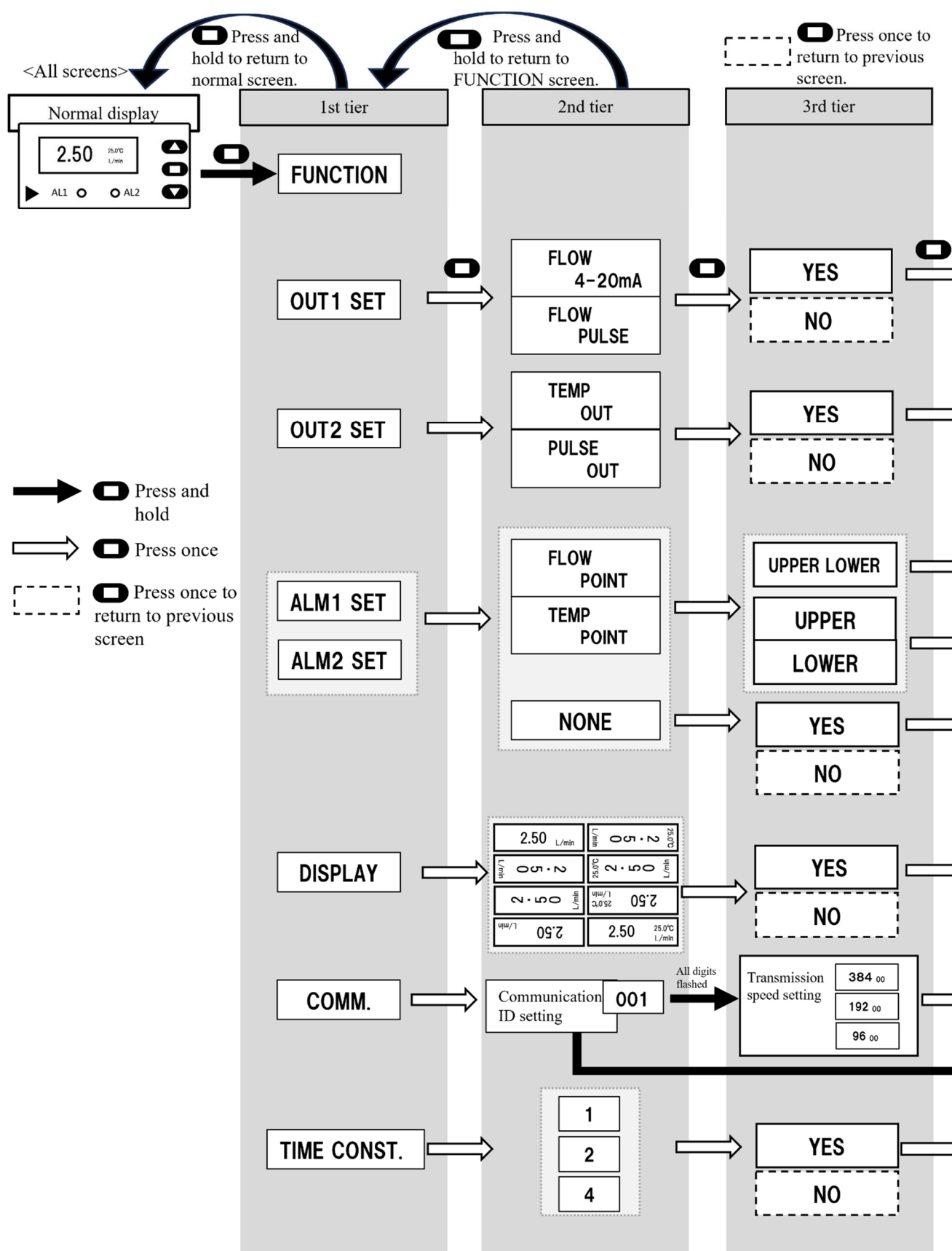
4.3.1 Basic process flow

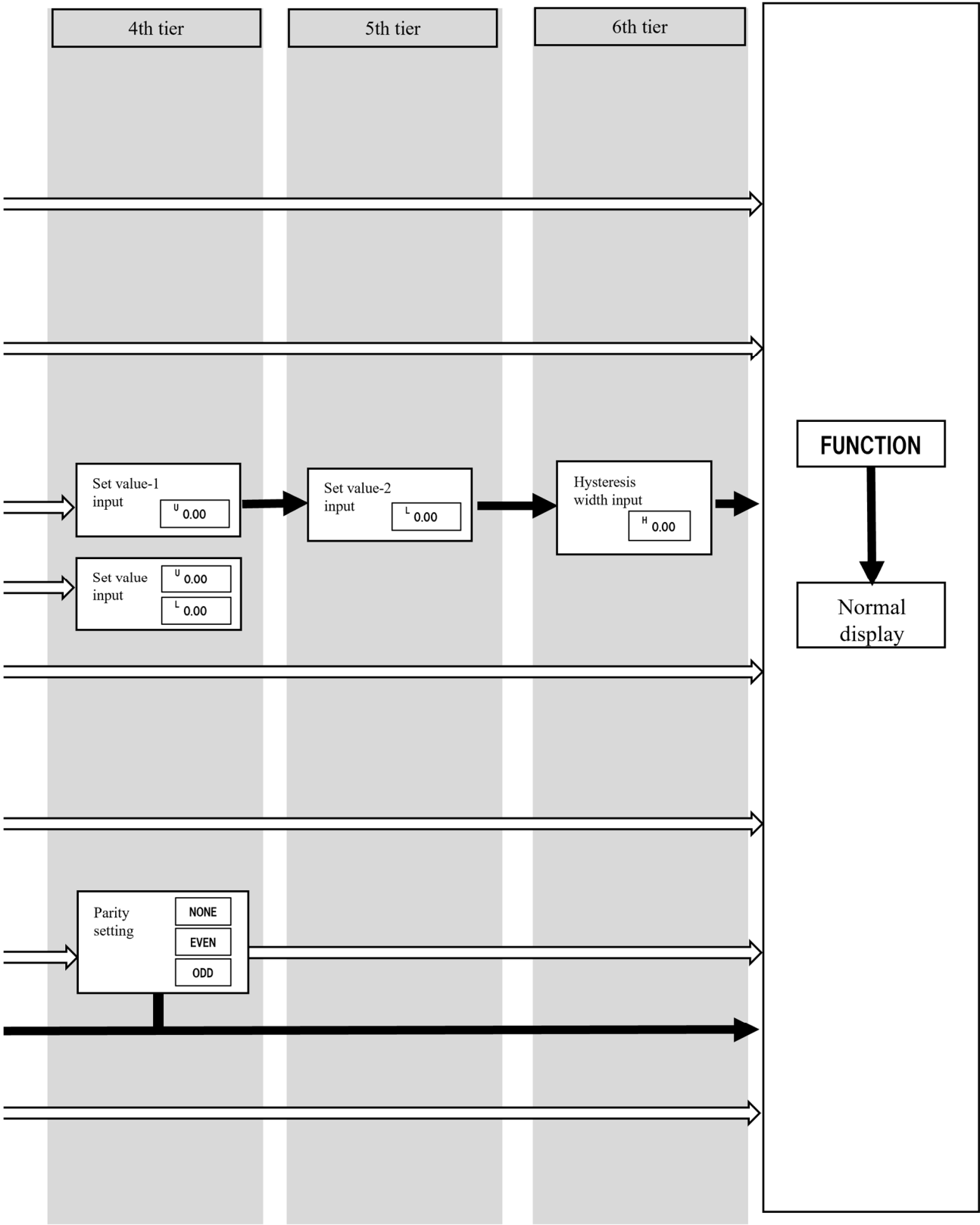
Make setting in the sequence of “Normal display” → “FUNCTION” → “Each FUNCTION menu (7 kinds)” → “FUNCTION” and back to “Normal display”.



