

Ins. No. S-400-5-E

Vortex Flow Monitor Eggs DELTA II

MODEL : FLM _____ D_



Every OVAL vortex flowmeter **Eggs DELTA II** 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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This manual uses the precaution words "NOTE", "CAUTION", and "WARNING" as explained below:

NOTE:

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

CAUTION:

Caution statements inform the user of hazards or unsafe practices which could result in minor personal injury or product/property damage.

WARNING:

Warning statements inform the user of hazards or unsafe practices which could result in severe personal injury or death.

1. BEFORE YOU BEGIN

Every **Eggs DELTA II** 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 instructions:

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

A WARNING:

Negligence of the above warnings can result in damage to the product.

This section provides necessary handling precautions. Before you begin, read this section thoroughly. As for other information, find the respective sections.

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

► NOTE: When you make inquiries, provide the product name, model number, serial number, ratings and other pertinent information.

1.1 Confirming the Product Nameplate

This flowmeter is assembled and adjusted according to individual customer specifications. Product code and ratings appear on the product nameplate attached on the side of converter. Make sure that the ratings shown conform to your particular specifications.



1.2 Transportation Considerations

It is desirable that this flowmeter be transported to the installation site in the shipping container used for transit from the factory.

1.3 Storage Considerations

If this flowmeter 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 stored in the same shipping container used for transportation from OVAL 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 this flowmeter 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.)

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 this flowmeter are stated on Chapter 5 "INSTALLATION" and Chapter 12 "GENERAL SPECIFICATIONS".

Read them well before installation and first-time operation.

3. GENERAL

This flowmeter 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. This flowmeter 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.
- External output is selectable from alarm, pulse and analog.
 Battery-powered model is equipped with a long-lasting battery (replaceable).
- (4) On the large LCD, display items can be switched between total flow and instantaneous flow, and reset total can be cleared to zero by operating MODE and RESET buttons.
- (5) The display can be rotated to an easy-to-view angle.

4. COMPONENT NAMES AND FUNCTIONS

4.1 Component Names



4.2 Display Functions and Operation

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

4.2.1 Display Menu Selection

Press the [MODE] button on the display to scroll through available menu items. Every time the [MODE] button is pressed, the display scrolls to the next item.

- ▶ NOTE: 1. The display reacts when you release the finger off the button.
 - 2. In this manual, "pressing a button" is described as turning ON, and "releasing your finger" is described as turning OFF.



Standard (without temperature and pressure compensation)

With temperature and pressure compensation



4.2.2 Display During Operation



4.2.3 Resetting the Resettable Total Flow

Pressing "RESET" button resets the resettable total (mode symbol "C") to zero. It is only resettable while "resettable total flow" is shown.

4.2.4 Measurement Unit

The measurement unit may be changed.

A flowrate unit that matches the customer specification (chosen from the candidates below) is configured as default.

mL, L, kL, m³, f, t³, gal, none, g, kg, t, lb

To change the indicated measurement unit, see Section 9 "Parameter Configuration".

4.2.5 Measurement Unit

[No output (battery-powered)] model is driven by the built-in battery. If the battery capacity becomes low requiring battery replacement, battery indicator (**1**) starts blinking at the top of the front display. Please replace the battery within one week after this indicator turns on.

(For the method of replacement, refer to 10.1 "Battery Replacement")



► NOTE: Regarding "All segments on" in Parameter Check Mode, all the segments of the display turns on including the battery indicator (not blinking). However this status does not suggest the low battery.

4.2.6 Flow Indicator Display

It displays the flow rate in ten segments linked with the instantaneous flow rate, basing the full-scale flow rate set value (parameter: AF) as 100%. (The maximum flow rate of the standard specification is set as default.)



5. INSTALLATION

5.1 Installation Location

Select an installation location that meets the following requirements.

- (1) A location free from excessive vibration and shock (preferably pipe oscillation 0.2G or less)
- (2) A location that provides easy access for display reading and servicing.
- (3) A location where the passage is kept full of fluid without air entrapment (for liquid measurement).
- (4) A location where fluid pressure is held at or below allowable pressure of 0.98MPa.
- (5) A location free from fluid freezing.

The product shall not be used in hazardous locations.

CAUTION:

To prevent damage to the converter case, avoid installation in the following locations:

- (1) A location where the operating ambient temperature exceeds the range of -10 to +60°C.
- (2) A location with exposure to direct sunlight.
- (3) A location with abrupt temperature change.
- (4) A location where it is exposed to any substances, such as oils and solvents, that may degrade the converter case (made of Polycarbonate.)
- (5) A location where it is exposed to rain or water.
- NOTE: If using the product in the environment that does not satisfy the above conditions, provide adequate countermeasure such as a protection case or sealing.

