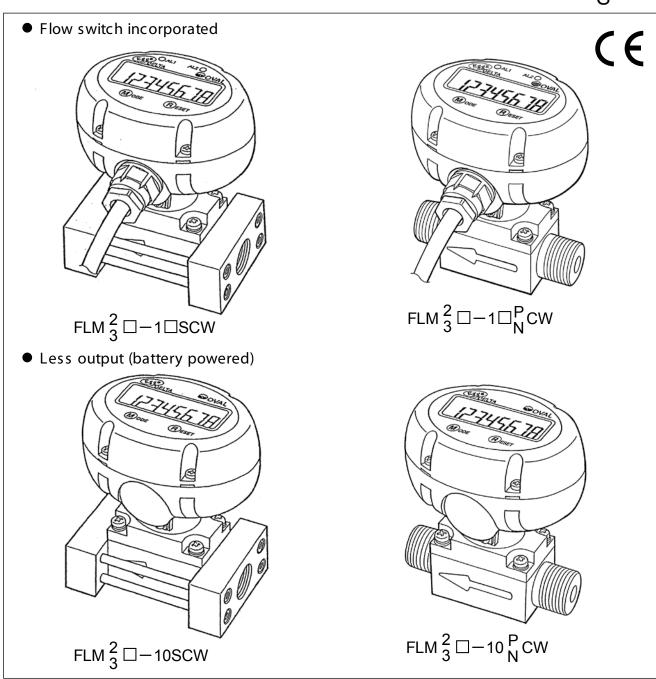
SPARLING/OVAL

OPERATION MANUAL

Vortex Flow Monitor

Eggs DELTA MODEL: FLM3 = -1 NCW



Every Sparling/Oval vortex flowmeter Eggs Delta is fabricated and shipped from our factory under stringent quality control. In order to maintain its design performance throughout its life, this manual offers the operator the necessary installation, operation and maintenance information. Be well familiar with these instructions before you place the meter in service and keep this manual at the field location for ready reference.

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CONVENTIONS

Shown in this manual are the signal words NOTE, CAUTION and WARNING, as described in the examples below:

NOTE: Notes are separated from the general text to bring the user's attention to important information.

CAUTION: Caution statements signal the user about hazards or unsafe practices which could result in minor personal injury or product or property damage.

MARNING: Warning statements signal the user about hazards or unsafe practices which could result in severe personal injury or death.

1. BEFORE YOU BEGIN

Every Eggs DELTA is thoroughly inspected and tested before it leaves the factory.

When received, it should be thoroughly inspected for indication of rough handling during transit.

Be sure to adhere to the following instruction:



!\ CAUTIONS

- Eggs DELTA is not compatible with flammable, corrosive, or toxic fluids.
- 2. Eggs DELTA is made of synthetic resin; avoid exposure to the sun.
- 3. Eggs DELTA is a non-explosionproof product and is not serviceable in explosionproof areas (hazardous locations).



√!\WARNING: Negligence of the above warnings can result in damage to the product.

Necessary handling precautions are described in this section; read the instructions carefully.

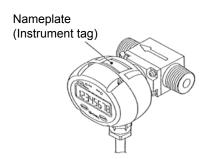
As for other information, find the respective sections.

For any inquiries, contact your nearest Sparling/OVAL designated sales office.

NOTE: When you make inquiries, include the product name, model number, stock number, ratings and other pertinent information.

1.1 Confirming the Nameplate

Eggs DELTA is assembled and adjusted according to individual customer specifications. Product code and ratings appear on the meter nameplate (tag) attached on the side of preamplifier. Make sure that the ratings shown conform to your particular specifications.



1.2 Transportation Considerations

- (1) It is desirable that Eggs DELTA be transported to the installation site in the shipping container used for transit from the factory.
- (2) Eggs DELTA is adjusted and inspected as one complete assembly consisting of the flowmeter body, sensor subassembly (flowrate detection), and preamplifier. Be sure to treat them as an integral assembly.

1.3 Storage Considerations

If Eggs DELTA upon receipt is to be stored for long periods of time before installation, unexpected faulty conditions could arise. If a long-term storage is anticipated, take the following precautions:

- (1) Keep the equipment in store in the same shipping container used for transportation from Sparling if possible.
- (2) Place of storage should conform to the following requirements:
- ★ Free from rainwater and moisture.
- ★ Free from vibration and impact shocks.
- ★ Temperature and relative humidity in the storage place are at or near room temperature and humidity (around 25°C and 65%)
- (3) Purge the Eggs DELTA that has once been placed in service with clean air, nitrogen gas, etc. to prevent the process fluid from adhering to the meter body, connections, pipe walls, housing and so on, before storage. (Wash clean with suitable detergent if necessary.)



$\angle!$ CAUTION: Do not use solvents, such as thinner or alcohol, for cleansing.

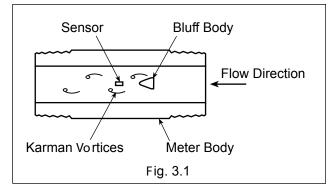
(4) For long-term storage, it can best be stored in the shipping container used for transportation from the factory.

2. OPERATING CONDITIONS

Operating conditions of **Eggs DELTA** are stated on the nameplate (tag), Chapter 5 "INSTALLATION" on pages 7 through 11, and in Chapter 11 "GENERAL SPECIFICATIONS" on page 23. Read them well before installation and first-time operation.

3. GENERAL

Eggs DELTA is a vortex flowmeter, using a piezoelectric sensor. Behind the bluff body located perpendicular to the fluid flow, Von Karman vortices form and shed proportional to the rate of flow. **Eggs DELTA** picks up these vortices with the piezoelectric sensor for flowrate measurement.

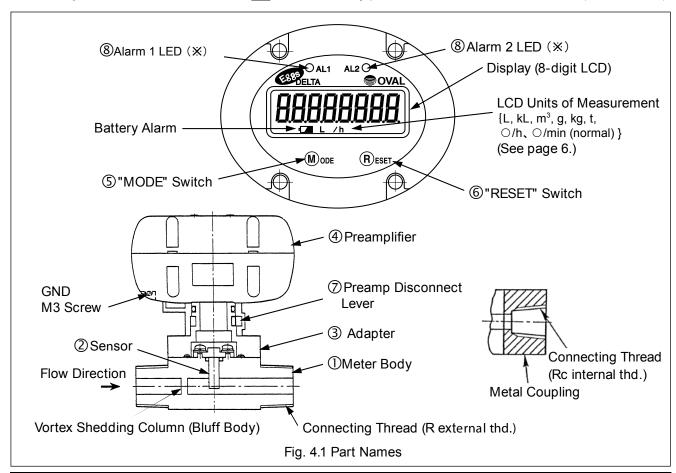


3.1 Features

- (1) Total absence of moving parts contributes to long service life.
- (2) Lightweight and compact with major parts made of resin molding.
- (3) As remote outputs, alarm outputs, pulse output, or analog output are selectable.
- (4) A large LCD display shows the total flow and instantaneous flowrate selectable by separating a selector magnet provided above the display and holding it close to the switch labeled "MODE" or "RESET".
- (5) The rotatable display may be oriented in any direction for maximum viewability.

