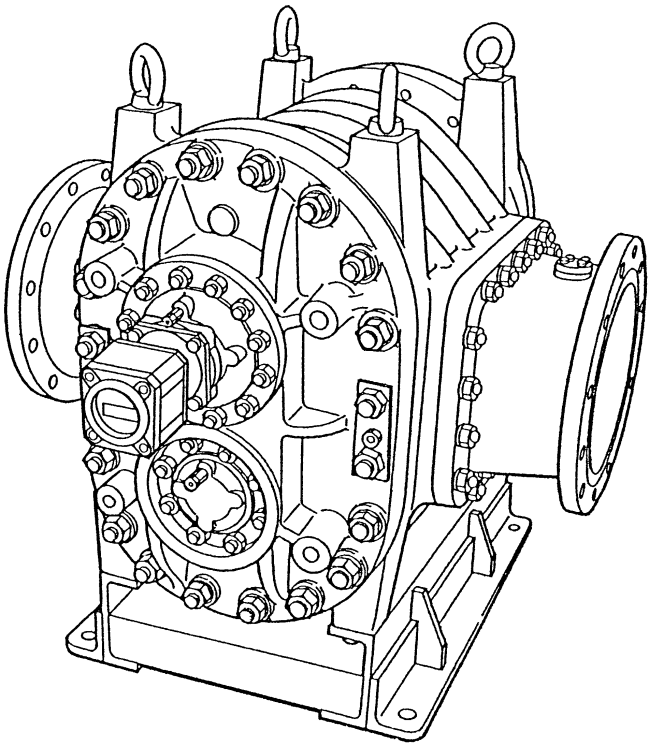
OVAL INSTRUCTIONS

Ins. No. B-414-6-E

Special design

ULTRA OVAL

Meter Size: 65
Register Model: UA
U8 (smart type)



Every OVAL flowmeter 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.

◆ About Meter Size Designation ◆

The size of OVAL positive-displacement flowmeters is basically identified by a two-digit code.

⚠ **CAUTION: Sections and paragraphs marked with ● applies to Smart type (register type: U8).**

CONTENTS

The indications **NOTE**, **CAUTION**, and **WARNING** shown throughout this manual are to draw your attention to specific items:

➡ NOTE

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

⚠ CAUTION

Caution statements call attention to user about hazards or unsafe practices that could result in minor personal injury or property damage.

⚠ WARNING

Warning statements call attention to user about hazards or unsafe practices that could result in serious personal injury or death.

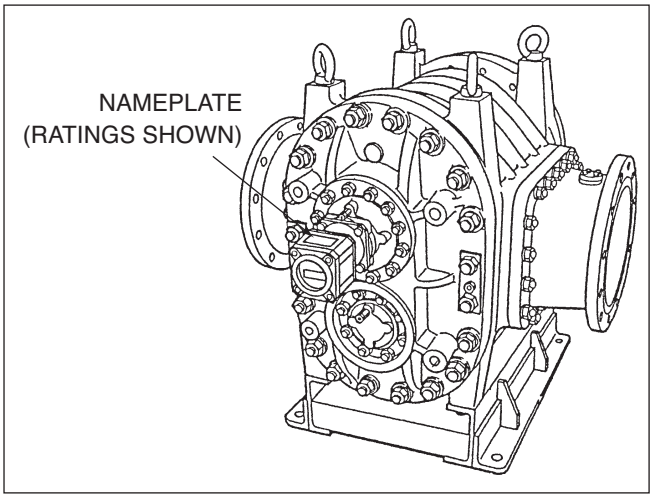
1. BEFORE YOU BEGIN

Every **Ultra Oval** is thoroughly tested before it leaves the factory. When received, it should be thoroughly inspected for indication of rough handling during transit.
Necessary handling precautions are described in this section; read the instructions carefully.
As for other information, find the respective sections from "CONTENTS" on pages 2 and 3.
For any inquiries, contact your nearest OVAL designated sales office.

⚠ CAUTION: When you make inquiries, include the product name, model number, stock number, ratings and other necessary information.