5.2 Physical Orientation

There is no restriction in installation position in terms of accuracy. Confirm that the flow direction arrow indicated on the side of the product body points to the actual flow direction.

► NOTE: The orientation of the display can be rotated by increments of 90 degrees. (Rotation is locked at the positions of 0°, 90°, 180°, and 270°). Rotate the display to your desired orientation.



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 main body inner diameter.).

See Table 5.1 for actual lengths of straight pipes.

To maintain design accuracy, observe the following instructions.

Nom. Dia. (mm)	Main body inner diameter (mm)	Upstream (L1) (mm)	Downstream (L2) (mm)
4	8.5	59 min.	25 min.
8 (male thread)	13	91 min.	39 min.
8 (female thread)	10.7	59 min.	25 min.
15	14	98 min.	42 min.
25	24.5	171 min.	73 min.

NOTE: See 12 "GENERAL SPECIFICATIONS" for this flowmeter pressure losses.

- (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.



5.4 Process Connections

(1) Connect this product so that an excessive force or impact is not applied to the connecting part. Tightening of tubes should be within the allowable tightening torque listed in the table on the right.

Nominal diameter	Allowable tightening torque
(mm)	(N•m)
4	12
8, 15	20
25	50

- 1. The connecting part of this product is tapered thread. Use seal materials such as seal tapes.
- 2. A resin (PPS resin) connection may be damaged if it is fastened excessively. Make sure to observe the above allowable torque.
- 3. When connecting the metal joint model, use a tool such as a spanner to tighten the metal joint of the body.
- (2) In cases where the product cannot be supported by the tubes or the product is installed in a location subject to strong vibration, fasten the product body on to a base using the screw holes (4-M4). However, make sure to insert a rubber sheet between the meter body and the base to match the tubing installation height (H) in order to prevent stress on the meter body connection parts.

Do not use screws at back of the meter body for metal coupling 25A. Secure the tubing with U-bolts, or similar fasteners.

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



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 this flowmeter.

6. WIRING DIAGRAM

For long-distance transmission, use shield cable of at least 0.75mm2 in diameter for extension. Wires should be routed away from noise sources such as the power cable. (Transmission length: Max. 1km with conductive area 2.0mm2. However, if using both analog output and pulse/alarm output, Max. 100m)



7. OPERATION

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

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

- (2) If hunting in output is observed due to air entrapment in large amount soon 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 this flowmeter is found erratic, locate the cause of trouble as follows.

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 in wrong direction.	Make sure of flow direction.
Registers pulses at	Affected by tubing vibration.	Support the meter body such that it is isolated from vibration.
	Affected by noises.	Locate sufficiently away from noise sources.
	Affected by air entrapment. (in liquid measurement)	Release bubbles.
Erratic flowrate	Affected by noises.	Locate sufficiently away from noise sources.
l'ouding.	Tubing condition is not satisfied.	Re-confirm tubing conditions.
	Upstream flowrate regulation.	Regulate flow downstream of the meter.

NOTE: See Table "9.3 Error Messages" for Error Message of LCD display.

9. PARAMETER CONFIGURATION

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

- Total flow data (title: totAL)

Code	Parameter name	Default Setting	Description	Remarks
F	Meter factor	Depends on the specification	Meter factor (Unit: [L/Pulse])	Ex.: Given meter factor 9.918 mL/P (= 9.918×10 ⁻³ [L/P]) → Set to "F9.9180-3" [L/P]. (Note 1) (Note 2) (Note 5)
н	Conversion factor	1.0000E0	Unit conversion factor (Unit: [Unit after conversion/L])	Changes units of total flow and instant. flowrate to unit other than [L]. (Without conversion, H1.0000E0) Ex.: At 0.85kg per 1L, change the flowrate to read in [kg]. \rightarrow Conversion factor is 0.85[kg/L] (= 8.5000×10 ⁻¹ [kg/L]) Therefore set to "H8.5000-1" [kg/L]. (Note 1) (Note 2)
Pu	Pulse weight	Depends on the specification	Weight of factored pulse output (Unit: [L/P])	Ex.: To change the weight of factored pulse to 10L/P (=1.00×10 ⁺¹ [L/P]) \rightarrow Set to "Pu 1.00E1" [L/P]. (Note 3)
Pon	Pulse width	30	Factored pulse "ON" duration (Unit: [ms])	Ex.: To set the pulse width of the factored pulse to 100 [ms] → Set to "Pon 100" [ms]. (Note 4)
Un	Indicated measurement unit	L	Measurement unit indicated at bottom of the LCD	The unit to be indicated on the LCD can be changed by changing the Un. (This setting is for indication only and does not affect the flow calculation.) Setting items (mL, L, kL, m ³ , ft ³ , gal, none, g, kg, t, lb,)
SP	Position of decimal point in total flow	Depends on the specification	Decimal point in accumulated total and resettable total	Ex.: To display the total flow to 0.01L (= 2 places below decimal point) -> Set to "SP .2".
d.o1	Assignment of digital output 1	AL1	Output specification of SIG1 (cable color: grey)	Setting items: U.PLS: Input signal synchronization pulse, PLS: Factored pulse, AL.1: Alarm 1, AL.2: Alarm 2, : No assignment
d.o2	Assignment of digital output 2	AL2	Output specification of SIG2 (cable color: white)	(Note) The setting of U.PLS is not used for this product. When it is specified, a signal obtained by dividing the detected signal by the hardware is output. The output frequency differs from the "unfactored
d.o3	Assignment of digital output 3	PLS	Output specification of SIG3 (cable color: yellow)	pulse" of the conventional model. The pulse width cannot specified (it is output at about 50% duty).