4. COMPONENT NAMES AND FUNCTIONS

4.1 Component Names NOTE: Battery powered model has no alarm LEDs (AL1 and AL2).



1) Meter Body:

Consists of a measuring pipe and a vortex shedding object (bluff body). As the process material flows, von Karman vortices form and shed behind the bluff body.

② Sensor:

Contains a piezoelectric sensor. The piezoelectric element oscillating with Karman vortices picks up the vortices formed as changes in electric charge.

3 Adapter:

Connects the meter body with the preamplifier.

4 Preamplifier:

Transforms changes in electric charge detected by the sensor into an output signal representing the flowrate and shows the instantaneous flowrate and total flow on an 8-digit LCD display.

You can select alarm outputs, pulse output, or analog output to a remotely located receiving instrument. The preamplifier display is rotatable: it can be oriented to any position for maximum readability.

⑤ "MODE" Switch:

By applying the selector magnet to the field labeled "MODE," the display scrolls through available menu items of variables in the order "Accumulated total flow" → "Hourly instantaneous flowrate" → "Per-minute instantaneous flowrate" → "Resettable total flow."

6 "RESET" Switch:

Applying the selector magnet to the field labeled "RESET" resets the "Resettable total flow" to zero".

7 Preamplifier disconnect lever:

Separates the preamplifier with a pull of this lever.

To eliminate the possibility of poor electrical contact and other undesirable trouble. CAUTION good practice is to keep your hands off this lever except for maintenance.

 Alarm indicator LED (with flow switch function)(x): No alarm indicator LEDs (AL1, AL2) are provided for battery-operated model.

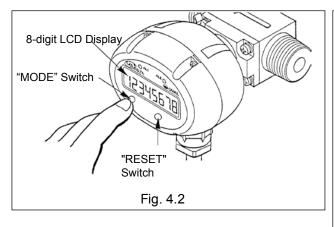
4.2 Display Functions and Operation

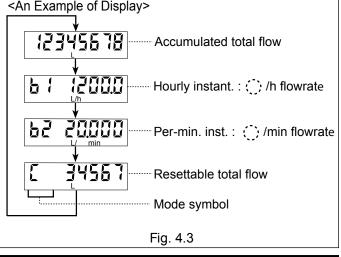
In normal operation, four variable-accumulated total flow, hourly instantaneous flowrate, per-minute instantaneous flowrate, and resettable total flow-can be shown along with the units of measurement.

4.2.1 Display Menu Selection

By depressing the "MODE" switch on the display to turn it on, the display scrolls through available menus items as shown in Fig. 4.2. The display changes from one menu item to another upon "MODE" switch depression, scrolling ss shown in Fig. 4.3.

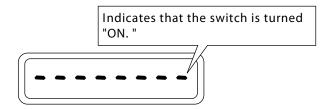
- NOTES: 1. The display scrolls on release of the finger holding the switch.
 - 2. It is expressed in this manual that the switch remains turned "ON" while pressing the switch; on release, it turns "OFF".





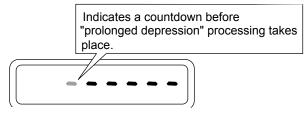
4.2.2 About the Displayed Messages during Operation

- ① Ordinary operation
 "MODE" switch is turned "ON" (selector magnet held close to it.)
- ⇒ 8 bars appear.



⇒ Immediately turning "OFF" (selector magnet the window to the next one.

- ② Prolonged operation Held turned ON without turning "OFF" immediately by removing the fingers.
- ⇒ Bars begin to disappear from the leftmost one.



⇒ Holding turned ON until the last bar disappears results in "prolonged depression" processing (?) to take place.

(Turning OFF before the last bar disappears results in the same behavior as in (1) to take place.

**Prolonged operation: An operation required for Normal mode? Parameter review mode selection, finalizing the parameter setting, etc.

NOTE: While RESET switch is in a valid mode (resettable total mode, etc.), the same message as stated above appears in response to RESET switch operation.

(There is no distinction between ordinary depression and prolonged depression.)

4.2.3 Total Counter Reset

Applying the selector magnet to the field labeled "RESET" resets the resettable total flow reading (mode symbol "C") to zero. It is only resettable while "resettable total flow" is shown.

NOTE: Reset timing remains the same as that of display menu selection (see Note 1 above).

4.2.4 About the Measurement Units

The measurement unit may be changed. A flowrate unit that matches the customer specification (chosen from the candidates below) is set up before the product leaves the factory.

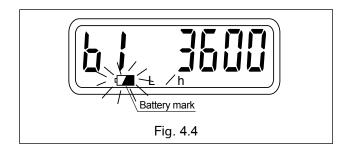
L, kL, m³, g, kg, t, /h, /min., (normal), none

To change the indicated measurement unit, see Section 9 "About Configuration of Parameters" on pages 12 through 20.

NOTE: A change in the indicated measurement unit here means nothing but a change in the unit indicated at the bottom of the LCD display, It by no means affect the process of flow measurement calculation.

4.2.5 Low Battery Alarm Indication

Product with "no output (battery-operated)" is driven by the built-in battery. If the battery capacity becomes low requiring battery replacement, battery mark () lights at the bottom of the front display. When this indicator goes on, you are requested to replace the battery within a week. (For the method of replacement, refer to page 22.)





Regarding "All lights on indication" (see page 20) in Parameter Check Mode, all the segments of the display go on with lit battery mark. However, the lighting of battery mark does not show the end of battery life.

5. INSTALLATION

5.1 Installation Location

Select an installation location that conforms to the following conditions:

- (1) Least vibration and impact shock
- (2) Optimum display viewability and easily accessible for maintenance and servicing
- (3) Free from bubble entrapment in liquids and completely filled with liquid at all times (liquid service only)
- (4) Place where fluid pressure can be kept under the permissible pressure 0.98 MPa
- (5) Liquids will not freeze.

CAUTION: Installation in a hazardous location is NOT permissible.

CAUTION: Because of potential damage to the preamplifier housing, avoid the following locations:

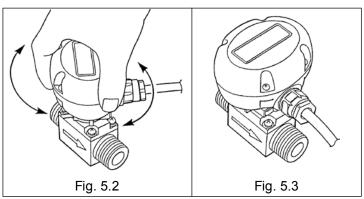
- 1. Ambient temperature falls outside a range from -10 to +60 °C.
- 2. Directly exposed to the sun.
- 3. Temperature changes sharply.
- 4. Preamplifier housing (made of polycarbonate is exposed to materials that can deteriorate it (oils, solutions, etc.).
- 5. Exposed to rainwater or running water.