1.1 Confirming the Nameplate

Every **Ultra Oval** is assembled and adjusted according to individual specifications. Product code number and ratings are stated on the nameplate of the register. By referring to them, make sure they conform to your particular specification.



1.2 Transportation Considerations

(1) To safeguard against damage during transit, transport your Ultra Oval to the installation site in the same container used for transportation from the factory if circumstances permit.
(2) Ultra Oval is adjusted and inspected as an assembly consisting of the meter body, sensor and register. It should therefore be handled as an integral assembly.
(3) The register is accurately adjusted and programmed. Do not attempt to remove the front cover to gain access to its internal assembly.

1.3 Storage Precautions

If your Ultra Oval is stored for long periods of time upon receipt before installation, unexpected faulty conditions could result. If a long-term storage is anticipated, take the following precautions:
(1) Keep your Ultra Oval in store in the same shipping container used for transportation from OVAL if possible.
(2) Place of storage should conform to the following requirements:
★ It is free from rain and water.
★ It is 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 Ultra Oval that has once been placed in service with clean air, N2 gas, etc. to prevent the metered fluid from adhering to the meter connections, piping inner walls, housing, etc. before storage. (Wash clean with suitable detergent if necessary.)
(4) In case of storage for extended periods of time, good practice is to keep in store in the same containers used for shipment from the factory.

1.4 Precautionary Notes on Construction

(1) The register is designed for use outdoors with waterproof construction.

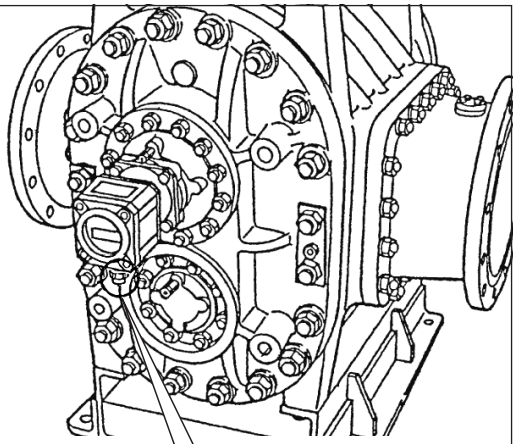
(2) Do not install substitute parts or perform any unauthorized modification to the instrument, or it will nullify the warranty.

(3) The cable lead-in supplied with the explosionproof type forms part of the flameproof construction. Do not attempt to use any substitute lead-in other than those supplied. Also tighten the union of pressuretight packing firmly upon completion of wiring connections.
- Output provided: Other thasn 00 in the last two digits of product code - Pressuretight packing is supplied.
- Output not provided: 00 in the last two digits of product code - Close-up plug is supplied.

(4) Of the four different pressuretight packings (ϕ9, ϕ10, ϕ11 and ϕ12) furnished as standard accessories, a ϕ11 packing is tentatively installed in place. Select from these and install the one that best fits the finished outside diameter of your particular cable.

Table 1.1 Applicable Cable Outside Dia. Unit in mm

Packing Code	Packing I.D.	Cable O.D.
9	9.0	8.5 to 9.0
10	10.0	9.1 to 10.0
11	11.0	10.1 to 11.0
12	12.0	11.1 to 12.0



Lead-in Fitting
(pressuretight packin)

➡ NOTE: Cable gland is not supplied with non-explosionproof type models. The customer is to prepare a watertight gland (thread size: G1/2). In such a case, provide means to preclude moisture from the register.

⚠ **CAUTION: Moisture intrusion into the register will blur display window and could impair the performance.**

2. OPERATING CONDITIONS

To maintain the stated high accuracy and long service life of the flowmeter, make sure that flowrate, pressure, temperature and viscosity are within the ratings as shown on the meter register nameplate. Do not fail to confirm these ratings before placing it in service.

⚠ **CAUTION:**

1. Although allowable ambient temperature is up to +60 °C for explosionproof units, it is desirable that the meter be used at room temperature and humidity.