■ Basic screen operation flow

The following describes a basic screen operation flow. Understand this flow to operate.





4.3.2 Setting of DISPLAY and totalized flow rate

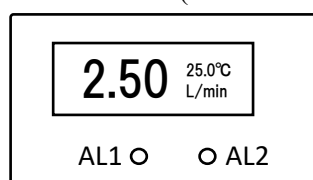
The contents to show on the main screen and their directions can be changed and integrated values can be shown.

■ DISPLAY operation flow chart

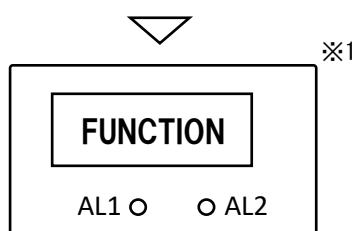
※1 Auto transition after no operation for about 3 seconds.

※2 Auto transition to normal display after no operation for about 10 seconds.

Normal screen (Instantaneous flow rate)

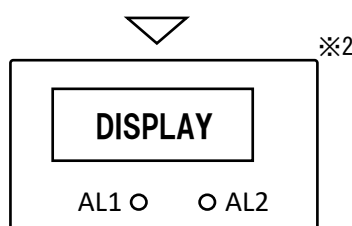


1. Press and hold the “SET” button.
“FUNCTION” is displayed.



2. While the display is flashing, press the “UP/DOWN” button to select “DISPLAY” and press the SET button once.
“DISPLAY” is displayed.

* Press and hold the “SET” button to return to the normal screen.

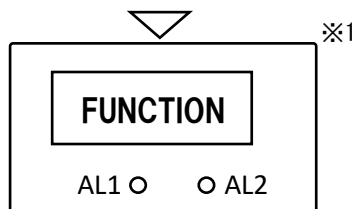
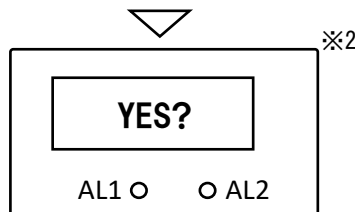


3. While the display is flashing, press the “UP/DOWN” button to select “Instantaneous flow rate value” display and press the “SET” button once.

* Select from among the following display patterns.

2.50 L/min	05.2 25.0°C	L/min 05.2
2.50 L/min	05.2 L/min	2.50 25.0°C
25.0°C 2.50 L/min		

4. “YES?” is displayed. To set, press the “SET” button once.
To change, press the “UP/DOWN” button to display “NO?” and select a display pattern again. Then, press the “SET” button once to select it.



5. Press and hold the “SET” button.
The normal screen is displayed.

Normal screen (Instantaneous flow rate)



■ Setting of totaled flow rate

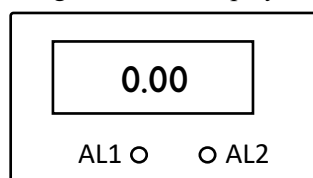
Normal screen (Instantaneous flow rate)



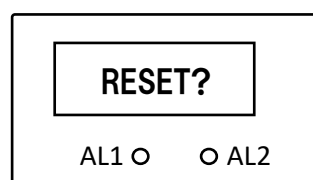
1. Press the "SET" button once.
An "integrated value" is displayed.



Integrated value display



2. Press and hold the "SET" button.
"RESET?" is displayed.



3. To reset, press the "SET" button once.

If not resetting, press the "UP/DOWN" button to display "NO?" and press the "SET" button once to return to the Integrated value screen.

* If NO is selected, the integrated value is not reset.

- The max. value to be integrated is "99999999". When the upper limit value has been reached, that value is held.
- The value is displayed in 4 digits. Upper and lower 4 digits are switched by pressing the "UP/DOWN" button.

4.3.3 Setting of OUT 1



Refer to “3. Connection Specifications” to lay wiring correctly.

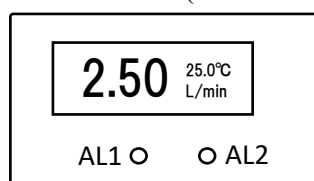
- The OUT 1 output can be selected between instantaneous flow rate (4 – 20 mA) and instantaneous flow rate (pulse).

■ OUT1 SET operation flow chart

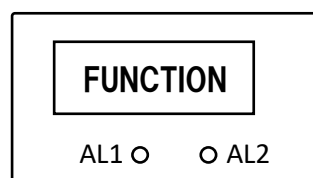
※1 Auto transition after no operation for about 3 seconds.

※2 Auto transition to normal display after no operation for about 10 seconds.

Normal screen (Instantaneous flow rate)



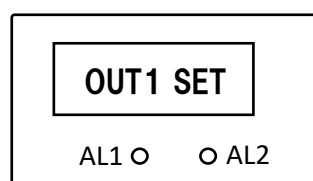
1. Press and hold the “SET” button.
“FUNCTION” is displayed.



※1

2. While the display is flashing, press the “UP/DOWN” button to select “OUT1 SET” and press the “SET” button once.
“OUT1 SET” is displayed.

* Press and hold the “SET” button to return to the normal screen.



※2

3. While the display is flashing, press the “UP/DOWN” button to select “FLOW 4-20mA” or “FLOW PULSE” and press the “SET” button once.

FLOW 4-20mA : Instantaneous flow rate output:

4 – 20 mA output (0 – 100% F.S.)

FLOW PULSE : Instantaneous flow rate output:

Pulse output (1kHz @F.S.,Duty:50%)



4. “YES?” is displayed. To set, press the “SET” button once.
To change an OUT1 output value, press the “UP/DOWN” button to display “NO?” and press the “SET” button once to return and select.



※1

5. Press and hold the “SET” button.
The “normal screen” is displayed.

Normal screen



4.3.4 Setting of OUT 2



Refer to “3. Connection Specifications” to lay wiring correctly.

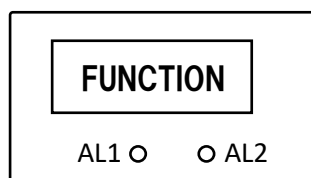
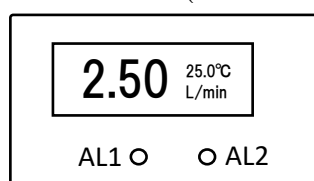
- The OUT 2 output can be selected between temperature (4-20mA) and integrated output (pulse output).