- Instantaneous flow data (title: rAtE)

Code	Parameter name	Default Setting	Description	Remarks
AF	Full scale flowrate	Depends on the specification	Flow indicator display and analog output full scale flowrate (Unit: [L/h])	Ex.: To change the analog output full scale flowrate (flowrate to produce a 20mA output) to 1800L/h → Set to "AF 1800" (L/h). The position of the decimal point is as specified with bP.
AdAn	Damping	2.5	Time constant to be added to the instantaneous flow rate (unit: [sec])	If a ripple in the instantaneous flow rate display and the analog output is large, increase AdAn to stabilize the indication. Ex.: To set the time constant for the instantaneous flow rate display and the analog output to 5 [sec] -> Specify "AdAn 5.0".
bP	Decimal point in instantaneous flow rate	Depends on the specification	The position of the decimal point for the instantaneous flow rate per hour: b1	Ex.: To display the instantaneous flow rate to 0.1L/h (= to one decimal place) → Specify "bP .1" Instantaneous flow rate per minute: b2 will be bP + 2 digits (Note 6)
At	Upper limit of the sampling	5	Timeout time for measurement of instantaneous flow rate (unit: [sec])	If flow pulses fail to arrive for At [sec], the instantaneous flowrate shows 0.
А	The number of sampling	1	The number of sampling cycles during measurement of instantaneous flow rate	Instantaneous flow rate is determined by measuring the time for A times of flow rate detection signals. When an indicated instantaneous flow rate varies excessively, specify a larger A to reduce variation.

- ► NOTE: 1. When it is desired to change meter factor (F) and conversion factor (H), select the proper unit that matches the indicated unit (Un).
 - 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.
 - Be sure to set up a value such that 0.5≤Pu/(F×H×CF) ≤ 10000 (Without temperature/pressure correction, CF=1)
 - 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.
 - 6. Specify the value so that the instantaneous flow rate indication will not exceed five digits. If it exceeds five digits, it will be displayed as shown in the example below.

Example) When bP=2 and the instantaneous flow rate is 800L/h

- Instantaneous flow rate per hour "b1 800.00" L/h
- Instantaneous flow rate per minute is 13.3331/min, exceeding 5 digits \rightarrow It will be displayed as "b2 9.9999".

- Alarm data (title: AL)

Code	Parameter name	Default Setting	Description	Remarks
A1d	Alarm 1 flow rate	0	Instantaneous flow rate that triggers Alarm 1 (Unit: [L/h])	(The decimal point position is as specified with bP)
A1H	Alarm 1 hysteresis	Depends on the specification	Hysteresis for Alarm 1 (Unit: [L/h])	(The decimal point position is as specified with bP)
A1S	Alarm 1 Status	LS	Status for Alarm 1	 [Left digit] L: Lower limit for alarm, H: Upper limit for alarm [Right digit] S: Transistor is ON when the alarm is activated, O: Transistor is OFF when the alarm is activated
A2d	Alarm 2 flow rate	Depends on the specification	Instantaneous flow rate that triggers Alarm 2 (Unit: [L/h])	(The decimal point position is as specified with bP)
A2H	Alarm 2 hysteresis	Depends on the specification	Hysteresis for Alarm 2 Unit: [L/h])	(The decimal point position is as specified with bP)
A2S	Alarm 2 Status	HS	Status for Alarm 2	[Left digit] L: Lower limit for alarm, H: Upper limit for alarm [Right digit] S: Transistor is ON when the alarm is activated, O: Transistor is OFF when the alarm is activated