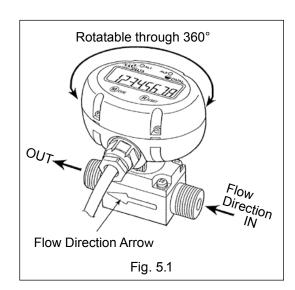
NOTE: If operation in an environment that fails to meet any of the above conditions is unavoidable, protective means, such as providing a protective housing or total enclosure, must be used.

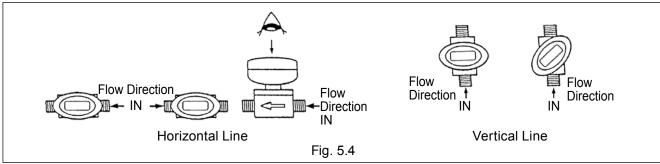
5.2 Physical Orientation

From an accuracy point of view, **Eggs DELTA** may be oriented to any position. Make sure that the flow direction arrow points in actual direction of flow.

NOTE: The display is free to rotate through 360 ° for maximum viewability.







CAUTION: In liquid service, meter installation in a vertical run (bottom to top) is recommended in applications where bubbles are likely entrapped in the line.

5.3 Tubing Instructions

Rule to follow is to secure a straight pipe longer than 7D upstream of, and 3D downstream of the meter (where D is the meter inside diameter). See Table 5.1 for actual lengths of straight pipes. To maintain design accuracy, observe the following instructions.

Table 5.1 Req'd Straight Pipe Lengths

Nom. Dia. (mm)	I. D. (mm)	Upstream (L1) (mm)	Downstream (L2) (mm)
4	8.5	59 min.	25 min.
8 (PPS)	13	91 min.	39 min.
8 (SCS14A)	8.5	59 min.	25 min.
15	14	98 min.	42 min.
25	24.5	171 min.	73 min.

NOTE: See page 23 for **Eggs DELTA** pressure losses.

5.4 Process Connections

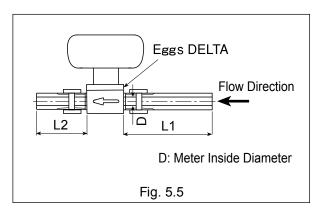
(1) If the meter body is of resin molding. Exercise care to avoid excessive stresses and impact shock while making connections. Observe the torque specifications given in the table below.

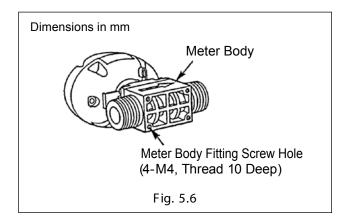
Nom. Dia. (mm)	Tightening Torque Specification (N·cm)
4, 8, 15	1960
25	9800

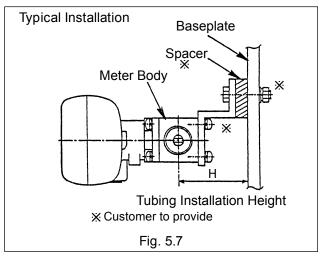
CAUTION:

- 1. Taper threads are used at connections. Use seal tape or similar seal material.
- 2. With synthetic resin connectors (PPS resin), adhere to the torque specifications above to avoid cracks by over tightening.
- 3. With metal connectors, hold the connector firmly with wrench, or similar tool, while connecting to the tubing.
- 4. If a tool, such as wrench, interferes with the preamplifier, rotate the preamplifier to avoid contact with the tool. Do not attempt to make tube connections while holding the preamp.

- (1) Inside diameter of the pipes to be connected must be the same or larger than that of the meter.
- (2) If a sharp increase in pipe diameter, such as a throttle valve and flared pipe, exists, locate it at least 50D away.
- (3) Provide a flow regulator valve downstream of the meter for controlling the flow.





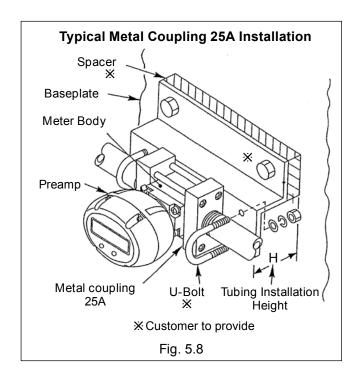


(2) If the tubing assembly cannot support the meter body, or if the meter is to be installed for some reason in a location subject to excessive vibration, secure the body to a rigid foundation, or baseplate, using threaded holes (4-M4) located at back of the body (Fig. 5.6). In line with the tubing installation dimension (H), fit a rubber sheet spacer between the bracket and foundation to secure the meter body anchorage avoiding stresses to the meter body anchorage (Fig. 5.7).

!\CAUTION: Do not use screws at back of the meter body for metal coupling 25A. Secure the tubing with U-bolts, or similar fasteners (Fig. 5.8).



Use extra care in making connections with the tubing by observing the instructions above.



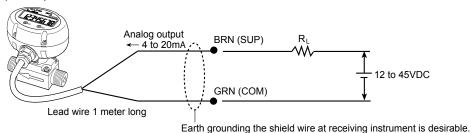
5.5 Flushing

If foreign matter is expected to flow into the tubing assembly on a new installation, for example, flush the tubing assembly thoroughly prior to installing Eggs DELTA.

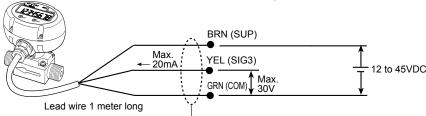
6. WIRING DIAGRAM

For a long run, extend the cable length using a shield cable 0.75mm² or larger. Separate field wiring from power cables and other noise sources. CAUTION (Transmission length 1 km and cable conductor area 2.0mm²)

(1) Analog output (2-wire): FLM□□□□□□□□

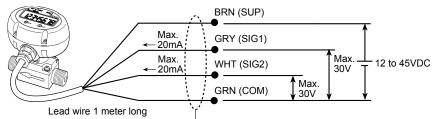


(2) Factored or unfactored pulse output (3-wire): $FLM \square \square \square \square \square \square$



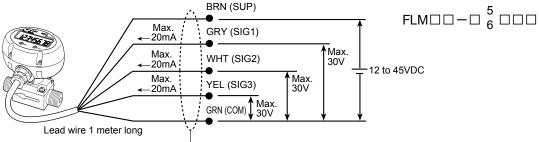
Earth grounding the shield wire at receiving instrument is desirable.

(3) High/low alarm output (2-output) (4-wire max.): FLM \square \square \square



Earth grounding the shield wire at receiving instrument is desirable.

(4) High/low alarm output (2-output) + factored pulse or unfactored pulse output (5-wire max):



Earth grounding the shield wire at receiving instrument is desirable.