■ OUT2 SET operation flow chart

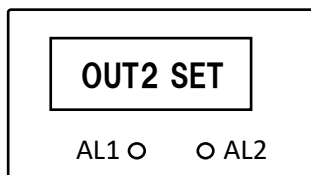
※1 Auto transition after no operation for about 3 seconds.

※2 Auto transition to normal display after no operation for about 10 seconds.

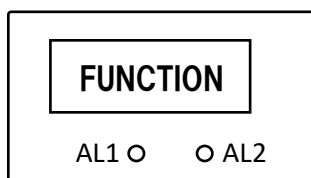
Normal screen (Instantaneous flow rate)



※1



※2



※1



Normal screen



1. Press and hold the “SET” button.
“FUNCTION” is displayed.

2. While the display is flashing, press the “UP/DOWN” button to select “OUT2 SET” and press the “SET” button once.
“OUT2 SET” is displayed.

* Press and hold the “SET” button to return to the normal screen.

3. While the display is flashing, press the “UP/DOWN” button to select “TEMP. OUT” or “PULSE OUT” and press the “SET” button once.

TEMP. OUT : Temperature output: 4-20mA output (0°C - 100°C)

PULSE OUT : Integrated output: Pulse output

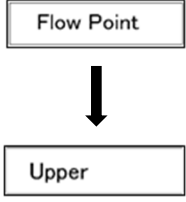
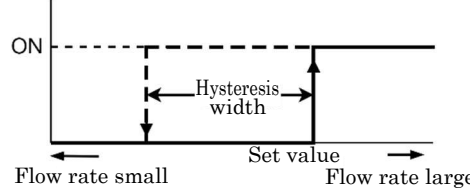
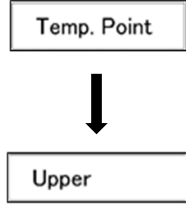
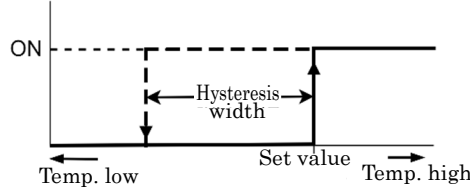
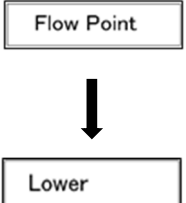
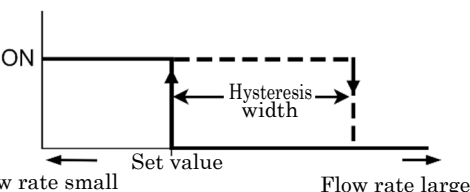
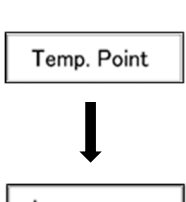
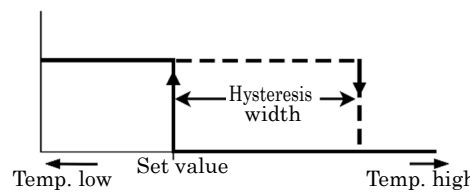
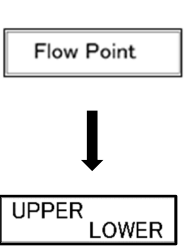
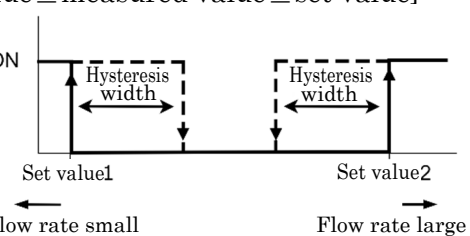
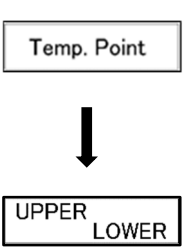
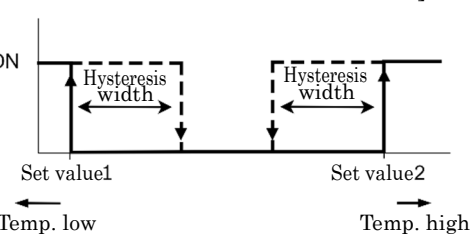
4. “YES?” is displayed. To set, press the “SET” button once.
To change an OUT1 output value, press the “UP/DOWN” button to display “NO?” and press the “SET” button once to return and select.

5. Press and hold the “SET” button.
The “normal screen” is displayed.

4.3.5 Setting of AL1 and AL2

The following conditions can be set to AL1 and AL2 respectively.

■ AL1 and AL2 setting items

Item selected		Main screen selected	Output
Hysteresis mode (Upper limit alarm)	Set by flow rate value		[Instantaneous flow rate \geq set value] 
	Set by temperature value		[Measured temperature \geq set value] 
Hysteresis mode (Lower limit alarm)	Set by flow rate value		[Instantaneous flow rate \leq set value] 
	Set by temperature value		[Measured temperature \leq set value] 
Wind comparator mode (Upper/lower limit alarm)	Set by flow rate value		[Set value \leq measured value \leq set value] 
	Set by temperature value		[Set value \leq measured value \leq set value] 

※A value of flow rate value: 0 – 110% and temperature value: 0 – 100°C can be set.

※For a detailed explanation of the settable range, refer to “Alarm Set Range” on page 29.

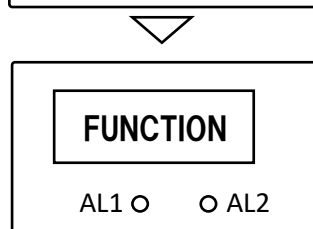
■ AL1 and AL2 setting method

- ※1 Auto transition after no operation for about 3 seconds.
- ※2 Auto transition to normal display after no operation for about 10 seconds.
- ※3 Auto transition to normal display after no operation for about 10 seconds. Return to FUNCTION by pressing and holding "SET".
- ※4 All digits flashing
- ※5 When all digits are flashing, pressing and holding "SET" reflects a set value. If "SET" is pressed and held when a digit is being selected, a set value is not reflected.

Normal screen (Instantaneous flow rate)



1. Press and hold the "SET" button.
"FUNCTION" is displayed.



※1

2. While the display is flashing, press the "UP/DOWN" button to select "ALM1 SET" and press the "SET" button once.
"ALM1 SET" is displayed.

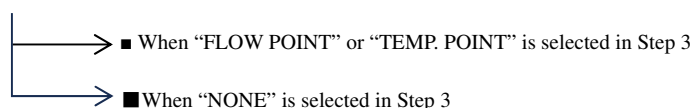
"ALM2 SET" is also selectable.

* Press and hold the "SET" button to return to the normal screen.

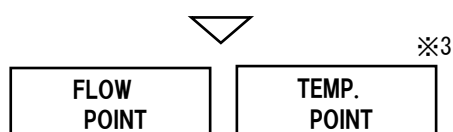


※2

3. While the display is flashing, press the "UP/DOWN" button to select "FLOW POINT", "TEMP. POINT" or "NONE" and press the "SET" button once.
The following describes the screen where "FLOW POINT" has been selected.