- Analog trim (title: AnA.tri.) * Displayed only for the specification with output

Code	Parameter name	Default Setting	Description	Remarks
A04	4mA trim		Mode to calibrate the analog 4 mA output (Unit: [mA])	- It should not be used normally as it is calibrated before shipment.
A20	20mA trim		Mode to calibrate the analog 20 mA output (Unit: [mA])	

- Simulated output (title: LooptESt)

Code	Parameter name	Default Setting	Description	Remarks
S.b	Simulated instantaneous flow rate	—	Instantaneous flow rate to be output as a simulated value	
S.c	Simulated total flow		Total flow to be output as a simulated value	Specify when performing a loop check.
StArt	Simulated output		Executing the simulated output using the flow rate conditions specified with Sb and Sc	

-Correction calculation data (title: ConPEn)

* Displayed only for the specification with the temperature/pressure conversion function

Code	Parameter name	Default Setting	Description	Remarks
ConP	Correction calculation selection	Depends on the specification	Selecting the correction calculation	Select one of Act, nor, Std, or Anr. Act: No correction calculation, nor: Normal conversion, Std: Standard conversion, Anr: ANR conversion
rE.P	Reference pressure	Depends on the specification	Specifying the reference pressure (unit: [kPa (gauge)])	Displayed only when "Std" is selected Specifying the reference pressure for the standard conversion.
rE.t	Reference temperature	Depends on the specification	Specifying the reference temperature (unit: [°C])	Displayed only when "Std" is selected Specifying the reference temperature for the standard conversion.
CPo	Compression coefficient in the reference state	1.0000	Specifying the compression coefficient of the fluid in the reference state	Use with the default setting when the correction by the compression coefficient is not necessary.
СР	Compression coefficient in the use state	1.0000	Specifying the compression coefficient of the fluid in the use state	Use with the default setting when the correction by the compression coefficient is not necessary.
а	Linear expansion coefficient a	0.000E0	Linear expansion coefficient of the meter body of the flowmeter	No need to be changed for this product. Use it as is with the default setting.
b	Linear expansion coefficient β	0.000E0	Linear expansion coefficient of the bluff body	No need to be changed for this product. Use it as is with the default setting.
CF	Correction conversion factor	_	Calculated value of the correction conversion factor	Conversion factor for the temperature/pressure correction. The conversion factor will be "1.000E0" when the correction function is not used.

► NOTE: * When "Act" (No correction calculation) is selected for "ConP", the items other than "ConP" and "CF" will not be displayed.

- Service mode (Title: 88888888) * Items to be used by OVAL's service personnel

Code	Parameter name	Description	Remarks		
l.Fr	Input frequency display	Indicating the frequency of the detected flow rate signal (Unit: [Hz])	Frequency after the hardware frequency division		
O.t	Operating time	Indicating the accumulated operating time after factory shipment (Unit: [hours])			
F. t	Flowing time	Indicating the accumulated flowing time after factory shipment (Unit: [hours])	It is for confirmation of the status of the		
SWM	MODE switch count	Indicating the number of times the MODE switch is pressed (Unit: count)	product, and not a setting parameter.		
SWR	RESET switch count	Indicating the number of times the RESET switch is pressed (Unit: count)			
ES.bt.	Energy Save mode setting	Status of the Energy Save mode setting. When the setting is "on", the LCD display is turned off to save power consumption when it is not operated for a certain period of time during the battery operation.	Reserved parameter. Normally unused.		
FC.r	Factory reset	Resetting all the parameters to the factory settings.	It should not be used normally		
SoFt.	Software revision	For internal control	It is for confirmation of the status of the product, and not a setting parameter.		

9.2 Parameter Setup Procedure

9.2.1 How to Modify Parameters

Given below is the parameter setup procedure:



► NOTE: For complete detail of MODE and RESET button operations in steps (1), (2), (6) and (7), see "9.2.2 Menu Trees and Button Operation".

9.2.2 Menu Trees and Button Operation



9.2.3 How to Enter Parameter Values

In the Parameter setting mode, there are three kinds of button operations depending on parameters: numerical value setting, item selection, and decimal point position setting.

(1) Numerical setup parameters

(F, H, Pu, Pon, AF, AdAn, At, A, A1d, A1H, A2d, A2H) A blinking digit is ready to be changed in the parameter

- **RESET** ... Press once to increment the value in the digit to be changed by one.

Or, press once to change a sign of the exponent ("E" <-> "-")

→ After changing the value, press and hold the "MODE"

for 2 seconds (The new setting is established and it goes back to the review mode)

(2) Decimal point setup parameters (bP, SP)

the review mode)

A numerical value that indicates the number of decimal places blinks in the parameter setting mode.