Polarities

Col.	Description
BRN	SUP. (and analog output)
GRY	SIG.1Alarm 1 output (high or low)
WHT	SIG.2 Alarm 2 output (high or low)
YEL	SIG.3 Factored or unfactored pulse output
GRN	СОМ

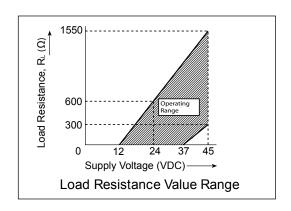


Fig. 6.1

7. OPERATION

(1) Making sure that there is no leak in the tubing system, progressively open the upstream valve.

CAUTION: To prevent adverse influence on associated equipment, avoid sharp increase in flowrate.

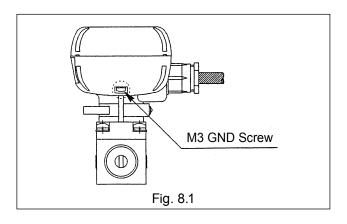
- (2) If the output hunts due to entrapped air in large quantities immediately after installation, open and close the upstream valve several times to let the air out completely.
- (3) Confirm that the indicated flowrate reading is not erratic.
- (4) Make sure that process fluid conditions (pressure, temperature, etc.) and flowrate meet the meter ratings.

8. TROUBLESHOOTING

When **Eggs DELTA** is found erratic, locate the cause of trouble as follows.

NOTE: See Table "9.3 About the Error Messages" on page 17 for Error Message of LCD display.

Problem	Possible Cause	Coping Action	
	Flowrate too low.	Progressively open the flow regulating valve.	
Fails to measure.	Flowrate too high.	Progressively closing the flow regulating valve, make sure that the display registers the flow.	
	Installed the wrong way round.	Make sure of flow direction.	
	Exposed to vibration of the tubing system.	Support the meter body such that it is isolated from vibration.	
Registers pulses at zero flow.		Locate sufficiently away from noise sources.	
at zero now.	Exposed to noises.	Earth ground the terminal (M3) under the preamp. (See Fig. 8.1 for earth ground terminal location.)	
	Influenced by entrapped bubble (liquid service).	Let bubble out.	
		Locate sufficiently away from noise sources.	
Erratic flowrate reading.	Exposed to noises.	Earth ground the terminal (M3) under the preamp. (See Fig. 8.1 for earth ground terminal location.)	
	Tubing conditions not matched.	Make a recheck on tubing conditions.	
	Upstream flowrate regulation.	Regulate the flowrate on the downstream side.	



9. ABOUT CONFIGURATION OF PARAMETERS

Specifications of this flow monitor are established by the configuration of parameters. They are set to default parameters before the product leaves the factory, and normally, further field reconfiguration is not required.

9.1 Parameters List

Table 9.1 (1/2)

				` ,	
Parameter	Code	Default Setting	Initial Value	Description	Remarks
Basic data	bdAtA				
Meter factor	F	Depends on individual specifications.	1.0000-2	Meter factor (Unit: [□/Pulse]) Setting range: 0.9999-9~9.9999E7	Ex.: Given meter factor 9.918 L/P. To change the indicated flowrate to [m³] →F=9.918 × 10⁻³[m³/P] × 10(Hardware frequency division) =9.918 × 10⁻²[m³/P] Therefore, set to "F9.9180-2". (Note 1) (Note 2) (Note 5)
Conversion factor	н	1.000E0	1.0000E0	Unit conversion factor (Unit: [△/L]) Values in fixed conversion, such as conversion factor and density under standard conditions △: Unit after conversion (Without conversion △=□) Setting range: "0.9999-9~9.9999E7	Changes units of total flow and instant. flowrate to any units desired. (Without conversion, H1.0000E0) Ex.: At 1.5kg per 1L, change the flowrate to read in kg. →Conversion factor is 1.5[kg/L] (=1.5000× 10 ⁺⁰ [kg/L]) Therefore set to "H1.5000E0" (kg/L). (Note 1) (Note 2)
Pulse weight	Pu	Depends on the type of product.	1.00E0	Weight of factored pulse output (Unit: [△/Pulse]) Setting range: 0.99-9 to 9.99E7	Ex.: To change the weight of factored pulse from 1L/P→10L/P (=1.00× 10 ⁺¹ [L/P]) →Set to "Pu 1.00E1" (L/p). (Note 3)
Indicated measurement unit	Un	L	L	Measurement unit indicated at bottom of the LCD	Select one from "L, kL, m3, g, kg, t, (normal), or none. (This setting is for indication only; it by no means affect the flow calculation.)
Decimal point in instantaneous flowrate	bP	Depends on the type of product.	0	Decimal point in instant. flowrate display b1 Decimal point in Alarm 1 setup (A1d), Alarm 1 hysteresis (A1H), Alarm 2 setup (A2d), Alarm 2 hysteresis (A2H), Analog full scale (AF) also moves relative to it. Setting range: 0, 1, 2	Ex.: To change the indicated min. rdg. in inst. flowrate from 1 L/h to 0.1 L/h (= one place below decimal point) → Set to "bP .1".
Decimal point in total flow	SP	Depends on the type of product.	0	 Decimal point in grand total and resettable total Setting range: 0, 1, 2, 3 	Ex.: To change the indicated min. rdg. in total flow from 1L to 0.01L (= 2 places below decimal point) → Set to "SP .2".
Sampling time	At	5	5	Hi. limit in instant. Flowrate sampling time (Unit: [sec]) Setting range: 1 to 999	If flow pulses fail to arrive A times during interval At [sec], the instantaneous flowrate shows 0.
Sample cycle number	А	1	4	Sampling cycles Setting range: 1 to 999	Instantaneous flowrate is determined by measuring the time for incoming flow pulses A times. If indicated instantaneous flowrate varies excessively, select a larger A to reduce variation.

Table 9.1 (2/2)

Parameter	Code	Default Setting	Initial Value		Description Remarks
Alarm data	AL				
Alarm 1 setup	A1d	0	27	Flowrate of alarm output 1	
Alarm 1 hysteresis	A1H	Depends on the type of product.	0	Hysteresis of alarm output 1	
Alarm 1 status	A1S	LS	HS	Output status of alarm output 1	For details, and WAlsout Alarma Outsutell
Alarm 2 setup	A2d	Depends on the type of product.	27	Flowrate of alarm output 2	For details, see "About Alarm Outputs".
Alarm 2 hysteresis	A2H	Depends on the type of product.	0	Hysteresis of alarm output 2	
Alarm 2 status	A2S	НЅ	HS	Output status of alarm output 2	
Analog data	AnA				
Analog full scale	AF	Depends on the type of product.	3600	Analog full scale flowrate (Unit: [? /h]) Setting range: 0.01 to 99999	Ex.: To change the analog output full scale flowrate (flowrate to produce a 20mA output) from 3600L/h to 1800L/h → Set to "AF 1800" (L/h).
Analog damping	AdAn	2.5	0	Analog time constant (soft) (Unit: [sec]) Setting range: 0.00 to 99.9	If analog output has high ripples, select a larger AdAn to stabilize the indicated reading. Ex.: To change the analog output time const. from 2.5 [sec] to [5 sec] → Set to "AdAn 5.0".
4mA trim	A04		(4.000)	Analog output 4mA trim	For details, see "Parameter Setup Procedure."
20mA trim	A20		(20.00)	Analog output 20mA trim	For details, see "Parameter Setup Procedure."
Pulse data	PuLSE				
Pulse width	Pon	30	1	Factored pulse output "ON" duration (Unit: [msec])	Ex.: To change pulse width from 1 ms to 50ms → Set to "Pon 50" (msec). (Note 4)
Pulse dummy output 1	Pd1	Not a parameter to be set up	_	Furnishes a 1Hz simulated factored pulse output irrespective of flowmetering.	This function is useful in loop check, etc. For operation in practice, see "About Dummy Output Functions (special features)."
Pulse dummy output 2	Pd2	Not a parameter to be set up		Furnishes a 10Hz simulated factored pulse output irrespective of flowmetering.	