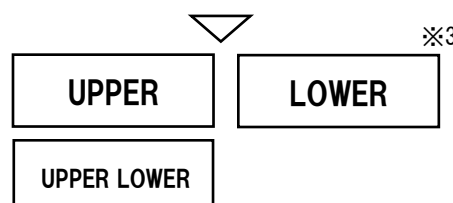


■ When "FLOW POINT" or "TEMP. POINT" is selected in Step 3



※3

1. While the display is flashing, press the "UP/DOWN" button to select "LOWER", "UPPER" or "UPPER LOWER" and press the "SET" button once.

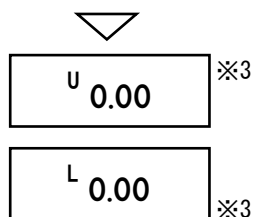


※3

2. While the display is flashing, press the "UP/DOWN" button.

A "set value input window" for "LOWER", "UPPER" or "UPPER LOWER" is displayed.

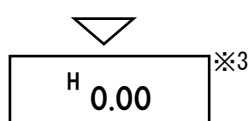
3. Input UPPER/LOWER and hysteresis width set values.



<Inputting the UPPER/LOWER set value>

- 1) Select an input digit.
(Flashing starts from the left digit and shifts to the right when a numerical value is set.)
- 2) When the selected digit is flashing, use the “UP/DOWN” button to select a numerical value.
- 3) Press the “SET” button once to shift to the next digit.
- 4) When all digits are flashing, press and hold the “SET” button to reflect the numerical value. ※4

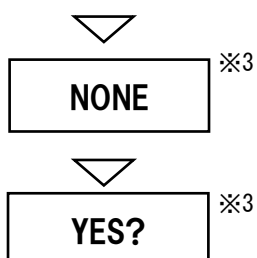
* To return to digit selection, press the “SET” button once.



<Inputting the hysteresis width set value>

- ※The setting steps 1) to 3) are the same as in Inputting the UPPER/LOWER set value.
- 4) When all digits are flashing, press and hold the “SET” button to reflect the numerical value. ※5

■ When “NONE” is selected in Step 3



1. While the display is flashing, press the “SET” button once. “YES?” is displayed.
2. While the display is flashing, press the “SET” button once. “FUNCTION” is displayed.

4.3.6 Setting of TIME CONST.

A time constant for flow rate measurement can be selected from among 1, 2 and 4. It has been set to “4” upon shipment from the factory.

Lower time constant increases a response rate, but decreases output stability.

■ Setting TIME CONST.

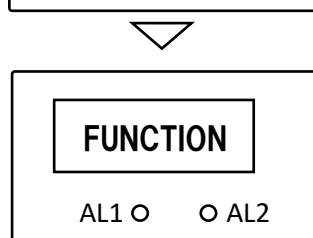
※1 Auto transition after no operation for about 3 seconds.

※2 Auto transition to normal display after no operation for about 10 seconds.

Normal screen (Instantaneous flow rate)



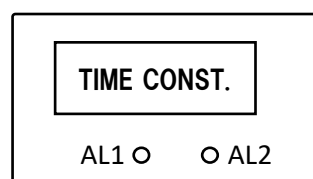
1. Press and hold the “SET” button.
“FUNCTION” is displayed.



※1

2. While the display is flashing, press the “UP/DOWN” button to select “TIME CONST.” and press the “SET” button once.
“TIME CONST.” is displayed.

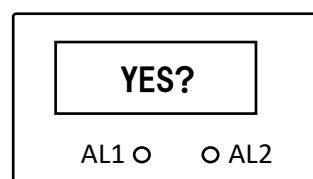
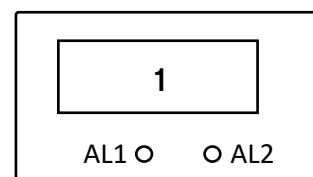
* Press and hold the “SET” button to return to the normal screen.



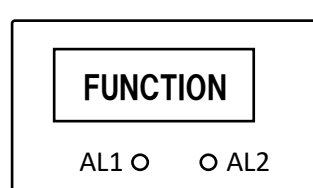
※2

3. While the display is flashing, press the “UP/DOWN” button to select “1”, “2” or “4” and press the “SET” button once.

The following describes the screen where “1” has been selected.



4. “YES?” is displayed. To set, press the “SET” button once.
To change an OUT1 output value, press the “UP/DOWN” button to display “NO?” and press the “SET” button once to return.