- **MODE** ... Not to be used in the setting operation.
- **RESET** ... Press once to move the decimal point one place to the left and increment the value by one.
- → When a desired position of the decimal point is set, press and hold the "MODE" for 2 seconds (The new setting is established and it goes back to



(3) Item selection parameters (Un, d.o1, d.o2, d.o3, A1S, A2S)

The field that can be changed blinks in the parameter setting mode.

MODE ... Press once to move the digit to be changed one place to the left. (Only for A1S and A2S)

RESET ... Press once to show the next available item.

→ When a desired item is displayed, press and hold the "MODE" for 2 seconds (The new setting is established and it goes back to the review mode)



9.2.4 Calibrating the Analog Output (AnA.tri)

Analog output is calibrated at the time of shipment; there is no need to perform this procedure under normal circumstances.

[Example] 4mA trimming procedure



→ 20mA output trim can be performed by the same procedure described above in 20mA trimming mode (A20).

9.2.5 Simulated Output Function (LooPtESt)

In the parameter review mode, simulated output can be performed by specifying "Instantaneous flow rate (S.b)" and "Total flow (S.c)" then executing "StArt".

Simulated output is calculated from parameters such as Meter factor, Pulse weight, Analog full scale, etc., based on Instantaneous flow rate (S.b) setting.

Signals output in the simulated output

- (1) SIG.1, SIG.2, SIG.3: "Factored pulse" or ""Alarm 1", or "Alarm 2" (depending on the setting of d.o1, d.o2, and d.o3)
- (2) Analog output

► NOTE: - Simulated output does not affect actual measured values (accumulated total and resettable total flow).

- Due to the capability of simulated output (frequency resolution), (S.b) and (S.c) values may automatically be changed to vaues available for simulated output that is closest to manually set value.

(The actual simulate output values for instantaneous and total flow rate will be displayed when the setting is established.)

- <u>Although simulated output function is available while the actual fluid is flowing, the actual flow rate</u> will not be measured by the transmitter

Example) Simulated output performed for 1800L/h, 100L



9.2.6 Alarm Output

[Alarm-related Parameters and Meanings]

Parameter Code	Name	Description
A1d	Alarm 1 setup	Alarm flowrate setting for Alarm output 1 (in hourly flowrate)
	Alarm 1 hysteresis	Hysteresis for Alarm output 1 (in hourly flowrate) Threshold between alarm setting value and the value at which the alarm is canceled.
A1S $ riangle 0$	Alarm 1 status	 Output status of alarm 1
A2d	Alarm 2 setup	Alarm flowrate setting for Alarm output 2 (description is same as A1d)
A2H DDDD	Alarm 2 hysteresis	Hysteresis for Alarm output 2 (description is same as A1h)
A2S $ riangle 0$	Alarm 2 status	Output status of alarm output 2 (Description remains the same as A1S.)

- When the instantaneous flow rate value exceeds (or falls below) the alarm setting value, the alarm indicator will be turned on and external alarm output signal will be generated.
- The alarms can have hysteresis.
- Two alarms, Alarms 1 and 2, are provided and the setting can be made respectively.

When the alarm function is not used, make sure to set A1d and A2d to "0"

-> When A1d or A2d is set to "0", the respective alarm function itself is disabled.

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



9.2.7 Temperature/Pressure Compensated Fixed Conversion

If the gas temperature/pressure compensated fixed conversion function is specified, conversion can be utilized by the following procedure.

The respective output and display indicate the result of conversion.

Normal conversion: (nor)

Converted to the volume at the reference temperature: 0°C and reference pressure: 1 atm (101.325kPa).

Corrected conversion factor CF = $\frac{Pr+101.325}{101.325} \times \frac{273.15}{tE+273.15} \times \frac{CPo}{CP}$

Standard conversion: (std)

Converted to the volume at the arbitrarily specified reference temperature and reference pressure.

 $\label{eq:corrected conversion factor CF} \mathsf{CF} = \frac{\mathsf{Pr} + 101.325}{\mathsf{rE}.\mathsf{P} + 101.325} \times \\ \frac{\mathsf{rE}.\mathsf{t} + 273.15}{\mathsf{tE} + 273.15} \times \\ \frac{\mathsf{CPo}}{\mathsf{CP}}$

ANR conversion: (ANR)

Converted to the volume at the reference temperature: 20°C and reference pressure: 1 atm (101.325kPa), humidity: 65%.