MADE IN JAPAN MNPJ-237

ULTRA OVAL	OVAL Corporation	
MODEL		
TAG. No	MAX PRESS.	
FLOW RANGE		
INT.	to	
CONT.	to	
FULL SCALE	TEMP.	PULSE UNIT
SERIAL No.	DATE	SIZE
FLUID		METER FACTOR
NOTE: 1. When measuring other liquids, consult us. 2. Place the meter body (outer case) in a horizontal position. For details see instruction manual.		

2. In cases where the register is exposed to elevated temperatures due to exposure to direct rays of the sun or to radiant heat, ensure, by providing a sunshade or similar protection, that the meter is used within the operating temperature range.

3. The UA type register is not provided with subtract function. If pulsation in the flow (where the fluid moves back and forth in the pipeline under the influence of pressure) or reversal of flow exists, the total counter may show erratic reading, accumulating all incoming pulses irrespective of flow direction.

2.1 Installation Conditions for Maintaining Explosionproof Rating

This product is approved as explosionproof. Failure to comply with the following conditions will automatically nullify this rating. Explanations denoted by an asterisk are given on the page that follows.
Model provided with output (Product code ends in a code other than 00.)

(1) Do not perform any unauthorized modification to this product.
(2) Before opening the enclosure, if necessary for some reason, ensure safety against hazards associated with flammable gases present in the atmosphere.
(3) Register Model UA; In case of TIIS explosionproof type used under the ambient temperature of 45°C or higher, use a cable resistant to the temperature of 75°C or higher.
Register Model U8; In case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher.
(4) Intrinsically safe rating remains valid only when no external circuit is connected to this equipment. To use it as rated, do not connect it to any external circuitry.
(5) Use under ambient temperature conditions below 60℃.
(6) Metered fluid temperature must be held below 120℃.

Specification (1): Output provided (Product code ends with a code other than 00.)

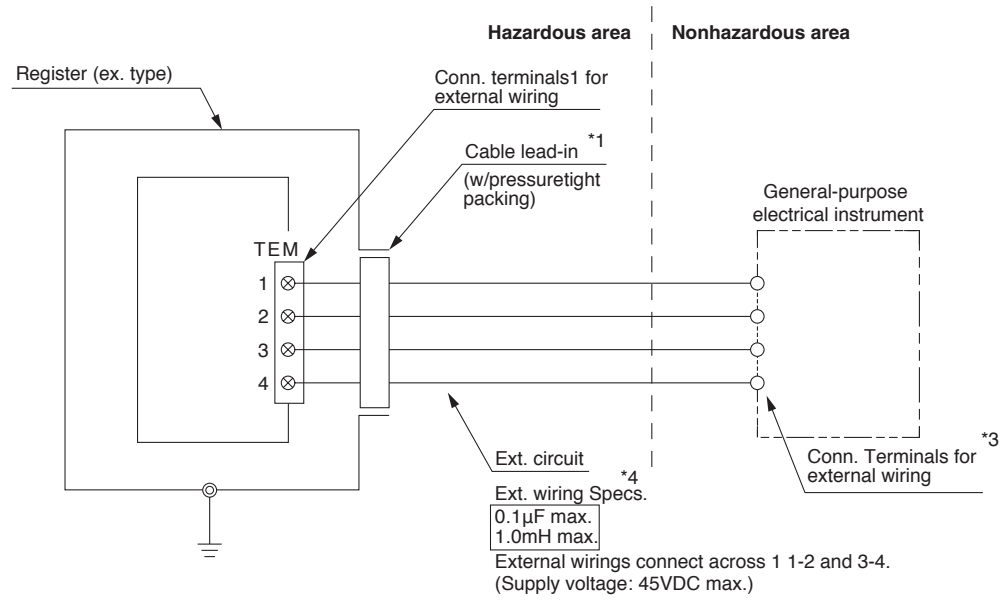


Fig. 2.1

Specification (2): Output not provided (Product code ends in 00.)