※1

5. Press and hold the “SET” button.
The “normal screen” is displayed.

Normal screen

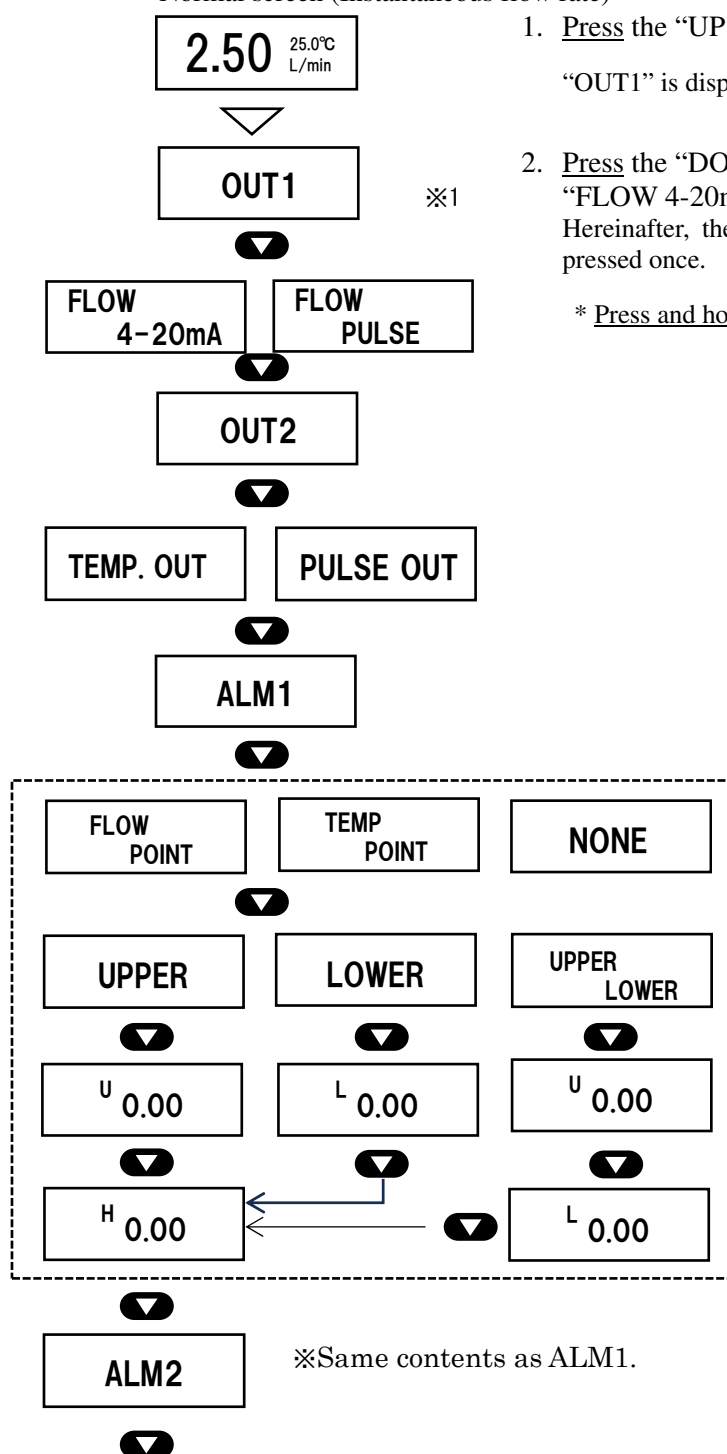


4.4 Checking the set value

- The set parameter values can be checked by the following procedure:

■ Function flowchart

Normal screen (Instantaneous flow rate)



1. Press the “UP and DOWN” buttons at the same time.

“OUT1” is displayed.

2. Press the “DOWN” button once.

“FLOW 4-20mA” or “FLOW PULSE” is displayed.

Hereinafter, the display is changed every time the “DOWN” button is pressed once.

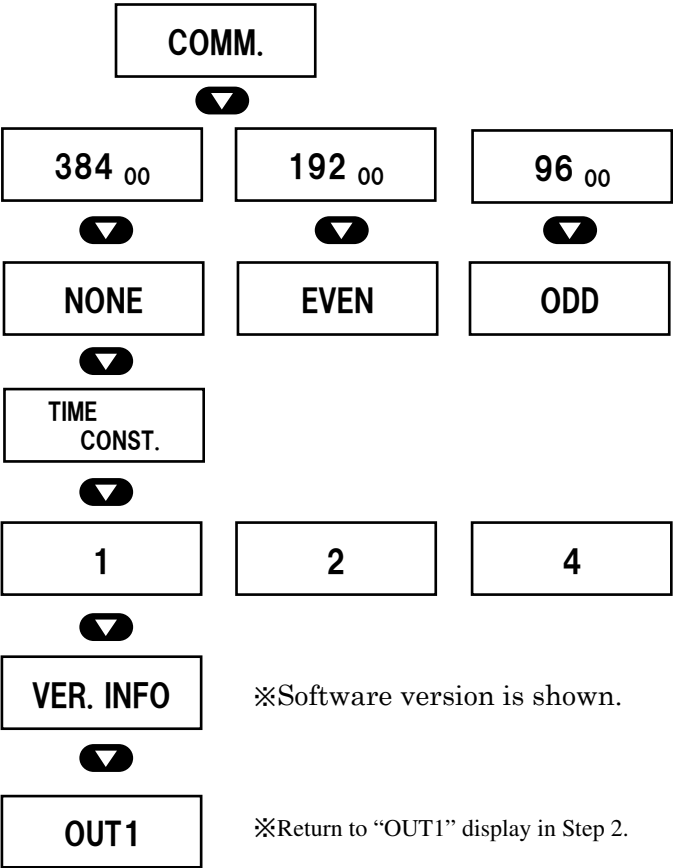
* Press and hold the “DOWN” button to return to the normal screen.

* Checking the ALM1 set value

※Same contents as ALM1.

To be continued to next page

Continued from previous page



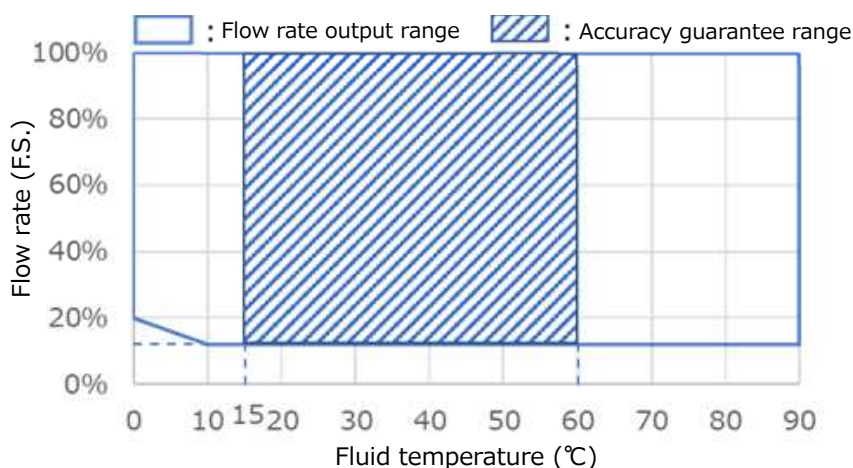
5. Range of Use

This chapter describes the range of use of the equipment.

5.1 The relation between the flow rate output range and the accuracy guarantee range

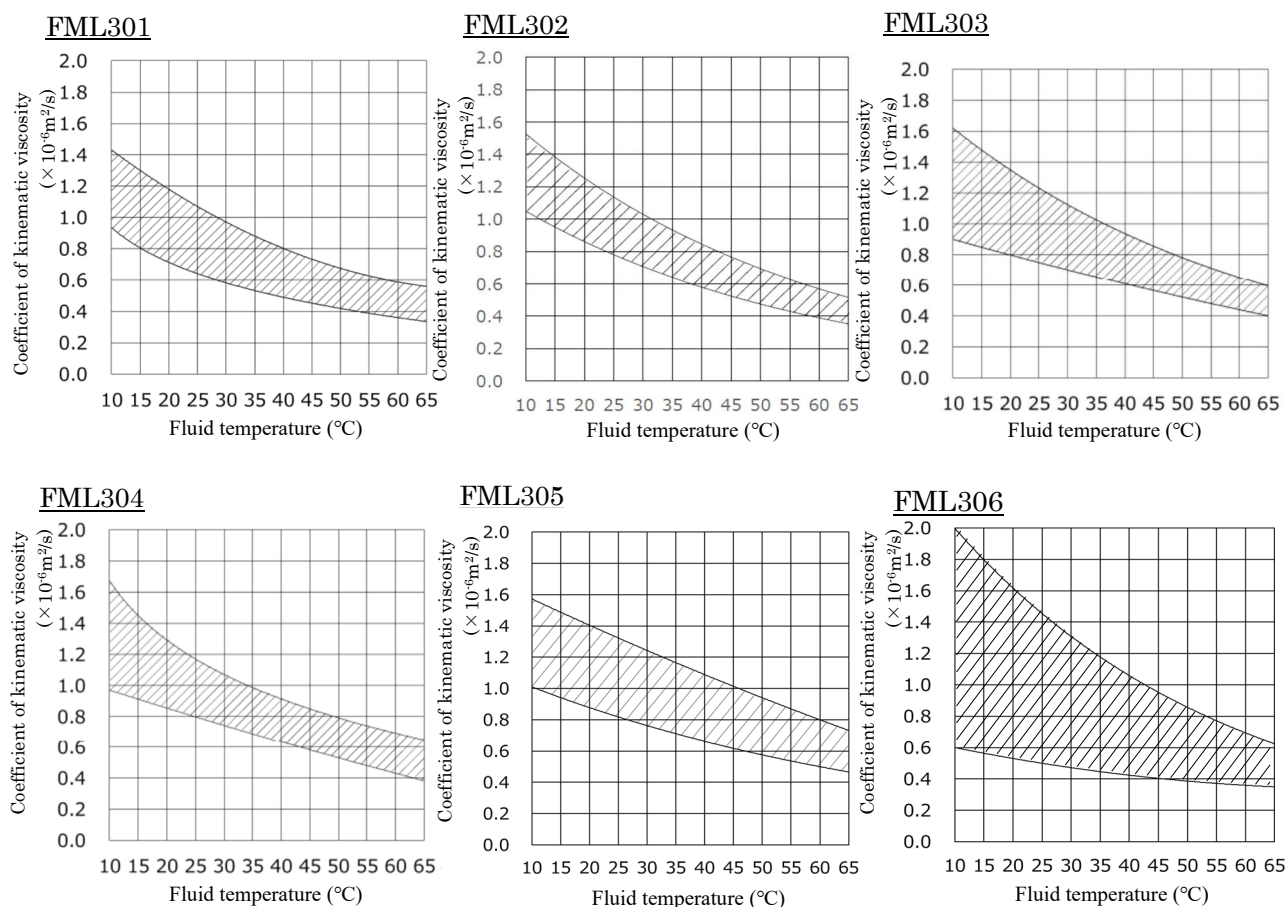
Check to see if it matches the conditions of use again.