Corrected conversion factor CF= $\frac{Pr+101.325}{101.325} \times \frac{273.15}{tE+273.15} \times \frac{CPo}{CP} \times 1.0899$

[Procedure]

- (1) Go to the compensated calculation data (Title: ConPEn) in the parameter review mode.
 Select the type of the compensation in the compensated calculation selection "ConP":
 Act: No correction calculation, nor: Normal conversion, Std: Standard conversion, Anr: ANR conversion.
- (2) Specify the reference pressure "rE.P", the reference temperature "rE.t", the compression coefficient in the reference state "CPo", and the compression coefficient in the use state "CP". (Some of them may not be displayed depending on the compensation calculation selection). If compensation by the compression coefficient is not required, specify "1.0000" for "CPo" and "CP".
- (3) Specify the process pressure "Pr" and the process temperature "tE" in the measurement mode. (After (1) to (3) are set, the conversion factor is shown in the compensation conversion factor "CF" in the parameter review mode)
- (4) Reconfigure the parameters. Depending on the values specified in (1) to (3), some parameters may require reconfiguration to perform output/display after conversion. See the cautions listed in the next page and reset the reconfigure the relevant parameters.

- Pr: Process pressure [kPa(gauge)]
- tE: Process temperature [°C]
- rE.P: Reference pressure [kPa(gauge)]
- rE.t: Reference temperature [°C]
- CPo: Compression coefficient in the reference state
- CP: Compression coefficient in the use state

[Cautions]

(1) Reconfiguring parameters based on temperature/pressure compensated conversion settings Depending on the conditions established for compensated conversion related parameters, the below parameters may require reconfiguration.

Code	Parameter name	Description
н	Conversion factor	Reset when the unit is changed in accordance with (3)
Pu	Pulse weight	Reset in accordance with (2)
Un	Indicated measurement unit	Reset when the unit is changed in accordance with (3)
SP	Position of the decimal point for the total flow	Reset according to the unit after conversion
AF	Full scale flow rate	Reset the maximum flow rate after conversion
bP	Position of the decimal point for the instantaneous flow rate	Reset in accordance with (3)
A1d, A2d	Flow rate for Alarms 1 and 2	Reset with the unit after conversion
A1H, A2H	Hysteresis for Alarms 1 and 2	Reset when the full scale flow rate "AF" is changed (Recommended value: Equivalent to 1% of the full scale flow rate "AF")

(2) Input restriction of Pu

There is an input restriction for the following parameters: meter factor "F", conversion factor "H", compensated conversion factor "CF", and Pulse weight "Pu". When the process pressure/temperature values cause the compensation factor "CF" to be a large value, the pulse weight error "PA. Err.Pu" may occur. Make sure to check below formula with the conditions with the maximum compensation factor and specify the pulse weight "Pu" which does not to exceed the input restriction.

[Input restriction]
$$0.5 \leq \frac{Pu}{F \times H \times CF}$$
 10000

(3) The number of digits of the instantaneous flow rate to be displayed

For instantaneous flow rate per hour, the total number of displayed digits is 5 including integer and decimals. For instantaneous flow rate per minute, two additional decimal places are displayed compared to the decimal point of instantaneous flow rate per hour.

When temperature/pressure compensation conversion is performed, the number of digits for instantaneous low rate may exceed the capacity of the display.

In that case, change the following parameters to make the number of digits to be displayed for the instantaneous flow rate appropriate.

- Change " bP", the decimal point position of the instantaneous flow rate
- Change "Un", the indicated measurement unit
- Change "H", the conversion factor

For the setting procedure, see Sections 9.1 and 9.2.1.

9.3 Error Messages

This product allows arbitrarily parameter setting changes. However, in cases of improper settings and existence of errors, error messages are displayed as below.

Message	Name	Description	Action to recover
PA. Err. 1	Parameter error 1	Backup data for the parameters is corrupted.	It is necessary to reset the parameters after initializing the CPU. (Contact OVAL's service network)
PA. Err. 2	Parameter error 2	Either data of the display mode, accumulated total flow and resettable total flow is corrupted.	It returns to the normal measurement mode with the MODE button, but the accumulated total flow and the resettable total flow will be reset.
PA. Err. 3	Parameter error 3	The parameter data for the factory reset is corrupted.	It returns to the normal measurement mode with the MODE button, but the factory reset function will not be available.
PA. Err. Pu	Pulse weight error	The setting value of the pulse weight "Pu" is too small for the meter factor "F" and the conversion factor "H".	Reset the values so as to satisfy the following relations among F, H and Pu. $0.5 \le Pu/(F \times H \times CF) \le 10000$ (CF=1 with no temperature/pressure correction)
Out. Err	Pulse output error	The pulse OFF width for the factored pulse output falls below 1 msec due to either of the following reasons: (1) The flow rate is excessive (2) The setting of the factored pulse width is too large	In case of (1): Reduce the flow rate. In case of (2): Reset the factored pulse width Pon so as to be an appropriate value for the flowmeter specifications.
FS. Err Full scale error		The measured flow rate is exceeding 1.2 times the full scale setting value due to either of the following reasons: (1) The flow rate is excessive (2) The setting of the factored pulse width is too small	In case of (1): Reduce the flow rate. The error is released when the flow rate becomes below the full scale setting value. In case of (2): Reset the full scale setting value so as to be an appropriate value for the flowmeter specifications.
(Blinking Battery sign)	Battery life	The voltage in the circuit has dropped.	Replace the battery. (A failure of the internal device is suspected if it does not recover after the battery is replaced)