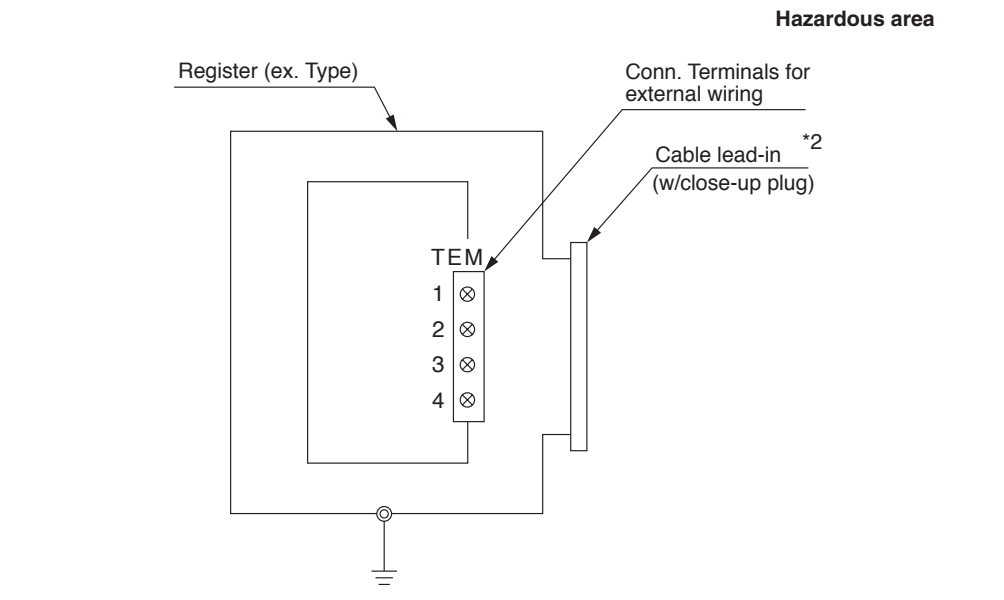


Fig. 2.2

➡ NOTE : Detailed explanation of asterisks *1 through *4 in Figs. 2.1 and 2.2.

*1 *3 *4	Explosionproof enclosure of the ex type equipment is represented by a code Exd II BT4/Exia II BT4. For models with the provision of output (product code ends with a code other than 00), a pressuretight packing *1 for cable entry is supplied as standard accessory. Flameproof rating (Exd II BT4) remains valid as long as it is used in place. However, because of a built-in battery pack, if supply power is removed from this state and an external circuity *3 is disconnected at the external circuit wiring connection terminals end, then intrinsic safety rating (Exia II BT4) applies.
*2	For models with no provision of output (product code ends in 00), close-up plugs *2 (manufactured by Shimada Electric, Model SBP-16) for cable entry are supplied as standard accessories. Intrinsically safe rating (Exia II BT4) remains valid as long as these are used in place.
*4	In working with models output available (product code ends with a code other than 00), use cables that link this product with a general-purpose electrical instrument (receiving instrument, etc.) which meet the following requirements: ・ Temperature rating : Register Model UA; In case of TIIS explosionproof type used under the ambient temperature of 45°C or higher, use a cable resistant to the temperature of 75°C or higher. Register Model U8; In case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher. ・ Electrical ratings : Allowable cable capacitance 0.1, μF max. Allowable cable inductance 1.0mH max.

3. GENERAL

Ultra Oval has been developed to meet the needs of accurate flowrate measurement.
The local direct-reading total counter is an all-electronic register built around a single-chip CPU. With latest electronic technologies used throughout, this versatile register displays accumulated total flow, instantaneous flowrate (digital readout) and provides, by option, a pulse and analog output proportional to the rate of flow.
In this meter, fluid flow is detected by sensing with an amorphous sensor the magnetic fields of permanent magnets embedded in the oval rotors. As a result, high reliability is achieved.