→ NOTES

- 1. When it is desired to change meter factor (F) and conversion factor (H), select the proper unit that matches the indicated unit (Un) for each.
- 2. When meter factor (F) and conversion factor (H) have been changed, data, such as pulse, analog, and alarm parameters, must also be changed to the proper units relative to the conversion.
- 3. Be sure to set up a value such that $F \times H/2 \le Pu \le F \times H \times 10000$.
- 4. Be sure to set a value such that factored pulse "OFF" width > 1 ms.
- 5. Setting of meter factor (F) includes frequency division (1/10) by hardware means.

9.2 Parameter Setup Procedure

9.2.1 Procedure to modify a parameter

Given below is the parameter setup procedure:

1 In "Measure Mode (normal mode)," turn MODE switch ON for 5 seconds to go into "Review Mode".

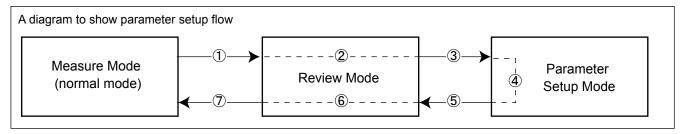
2 Using MODE and RESET switches, show the parameter you want to modify.

3 Turn MODE switch ON for 2 seconds to go into "Parameter Setup Mode".

4 Using MODE and RESET switches, set up a new parameter. (See Para. 11.5.2 below for the procedure).

5 Following the parameter entry, turn MODE switch ON for 2 seconds to go back to "Review Mode".

7 Turn MODE switch ON for 5 seconds to go back to "Measure Mode".



NOTE: For complete detail of MODE and RESET switch operations in steps ①, ②, ⑥ and ⑦, see "Table 9.4 Menu Trees and Switch Operation" on page 20.

(6) Using MODE and RESET switches, show the title (= one from bdAtA, AL, AnA, or PuLSE).

9.2.2 Procedure to Enter a Parameter

The procedure to enter a parameter (switch operations sequence in "Parameter Setup Mode") comes in three ways (numerical setup, decimal point location setup, and analog 4/20mA trim) that follows:

NOTE: Meanings and functions of individual parameters appear in the Parameter List on pages 12 and 13.

Kind 1 Numerical setup parameters (F, H, Pu, At, A, A1d, A1H, A2d, A2H, AF, AdAn, Pon)

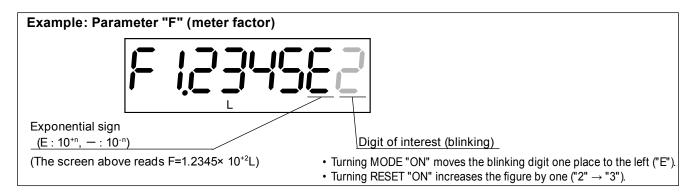
The blinking digit in the parameter setup mode is the place of interest.

MODE - - - Each time the switch is turned on, the place of interest moves one place to the left.

RESET - - - Each time the switch is turned on, the figure in the blinking place increases by one.

Or exponential sign toggles ("E, " "-," etc.).

→ Following the parameter setup, hold the MODE switch turned ON for 2 seconds (the new setting is established and the screen returns to the review mode).



Kind 2 Unit setup parameter (Un)

In the parameter setup mode, the measurement unit to be set up flickers.

MODE--- Not used in the setup process.

RESET -- Each time the switch is turned ON, the measurement unit indicated changes one after another.

→ When the desired measurement unit appears, press the MODE switch twice (the unit is established and the screen returns to the review mode).

Example: Parameter "Un" (indicated measurement unit) Indicated measurement unit (Flickers) Each time the RESET switch is turned ON, the indicated unit changes one after another through available units as $[g\rightarrow kg\rightarrow t\rightarrow L\rightarrow kL\rightarrow m^3\rightarrow L(normal)\rightarrow kL(normal)\rightarrow m^3(normal)\rightarrow none.]$

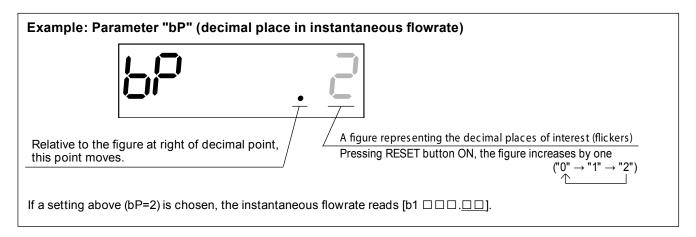
Kind 3 Decimal point setup parameters (bP and SP)

In the parameter setup mode, a figure representing the decimal places of interest flickers.

MODE--- Not used in the setup process.

RESET -- Each time the switch is turned ON, the decimal point moves to the left and the figure increases by one.

→ When the decimal point appears at the desired place, hold the MODE switch depressed for 2 seconds (the setting is established and the screen returns to the review mode).

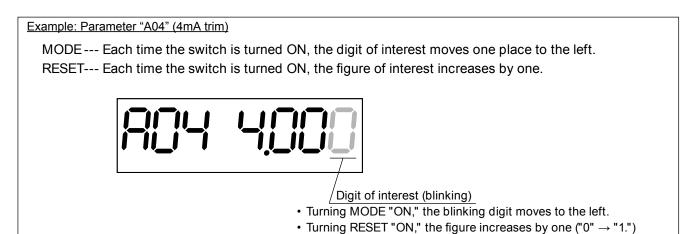


Kind 4 Analog output 4/20mA trim

• During the analog trim, keep on monitoring the analog output with milliammeter.

Given below is the 4mA trim procedure (the same holds true with 20mA trim).

- (1) At "A04 4.000," hold "MODE" depressed for 2 seconds to go into the parameter setup mode; the least significant digit "0" at extreme right blinks on and off and a 4mA simulated output from the register appears.
- (2) Set the milliammeter reading of analog current output in the procedure below. (If it reads 3.988mA, for example, set to "A04 3.988.")