FML30X Series Flow Rate Output Range and Accuracy Guarantee Range



5.2 Accuracy guaranteed kinematic viscosity coefficient

Check to see if they match the conditions of use again.



6. Communication Setting

This chapter describes communication setting.

This product supports Modbus RTU communication. By setting an ID to respective individual units in coordination with a master device, the vortex flow meter may be operated as a slave device. Follow the standard to use the product.

6.1 RS-485 basic specifications

Item	Description	Remarks
Synchronization method	Start-stop	—
Transmission speed	38400 / 19200 / 9600bps	Set on main screen
Start-stop bit	1 bit	—
Data length	8 bits	—
Parity	NONE / ODD / EVEN	Set on main screen
Transmission method	2-wire, half duplex	
Isolation	Between communication – control: Non-isolated	
Communication ID	1 – 247	Set on main screen

6.2 Communication setting method

■ Communication setting operation flow chart

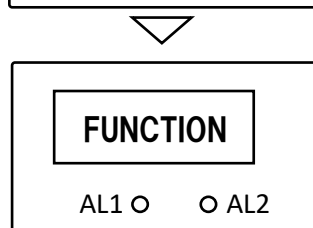
※1 Auto transition after no operation for about 3 seconds.

※2 Auto transition to normal display after no operation for about 10 seconds.

Normal screen (Instantaneous flow rate)



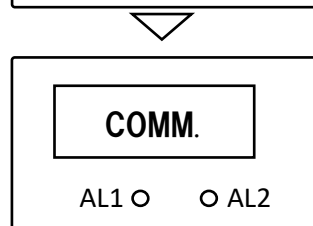
1. Press and hold the “SET” button.
“FUNCTION” is displayed.



※1

2. While the display is flashing, press the “UP/DOWN” button to select “COMM.” and press the “SET” button once.
“COMM.” is displayed.

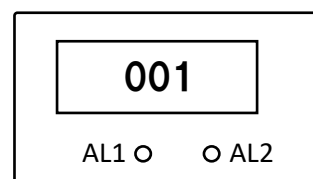
* Press and hold the “SET” button to return to the normal screen.



※2

3. While the display is flashing, press the “SET” button.
“001” is displayed with the 1st digit flashing.

Com. ID set



4. Set a communication ID.

<Inputting the communication ID set value>

- 1) Select an input digit.

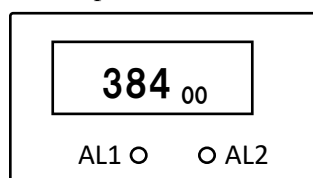
(Flashing starts from the left digit and shifts to the right when a numerical value is set.)

- 2) When the selected digit flashes, use the “UP/DOWN” button to select a numerical value.
- 3) Press the “SET” button once to shift to the next digit.
- 4) When all digits flash, press and hold the “SET” button to reflect the numerical value.

“Transmission speed setting” is displayed.

* To return to digit selection, press the “SET” button once.

Trans.speed set

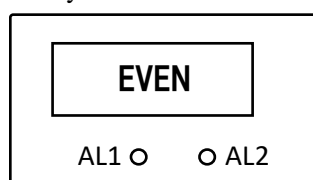


5. Set the transmission speed.

While the display is flashing, press the “UP/DOWN” button to select “384 00”, “192 00” or “96 00” and press the “SET” button once.

“EVEN”, “NONE” or “ODD” is displayed for parity setting.

Parity set



6. Set parity.

While the display is flashing, press the “UP/DOWN” button to select “EVEN”, “NONE” or “ODD” and press the “SET” button once.

* Press the “SET” button once to return to FUNCTION.

6.3 Data/address list

Data type	Address	Description	Range	
Input Register	30001	Full scale flow rate (Mantissa) ※1	FML301-D : 250 FML302-D : 400 FML303-D : 160 FML304-D : 500 FML305-D : 100 FML306-D : 250	
	30002	Flow rate decimal place (Number of decimal places) ※1	FML301-D : 2 FML302-D : 2 FML303-D : 1 FML304-D : 1 FML305-D : 0 FML306-D : 0	
	30003	Instantaneous flow rate (Mantissa) ※1	FML301-D : 0 ~ 275 FML302-D : 0 ~ 440 FML303-D : 0 ~ 176 FML304-D : 0 ~ 550 FML305-D : 0 ~ 110 FML306-D : 0 ~ 275	
	30004	Fluid temperature (Mantissa)※2	-100 ~ 1100 , -1000 ※3	
	30005	Alarm 1 occurrence	0 : Not occurred 1 : Occurred	
	30006	Alarm 2 occurrence	0 : Not occurred 1 : Occurred	
Holding Register	40001	Integrated flow rate (Mantissa lower 4 digits) ※1	0 – 9999 ※4	
	40002	Integrated flow rate (Mantissa upper 4 digits)	0 – 9999 ※4	
	40003	Output 1 select	0 : Instantaneous flow rate pulse output 1 : Instantaneous flow rate current output	
	40004	Output 2 select	0 : Integrated pulse output 1 : Fluid temperature current output	
	40005	Display indicating direction select	0 : No rotation (Fluid temp. indication) 1 : No rotation (No fluid temp. indication) 2 : 180° rotation (Fluid temp. indication) 3 : 180° rotation (No fluid temp. indication) 4 : CCW 90° rotation (Fluid temp. indication) 5 : CCW 90° rotation (No fluid temp. indication) 6 : CW 90° rotation (Fluid temp. indication) 7 : CW 90° rotation (No fluid temp. indication)	
	40006	Alarm 1 ※5	Monitor object	0 : None 1 : Instantaneous flow rate 2 : Fluid temperature
	40007		Monitor mode	0 : Lower limit 1 : Upper limit 2 : Upper/lower limits
	40008		Upper threshold (Mantissa) ※1 ※2	
	40009		Lower threshold (Mantissa)※1 ※2	
	40010		Hysteresis width (Mantissa) ※1 ※2	
	40011	Alarm 2 ※5	Monitor object	0 : None 1 : Instantaneous flow rate 2 : Fluid temperature
	40012		Monitor mode	0 : Lower limit 1 : Upper limit 2 : Upper/lower limits
	40013		Upper threshold (Mantissa) ※1 ※2	
	40014		Lower threshold (Mantissa)※1 ※2	
	40015		Hysteresis width (Mantissa) ※1 ※2	