<Features>

(1) Absence of any mechanically sliding components except for oval rotors contributes to long service life.
(2) Small wetted parts and pocketless design makes this meter suitable for flow measurement of chemical liquids.
(3) You can monitor accumulated total flow and instantaneous flowrate locally on the digital display.
(4) When coupled with a remotely located receiving instrument, output signals can readily and simply be used for applications including control, adjustment and recording.
(5) The explosionproof construction offers increase of safety.
(6) Both the local totalizer type and externally powered type, a nonvolatile memory retains the most recent total count in the event of power failure or power cycling.
(7) Low battery alarm is among its many alarm displays.

➡ NOTE : See Section 9.3 on page 19.

<NOTE>

Using the meter for a long period of time, its error will deviate more or less from the initial factory calibration's. Upon request, we may conduct an instrumental error testing and establish a "new meter factor" in the scaler when your Ultra Oval is returned to the factory for periodic inspection or for other reasons.

4. PART NAMES

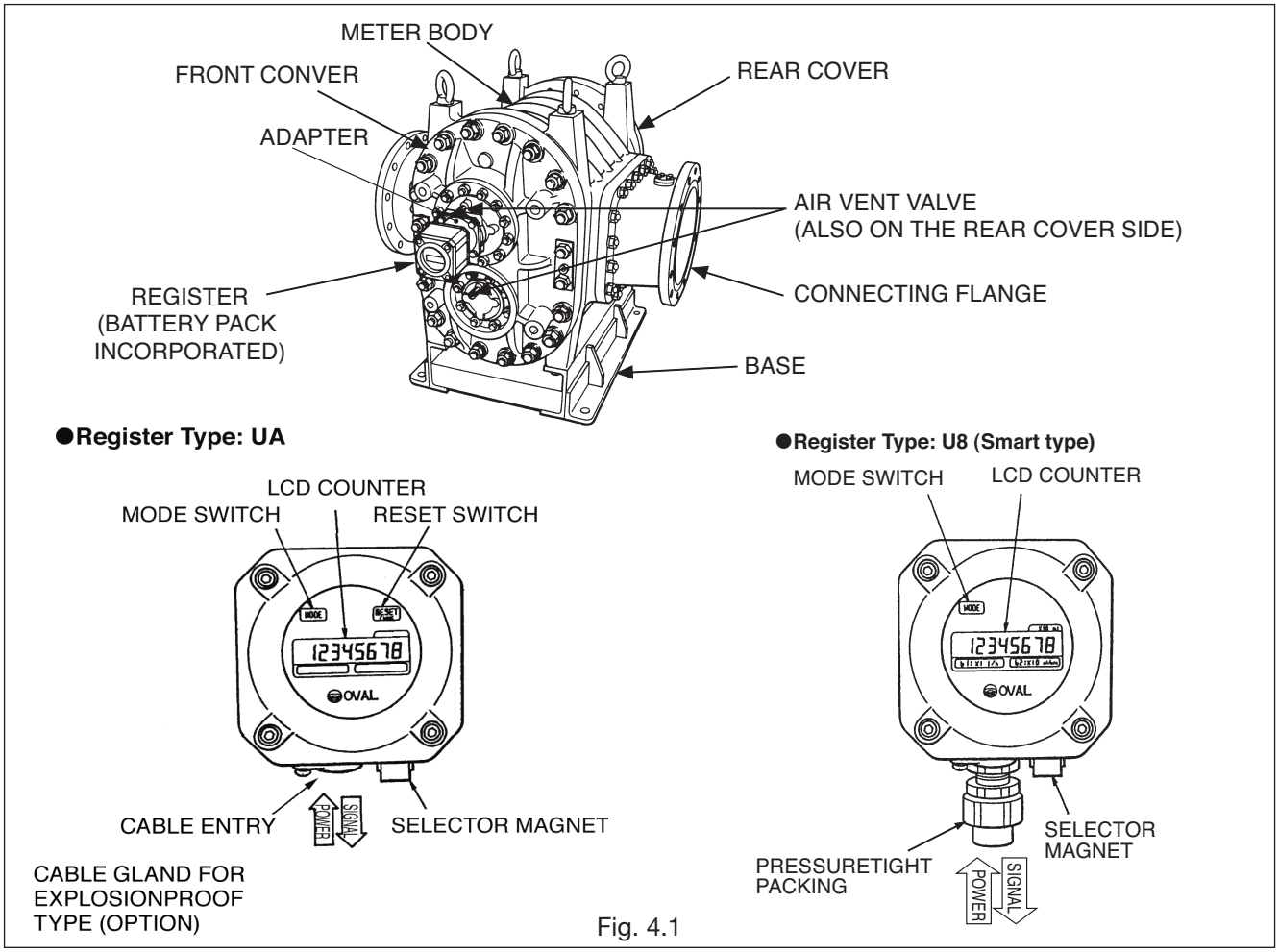


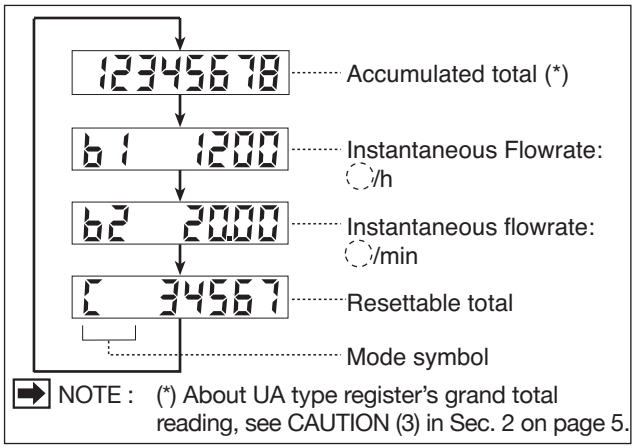
Fig. 4.1

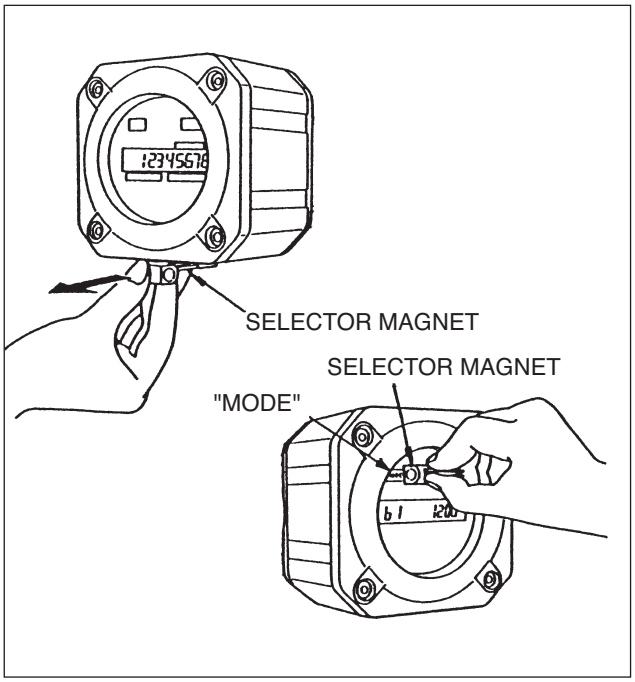
5. LCD COUNTER DISPLAY

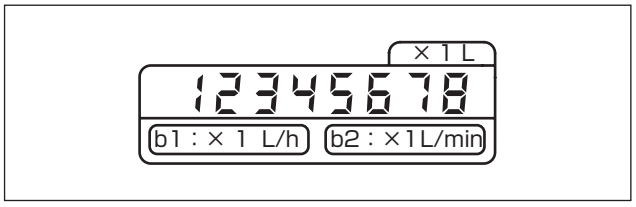
5.1 Register Model UA

5.1.1 About "MODE" Switch

Removing the selector magnet inserted at the bottom of the register, apply it to the labels "MODE" and "RESET" on the LCD counter face and the display will scroll forward through the available readings as shown.