Following entering the setting, hold MODE depressed for 2 seconds to establish the setting.

- (3) Analog output is trimmed; make sure of the milliammeter reading once again.

 (The indicated reading returns to "A04 4.000" (the least significant digit at extreme right blinking) now.)
 - If the reading is within the tolerance with respect to 4mA, by holding MODE depressed for 2 seconds the second time, you can exit the setup mode. → Adjustment is complete.
 - If the reading still remains outside the tolerance, repeat step (2) above.

9.2.3 About Alarm Outputs

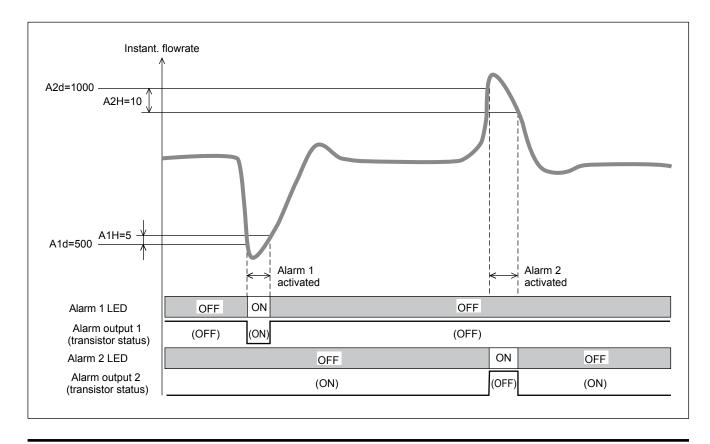
- Whenever the instantaneous flowrate exceeds (or falls below) the alarm setpoint, the front panel LED comes on with a remote alarm signal (open collector) produced.
- The alarm comes in two points alarm 1 and alarm 2 independently set up.

NOTE: About available alarm-related parameters, see Table 9.4 "Menu Trees and Switch Operation" on page 20.

Table 9.2 Alarm-related Parameters and Meanings

Parameter Code	Name	Description			
A 1 d 🗆 🗆 🗆	Alarm 1 setup	Sets up alarm flowrate of alarm output 1 (in hourly flowrate)			
A 1 H 00000	Alarm 1 hysteresis	Sets up hysteresis of alarm output 1 (in hourly flowrate) Width from alarm setpoint to the point where alarm is lifted. Output status of alarm 1 △: Sets up high alarm or low alarm. "H" set up → Hi alarm (alarm activated above the setpoint) "L" set up → Lo alarm (alarm activated below the setpoint)			
	Alaini Thysicicsis	Width from alarm setpoint to the point where alarm is lifted.			
		Output status of alarm 1			
		 ∴ Sets up high alarm or low alarm. "H" set up → Hi alarm (alarm activated above the setpoint) 			
A1S ΔΟ	Alarm 1 status	"L" set up \rightarrow Lo alarm (alarm activated below the setpoint)			
		○: Remote output status when alarm is activated.			
		"S" set up → ON			
		"O" set up → OFF			
A 2 d 🗆 🗆 🗆	Alarm 2 setup	Flowrate of alarm out 2 (Description remains the same as A1d.)			
A 2 H 🗆 🗆 🗆	Alarm 2 hysteresis	Hysteresis of alarm out 2 (Description remains the same as A1H.)			
Α2S ΔΟ	Alarm 2 status	Output status of alarm out 2 (Description remains the same as AIS.)			

Example: A1d=500, A1H=5, A1S=LS, A2d=1000, A2H=10, A2S=H0



9.2.4 About Dummy Output Functions (special functions)

By the following steps, a 1Hz or 10Hz simulated factored pulse train can be furnished irrespective of flowmeter measurement.

NOTE: This feature is not available with the unfactored pulse output specification. (Dummy output is not featured for unfactored pulse output.)

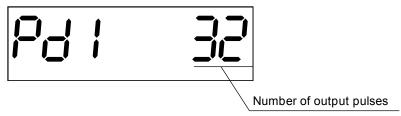
- 1Hz simulated output mode (dummy output 1 mode Code: Pd1)
- (1) According to the Table 7.5 "Menu Trees and Switch Operation" (page 19), show dummy output 1 ("Pd1 1") on the LCD.



(2) Turn MODE button ON for 2 seconds to go to the dummy output run mode. (The display shows "Pd1 0".)



- (3) Operation within the dummy output run mode
 - Turn RESET button ON → Dummy output appears and the counter counts in sync with the pulse output produced.
 - Turn MODE button ON → Dummy output stops
 - Hold MODE button turned ON for 2 seconds → Dummy output run mode is terminated, returning to the state (1)



- NOTE: 1. The procedure above also applies to the 10Hz simulated output mode (dummy output 2 mode Code: Pd2).
 - 2. Pulse width is set by parameter Pon.

9.2.5 Parameter Initialization

- (1) Remove the external power source.
- (2) Holding the selector magnet close to the MODE switch, turn the battery switch (SW2-6) from OFF to ON.
- (3) The LCD lights up in all figure places. (The selector magnet is held in proximity.)
- (4) When the screen shows "PA. rESEt," remove the selector magnet to turn "OFF" → Initialization is complete. (Holding the magnet in proximity while "PA. rESEt" is shown causes the modes to go to the measure mode without initialization.)
- NOTE: Parameter initialization is the step to be taken upon detection of a parameter error "PA.Err 1" or other erratic condition. Do not take this step unless absolutely necessary.

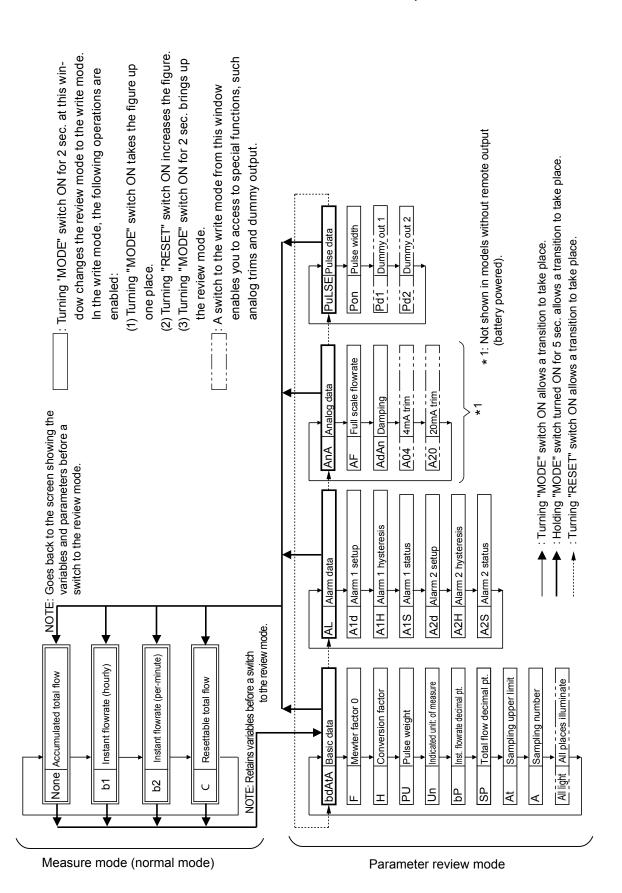
9.3 About the Error Messages

The preamplifier can be reconfigured for new parameters at your option. However, if some parameters you set up conflict, or when an erratic condition arises, the LCD display will tell the operator with an error message from Table 9.2 below.