※1 The flow rate decimal place is applied to all expression of flow rates.

※2 The fluid temperature is expressed in units of 0.1°C (1st decimal place).

※3 The output of fluid temperature is valid only when fluid flows. “-1000” is a value at fluid stop (temperature output invalid).

※4 For resetting the integrated flow rate value, write “0”.

※5 For each of Alarm 1 and Alarm 2, setting (writing) must start from the address lower place to upper place. The settable range is restricted by the lower address value. Also, as a result of setting, the upper address value may be rewritten automatically due to restriction.

For details of restriction of the setting range, refer to “Alarm setting range” below.

6.4 Alarm setting range

The following table shows alarm setting ranges.

Parameter setting (writing) order				
Monitor object	Monitor mode	Upper threshold (Mantissa)	Lower threshold (Mantissa)	Hysteresis width (Mantissa)
Instantaneous flow rate / fluid temperature	Lower limit		$0 \leq \text{Set value} < X$	$0 \leq \text{Set value} < X - \text{Lower threshold}$
	Upper limit	$0 < \text{Set value} \leq X$		$0 \leq \text{Set value} < \text{Upper threshold}$
	Upper/lower limits	$1 < \text{Set value} \leq X$	$0 \leq \text{Set value} < \text{Upper threshold} - 1$	$0 \leq \text{Set value} < \frac{\text{Upper threshold} - \text{Lower threshold}}{2}$ Cut off after decimal point

Set value of X

- "Instantaneous flow rate"

FML-301:275、FML-302:440、FML-303:176、FML-304:550、FML-305:1100、FML-306:275

- "Fluid temperature"

1000

7. Quick Guide

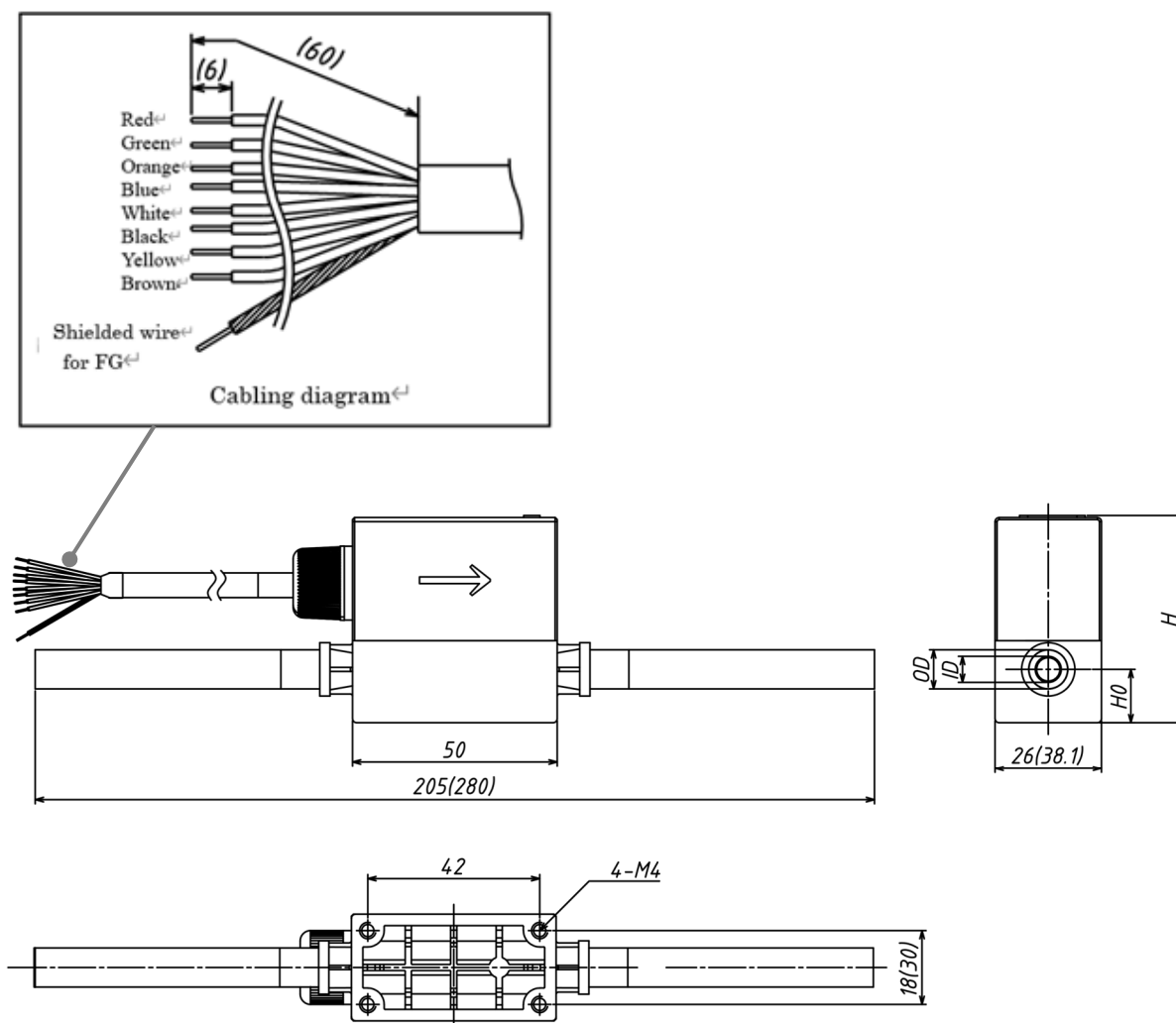
The following in the table are various setting methods and confirmation for your reference.