10. MAINTENANCE PROCEDURE

10.1 Battery Unit Replacement

If you want to purchase a battery unit for replacement, please contact the shop you purchased the product main unit.

The battery unit is a dedicated product. Other commercially-available batteries are not usable. If a battery other than the dedicated product is used, we cannot guarantee or repair the product.

- (1) Rotate the display of the converter to set its orientation to any of the 45°, 135°, 225°, or 315° position.
- Pull the display in an upward direction.The display and the body are connected with the cable, so lift it carefully.

It is not necessary to remove the cable connection when replacing the battery unit.



(3) When the display is opened, the battery unit appears.

The battery unit is fixed with hook-and-loop fastener. Peel the fastener to release the battery unit. Do not pull the hook-and-loop fastener since it will be used again after the battery replacement.



(4) Take out the battery unit. Hold the lead wire at the root of the connector that is connected to the internal printed board and pull upwards to detach the connector.



- (5) Insert the connector of the new battery unit so that the red lead wire is on the "+" side. Then, place the battery unit to the original position and fix the cable and the battery unit with the hook-and-loop fastener.

(6) Mount the display unit, watching carefully not to jam the cable.

The display unit can be mounted when the orientation is set to any of the 45°, 135°, 225°, or 315° position. Check that there is no gap between the display unit and the body. Rotate the display orientation by 45° to set it in the lock position.



11. OUTLINE DIMENSIONS



	-	ψu	п	-	~~		112	(9)
$FLM_3^2 S-1 \Box \frac{P}{N} D \Box$	4	8.5	R3/8 NPT3/8	80	32	29	86.2	260
$FLM_3^2 0-1 \Box \stackrel{P}{N} D \Box$	8	13	R1/2 NPT1/2	80	32	29	86.2	260
$FLM_3^2 1-1 \Box \underset{N}{P} D \Box$	15	14	R3/4 NPT3/4	85	32	29	86.2	260
$FLM_3^2 2-1 \Box \underset{N}{P} D \Box$	25	24.5	R1•1/4 NPT1•1/4	120	46	46	103.2	390

Rc female thread





Signal cable is not furnished with battery powered model.

Madal	Nominal		Approx					
Widder	Diam.	φd	Rc	L	W	H1	H2	(g)
FLM $\frac{2}{3}$ S–1 \square SD \square	4	8.5	Rc1/4	91	50	29	86.2	720
FLM ² / ₃ 0–1□SD□	8	13	Rc1/4	91	50	29	86.2	720
FLM ² / ₃ 1–1□SD□	15	14	Rc1/2	91	50	29	86.2	720
FLM $\frac{2}{3}$ 2–1 \Box SD \Box	25	24.5	Rc1	126	46	46	103.2	970