Table 9.3

Message	Name	Description	Action to recover
PA.Err.	Parameter setup error	Parameters are write-protected.	Seek our service at the sales office in your area.
PA.Err.1	Parameter error 1	Backup data retained for parameters has been damaged.	A fault in the preamplifier is a possibility.
PA.Err.2	Parameter error 2	Some of the backup data retained for the display mode, accumulate total flow reading, or resettable total flow reading have been damaged.	Can be restored with MODE switch, but the accumulated total flow and resettable total reading will be reset to 0.
PA.Err.Pu	Pulse weight "Pu" setti too small with respect factor 0 (F) and convers factor (H) setting.		Change the setting to an appropriate value that satisfies the following formula: F× H/2≤ Pu≤ F× H× 10000
AnA.Err	Analog output error	Analog output level exceeded 120% of full scale.	Check to see if the flowrate is unusual.
Out.Err	Pulse output error	Pulse "OFF" width in the factored pulse output falls short of 1 msec.	Change pulse width "Pon" setting to an acceptable value.

Table 9.4 Menu Trees and Switch Operation



10. MAINTENANCE

10.1 Switches, Potentiometers, and Test Pins

Amplifier Board

Part Name	Printed Label	Description		
Trigger level setup potentiometer	TL	Adjusts trigger level (pulse generating sensitivity) over a range 80mV _{P-P} to 1500mV _{P-P} .		
Amplified waveform monitor test pins	\ominus \bigcirc	Monitors amplified sensor output signal (sinusoid wave).		
Trigger waveform monitor test pins	⊖OV ~ ⊕TGR	Monitors triggered waveform (rectangular wave).		
Digital filtered waveform		Monitors digital filtered waveform. With respect to the trigger waveform, the following frequency division applies.		
monitor test pins	Θ OV \sim Θ PLS	Metered Fluid Liquid Gas		
		Frequency 1/5 1/25		

Output Board

Part Name	Printed Label	Description
Output select switch 1	SW1	"A" side: Analog output service (standard) "P" side: SIG. 3 output service
Output select switch 2	SW2	SIG. 3 output setup "N" side: Unfactored pulse output "C" side: Factored pulse output X When SIG. 3 is not used, "N" setting applies.
Output select switch 3	SW3	Always "A1"
Output select switch 4	SW4	Always "A2"
Analog output test pins	⊕® ~ ⊕IN−	Monitors 40mV to 200mV voltage with respect to analog 0 to F.S.

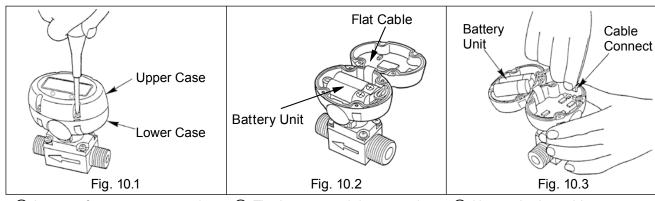
NOTE: Potentiometers and switches are factory adjusted before shipment of the product. Do not readjust their settings.

10.2 Battery Pack Replacement

With battery pack removed, flow measurement can no longer be made, but the CPU retains all the parameters in the memory; no reconfiguration is required.

To replace battery pack, follow the procedure below using screwdriver.

(1) Battery Pack Removal

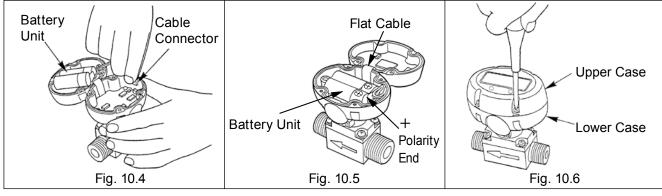


- ① Loosen four screws securing the preamplifier housing and open the upper case.
- ② The battery pack is secured to the lower case.
- ③ Uncouple the cable connector and remove the battery pack.



Pay attention to the electronics board coupled with flat cable within the housing.

(2) Battery Pack Installation

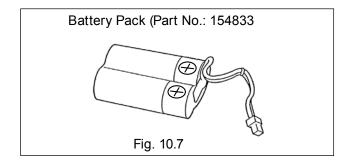


- ① Install the cable connector of a new battery pack into its receptacle. The connector is polarized for correct installation: do not force into position; reverse the direction if it has not fitted in (Fig. 10.4).
- With positive polarity end pointing in the direction of cable connector receptacle, set the battery pack in the lower case (Fig. 10.5).
- NOTE: Be careful not to leave screws and washers that have been removed in the preamplifier.
- 3 Tighten four fitting screws of the preamplifier upper case evenly to a 24.5N•cm torque (Fig. 10.6).

CAUTION: Over tightening can damage the housing. Observe the torque specification.

Make sure that the LCD is illuminated and the low battery alarm has disappeared.

CAUTION: Battery packs are dedicated parts available at the nearest Sparling/OVAL sales office in your area.