No.	Various setting methods	Operation methods and reference page											
1	Changing the display contents Displaying the totalized flow rate	Refer to: 4.3.2→ Setting of DISPLAY and totalized flow r (Page 15)											
2	Changing OUT1 output	Refer to: 4.3.3→ Setting of OUT 1 (Page 17)											
3	Changing OUT2 output	Refer to: 4.3.4 → Setting of OUT 2 (Page 18)											
4	Setting and inputting AL1	Refer to: 4.3.5 → Setting of AL1 and AL2 (Page 19)											
5	Setting and inputting AL2	Refer to: 4.3.5 → Setting of AL1 and AL2 (Page 19)											
6	Checking the set value	Refer to: 4.4 → Checking the set value (Page 23)											
7	Cable specifications	8-core (4-pair) shielded wire with 5.0mm finish OD regardless of whether the Display is included. Conductor: Tin-plated annealed stranded copper, AWG26 (30/0.08 TA) Insulator: Lead-free heat-resistant semi-rigid vinyl chloride mixture, OD: 0.79mm Sheath: Lead-free heat-resistant vinyl chloride mixture, matte black											
8	Temperature output signal specification	Temperature output without the Display is voltage output of 1 to 5V DC (0 to 100°C) at load resistance of 250 kΩ or more. Temperature output with the Display is current output of 4 to 20mA (0 to 100°C).											
9	Max. connectable units for communication	Up to 247 units are connectable.											
10	Allowable pressure resistance with piping	When the fluid temperature is 25°C: <table><tr><td>FML-301</td><td rowspan="3">1MPa(G)</td></tr><tr><td>FML-302</td></tr><tr><td>FML-303</td></tr><tr><td>FML-304</td><td>0.75MPa(G)</td></tr><tr><td>FML-305</td><td>0.65MPa(G)</td></tr><tr><td>FML-306</td><td>T.B.D.</td></tr></table>		FML-301	1MPa(G)	FML-302	FML-303	FML-304	0.75MPa(G)	FML-305	0.65MPa(G)	FML-306	T.B.D.
FML-301	1MPa(G)												
FML-302													
FML-303													
FML-304	0.75MPa(G)												
FML-305	0.65MPa(G)												
FML-306	T.B.D.												
11	Supply power	The supply power is 12/24V DC ±10%. A red wire is connected to the “positive (+)” side of the supply power, a green one to the “negative (-)” side (Ground), and a transparent one (shielded) to Ground inside the product, respectively.											
12	Current output signal specification	4 to 20mA current output (0L/min.-F.S. L/min.) Allowable load resistance: 250 to 500Ω at 24V DC input and 250Ω or less at 12V DC input											
13	Pulse output signal specification	Pulse output is 1,000Hz (F.S. L/min.) and duty is 50%. All outputs other than current output are NPN open collector output, 30V DC and 80mA at maximum.											

8. Appendixes

8.1 External View

■ FML301-D~FML306-D



※Inside () dimension: FML-306-D

Model	Connection tube size	Dimensions(mm)			
		O.D.	I.D.	H	H0
FML301-D	3/8 inch	9.52	6.35	50.5	13.0
FML302-D	3/8 inch	9.52	6.35	50.5	13.0
FML303-D	1/2 inch	12.70	9.52	50.5	13.0
FML304-D	3/4 inch	19.05	15.87	52.5	12.0
FML305-D	1 inch	25.40	22.20	61.2	15.7
FML306-D	1(1/2) inch	38.10	33.70	75.5	22.5

8.2 Applicable fluids

All materials in contact with liquid use “NewPFA”. “NewPFA” is the top quality grade of “PFA” (PerFluoroAlkoxy) having outstanding chemical resistance. The following lists typical chemicals which have cleared a chemical resistance test.

Abietic Acid	アビエチン酸	Dibutyl Phthalate	フタル酸ジブチル	Nitrogen Dioxide	二酸化窒素
Acetic Acid	酢酸	Dibutyl Sebacate	セバシン酸ジブチル	2-Nitroisobutanol	2-ニトロ-2-メチルプロパノール
Acetic Anhydride	無水酢酸	Diethyl Carbonate	炭酸ジエチル	n-Octadecanol	n-オクタデカノール
Acetone	アセトン	Dimethyl Ether	ジメチルエーテル	Ozone	オゾン
Acetophenone	アセトフェノン	Dimethylformamide	ジメチルホルムアミド	Tetrachloroethylene	テトラクロロエチレン
Acrylic Anhydride	無水アクリル酸	Ethyl Acetate	酢酸エチル	Phenol	フェノール
Allyl Acetate	酢酸アリル	Ethanol	エタノール	Phosphoric Acid	リン酸
Allyl Methacrylate	メタクリル酸アリル	Ethyl Ether	エチルエーテル	Phosphorus Chloride	塩化リン
Aluminium Chloride	塩化アルミニウム	Ethylene Glycol	エチレングリコール	Phthalic Acid	フタル酸
Ammonia	液体アンモニア	1-Fluoromaphthalene	1-フルオロナフタレン	Pinene	ピネン
Ammonium Chloride	塩化アンモニウム	Formaldehyde	ホルムアルデヒド	Piperidine	ピペリジン
Aniline	アニリン	Formic Acid	酢酸	Potassium Acetate	酢酸カリウム
Benzonitrile	ベンズニトリル	Gasoline	ガソリン	Potassium Hydroxide	水酸化カリウム
Benzoyl Chloride	塩化ベンズイル	Hexachloroethane	ヘキサクロロエタン	Potassium Permanganate	過マンガン酸カリウム
Benzyl Alcohol	ベンジルアルコール	Hexane	ヘキサン	Vindin	ビンジン
Boric Acid	ホウ酸	Hydrazine	ヒドラジン	Sodium Hydroxide	水酸化ナトリウム
Bromine	臭素	Hydrochloric Acid	塩酸	Sodium Hypochlorite	次亜塩素酸ナトリウム
n-Butylamine	n-ブチルアミン	Hydrogen Fluoride	フッ酸	Sodium Carbonate Hydrogen	過酸化ナトリウム
Butyl Acetate	酢酸ブチル	Hydrogen Peroxide	過酸化水素	Sulfuric Acid	硫酸
Calcium Chloride	塩化カルシウム	Methyl Ethyl Ketone	メチルエチルケトン	Tetrabromoethane	テトラブロモエタン
Carbon Dioxide	二酸化炭素	Methacrylic Acid	メタクリル酸	Tetrachloroethylene	テトラクロロエチレン
Cetane	セタン	Methanol	メタノール	Trichloroacetic Acid	トリクロロ酢酸
Chlorine	塩素	Na phthalene	ナフタレン	Tricresyl Phosphate	リン酸トリクレシル
Chloroform	クロホルム	Na phthol	ナフトール	Trichloroethylene	トリクロロエチレン
Chlorosulfuric Acid	クロスルホン酸	Nitric Acid	硝酸	Triethanolamine	トリエタノールアミン
Chromic Acid	クロム酸	Nitrobenzene	ニトロベンゼン	Vinyl Methacrylate	メタクリル酸ビニル
Cyclohexane	シクロヘキサン	2-Nitrobutanol	2-ニトロブタノール	Xylene	キシレン
Cyclohexanone	シクロヘキサノン	Nitromethane	ニトロメタン	Zinc Chloride	塩化亜鉛

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