12. GENERAL SPECIFICATIONS

Iten	n	Description								
Nominal size		4mm	8mm	15mm	25mm					
	R male thread Material: PPS	R3/8	R1/2	R3/4	R1·1/4					
Process connection	NPT male thread Material: PPS	NPT3/8	NPT1/2	NPT3/4	NPT1·1/4					
	Rc female thread Material: SCS14A	Rc1/4	Rc1/4	Rc1/2	Rc1					
Applicable fluids	Liquid		Wat	er						
(Note 1)	Gas		Air, Nitro	gen gas						
	Water	0.4 to 4	1.1 to 15	2.8 to 45	8.3 to 133					
(L/min)	Air at atmospheric pressure	7.2 to 17	18 to 90	55 to 283	167 to 850					
Tomporati wa kongo	Fluid		-10 to +80°C	(no freezing)						
Temperature range	Ambient		-10 to	+60°C						
Max. operating pres	sure		0.98N	/IPa						
Accuracy		Liq	juids: $\pm 2\%$ of full scale	Gas: $\pm 3\%$ of full so	cale					
Repeatability			± 0.	5%						
Brossura Jasoa	Water	0.31 to 31		0.12 to 34.3						
(kPa)	Air at atmospheric pressure	0.13 to 0.7		0.06 to 1.52						
Major parts material		Body and sensor: PPS resin (Polyphenylene sulfide) Converter case: Polycarbonate Wet sealing material: Fluoro rubber								
Installation location		 Free from rain and water ② Minimal temperature variation ③ No exposure to direct sunlight (equivalent to IP53) 								
Display (LCD)		 Accumulated total flow 8-digit Instantaneous flowrate per hour 5-digit Instantaneous flowrate per minute 5-digit Instantaneous flowrate per minute 5-digit Resettable total flow 7-digit Fluid pressure setting) Fluid temperature setting The display shows items ①②③④ in rotation as MODE button is pressed. When the temperature/pressure compensation (fixed conversion) is specified, ⑤ and ⑥ are also displayed. The display can be rotated to the positions on 0°, 90°, 180°, and 270°.								
	Battery powered		Nor)e						
		Analog output	4 to 20mA							
Output	Externally powered	Alarm output	Open drain output (equivalent to open collector), Allowable current: 20mA, Maximum applied voltage: 30V Output point: 2 points (Set arbitrary values for [High limit alarm instant flow] and [Low limit alarm instant flow])							
		Factored pulse output	Factored pulse output Open drain output (equivalent to open collector), Allowable current: 20mA, Maximum applied voltage: 30V Pulse width: 30ms (selectable range: 1 to 999ms)							
Power sourco	Battery powered	Dedicated lit	hium battery unit Life: ap	prox. 6 years (at room	n temperature)					
Fower source	Externally powered	12 to 45VDC Max.30mA								
Transmitter cable (E)	kternally powered)		5-conductor shield c	able (1m attached)						
Transmitter length (Externally	Max. 1km (CVVS: 1.25 to 2.0mm ²)								
powered)		Max. 100m when using analog output with pulse/alarm output								
Applicable standard	s	EN 61326-1 EN IEC63000								

Note 1: Hazardous fluids (flammable, corrosive, toxic, etc.) cannot be measured.

Display and Output Unit (Standard Setting)

(1) Liquid service

		Total unit and fa	Maximum flow		
Model	Nom. dia. (mm)	Pulse unit [L]	Maximum output frequency [Hz]	rate L/min	
FLM2S-1	4	0.01	6.67	4	
FLM20-1 🗆 D 🗆	8	0.1	2.50	15	
FLM21–1	15	1	0.75	45	
FLM22-1 D	25	1	2.22	133	

(2) Gas service

		Total unit and fa	Maximum flow		
Model	Nom. dia. (mm)	Pulse unit [L]	Maximum output frequency [Hz]	rate L/min	
FLM3S-1000	4	0.1	2.83	17	
FLM30–1 🗆 D 🗆	8	1	1.50	90	
FLM31–1□□D□	15	1	4.72	283	
FLM32-1 DD	25	10	1.42	850	

13. PRODUCT CODE EXPLANATION

ltere				F	Prod	uct	cod	е				Description	
Item ①		2	3	4	5	-	6	7	8	9	10	Description	
Model	F	L	Μ									Eggs DELTA II	
Eluid Coto	aor			2								Liquid	
	sou	У		3								Gas	
					S							4mm	
Nominal					0							8mm	
Diameter	(N.E).)			1							15mm	
					2							25mm	
						-							
Display		1					1					LCD display provided	
								0				No output (battery-powered)	
								1				Factored pulse output	
								2				Analog output	
Output								4				High/low alarm output	
								5				Factored pulse output + High/low alarm output	
								7				Analog output + Factored pulse output + High/low alarm output	
									Р			R male thread Material: PPS	
Process C	Conr	ecti	ion						Ν			NPT male thread Material: PPS	
									S			Rc female thread Material: SCS14A	
Version D									D		Always "D"		
										0	None		
Character	ictic	Co	do								Ν	Normal conversion	
	ISUC	. 00									S	Standard conversion	
											Ζ	Other temperature/pressure compensation	

14. KC mark

Model

ltom		Pro	duct c	ode		Description	
Item	1	2	3		4	Description	
Model	F	L	Μ			Eggs DELTA II	
Dowor Supply					В	Battery type	
					D	External power supply	

Equipment Class: Class A for Office Use

사용자안내문

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서

가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※사용자 안내문은 " 업무용 방송통신기자재 " 에만 적용한다 .

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All specifications are subject to change without notice for improvement.



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