11. GENERAL SPECIFICATIONS

Table 11.1

Item			De	scription		
Liquid use		FLM2S	FLM20	FLM21	FLM22	
Model	Gas use	FLM2S FLM3S	FLM30	FLM21	FLM22 FLM32	
Nominal Diameter and Connection		4mm R3/8 male NPT3/8 male or Rc1/4 female	8mm R1/2 male NPT1/2 male or Rc1/4 female	15mm R3/4 male NPT3/4 male or Rc1/2 female	25mm R1 • 1/4 male NPT1 • 1/4 male or or Rc1 female	
Acceptable	Liquid		,	Water	l	
Fluids (Note 1)	Gas		Air ar	nd nitrogen		
Flow Range	Water	0.4 to 4	1.1 to 15	2.8 to 45	8.3 to 133	
(L/min)	Atm. press., air	7.2 to 17	18 to 90	55 to 283	167 to 850	
Operating Temp.	Fluid	Sta	ndard type: -10 to +80°	C (free from dew conder	nsation)	
Range	Ambient		-10	to +60°C		
Max. Operating P	ressure		0.	98MPa		
Accuracy			± 3%	of full scale		
Repeatability			±	0.5%		
Pressure Loss	Water	0.31 to 31		0.12 to 34.3		
(kPa)	Atm. cress., air	0.13 to 0.7		0.06 to 1.52		
Major Parts Mate	rials	Meter body, sensor, adapter: PPS resin (polyphenylene sulfide) Preamplifier housing: Polycarbonate Wetted parts seals: Fluorine rubber				
Installation Locati	ion	① Free from rain and	water, ②Minimal temp	. change, ③ Free from di	rect sunlight	
Display (LCD digital displa	ay)	① Accumulated total flow ② Hourly instant flowrate ③ Per-minute instant flowrate ④ Resettable total flow 7 digits ① Digital are selectable with external mode switch and LCD shows flow units [L, m³, g, kg, t, L (norm.), respectively. (norm.) and decimal point. (Display is rotatable through 360°.)			., m³, g, kg, t, L (norm.), m³	
	Battery powered			None		
		Analog output	4 to 20mA at 0-FS (and	alog trim with front panel	switches)	
Output	powered		Open collector output allowable current: 20mA Max. voltage impression: 30V Front panel LED (in red) shows alarm condition. [High/low alarm output statu (ON/OFF selectable) and setpoints adjustable with front panel switch.]			
(Note 2)		Pulse output	Open collector output allowable current: 20mA Max. voltage impression: 30V Pulse width (Factored pulse: 30ms unfactored pulse: 1 ms)			
Power	Battery powered	Lithium battery pack Battery life: 4 years at room temp A low battery alarm is provided.				
	Externally powered	12 to 45V DC				
Signal Cable		5-conductor shielded cable (one meter long furnished)				
Transmission Len	gth	One kilometer when extended with cable 2.00 mm² in conductor area)				
Backup		Retains parameters and variables in an internal E ² PROM.				

- NOTE: 1. Flammable, corrosive, and toxic fluids are not acceptable.
 - 2. Analog output and open collector output can not be used in combination.

■ Indicated and Remote Output Units (default settings)

(1) Liquid service

Nom. dia., Total flow units and Model Factored output units (mm) FLM2S-1□□CW 4 0.01 L FLM20-1□□CW 8 0.1 L FLM21-1□□CW 15 1 L $FLM22-1\square\square CW$ 25 1 L

(2) Gas service

Model	Nom. dia., (mm)	Total flow units and Factored output units				
FLM3S-1□□CW	4	0.1 L				
FLM30-1□□CW	8	1 L				
FLM31-1□□CW	15	1 L				
FLM32-1□□CW	25	10 L				

■ Unfactored Pulse Units

FLM2S	0.0004450
FLM20	0.002204
FLM21	0.01182
FLM22	0.0633

	Unit: L
FLM3S	0.002225
FLM30	0.01102
FLM31	0.05908
FLM32	0.3165

NOTE: Unfactored pulse units may in some cases differ from nominal values, depending on the model used. Refer to the nameplate (instrument tag).

■ DECLARATION OF CONFORMITY

Applicable directives	EMC directive: 89/336/EEC, 92/31/EEC, 93/68/EEC
Applicable standards	EN55011:1998/A1:1999 Group 1 Class B EN61000-6-2: 1999

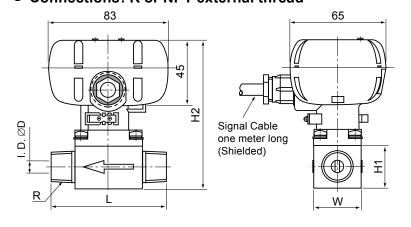
12. PRODUCT CODE EXPLANATION

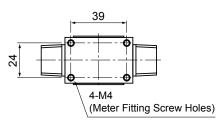
Table 12.1

Item PR		ODI	JCT	СО	DE				DESCRIPTION							
item	1	2	3	4	(5)	6	7	8	9	10	11	DESCRIPTION				
Model	F	L	М									Vortex flow monitor Eggs DELTA				
Application	n.	2							Liquid service							
Application	111			3								Gas service				
					S							4 mm				
Nominal I	Jian	oto	r		0							8 mm				
INOIIIIIai I	Jiaii	iele	1		1							15 mm				
					2							25 mm				
						_										
Display	Display 1									LCD display provided						
0					0				Less output (battery powered)							
1					1				Factored pulse output							
2							Analog output									
Output 3							Unfactored pulse output									
4					High/low alarm output											
5					Factored pulse output + high/low alarm output											
								6				Unfactored pulse output + high/low alarm output				
									Р			R external thread Material: PPS				
Process (Conr	nect	ion						N			NPT external thread Material: PPS				
									Т			Rc internal thread Material: SCS14A				
Version	Version C Always "C"						Always "C"									
Construc	Construction W Waterproof (standard)															

13. OUTLINE DIMENSIONS

Connections: R or NPT external thread





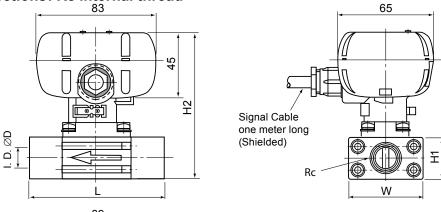
→NOTE:

Signal cable is not furnished with battery powered model.

[Unit: mm]

Model	Nominal Diam.	Ø D (Meter I.D.)	R	L	W	H1	H2	Approx. Weight [g] (cable weight incl.)
FLM ² ₃ S−1□ ^P _N CW	4	8.5	R3/8 Ext. thd. NPT3/8 Ext. thd.	80	32	29	102	285
$FLM_3^20-1\square_N^PCW$	8	13	R1/2 Ext. thd. NPT1/2 Ext. thd.	80	32	29	102	285
$FLM_3^21-1\Box_N^PCW$	15	14	R3/4 Ext. thd. NPT3/4 Ext. thd.	85	32	29	102	290
$FLM_3^22-1\square_N^PCW$	25	24.5	R1•1/4 Ext. thd. NPT1•1/4 Ext. thd.	120	46	46	119	420

Connections: Rc internal thread



- 4-M4 (Meter Fitting Screw Holes)
- NOTE:
- 1.25A cannot be secured with meter fitting screws.
- 2. Signal cable is not furnished with battery powered model.

[Unit: mm]

Model	Nominal Diam.	Ø D (Meter I.D.)	Rc	L	W	H1	H2	Approx. Weight [g] (cable weight incl.)
FLM ² ₃ S−1□SCW	4	8.5	Rc1/4 Int. thd.	91	50	29	102	660
FLM ² ₃ 0−1□SCW	8	8.5	Rc1/4 Int. thd.	91	50	29	102	660
FLM ² ₃ 1−1□SCW	15	14	Rc1/2 Int. thd.	91	50	29	102	660
FLM ² / ₃ 2−1□SCW	25	24.5	Rc1 Int. thd.	126	46	46	119	960

2011.10 Revised △ IDS FLM S-190-7-E(1)

All specifications are subject to change without notice for improvement.



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