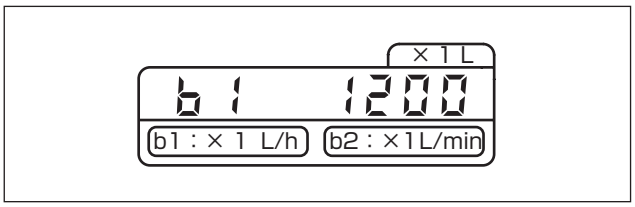






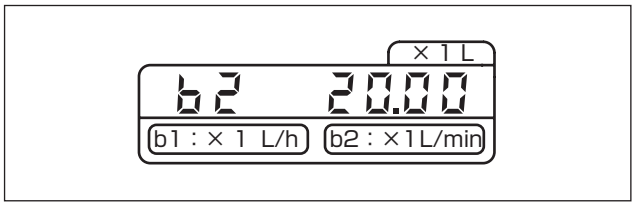
(1) Accumulated Total Flow

An accumulated total of 12345678 L is shown here.



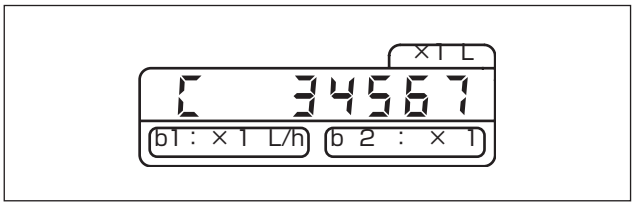
(2) Instantaneous Flowrate (b1)

An instantaneous flowrate of 1200 L/h is shown here.



(3) Instantaneous Flowrate (b2)

An instantaneous flowrate of 20.00 L/min. is shown here.



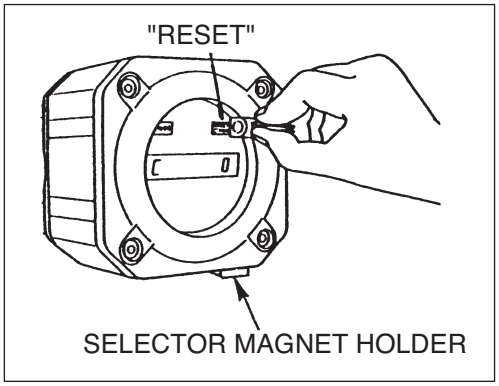
(4) Resettable Total Flow

A resettable accumulated total of 34567 L is shown here.

5.1.2 About "RESET" Switch

Only in the resettable mode, or in Mode Symbol: "C", the accumulated total reading is resettable.

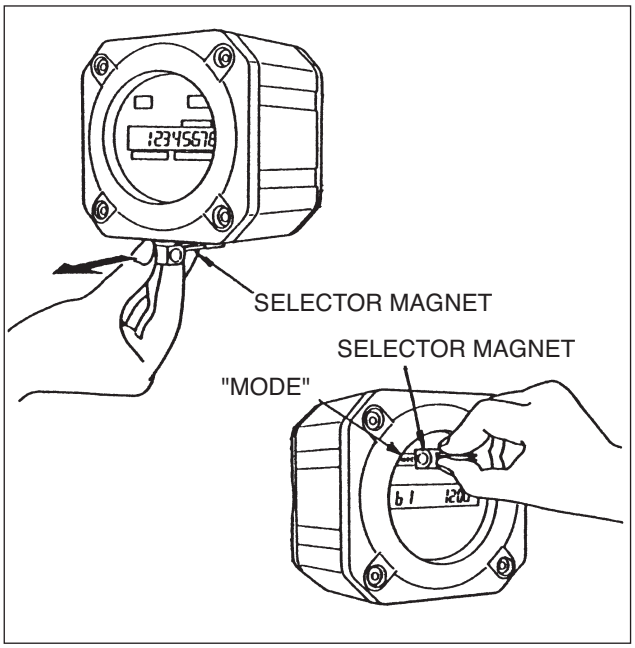
⚠ CAUTION:
Do not fail to install the selector magnet in its holder after use lest you will not lose it. It uses an intensive magnet; never hold it close to floppy disks or other magnetic storage items.



● 5.2 Register Model U8

5.2.1 About "MODE" Switch

Removing the selector magnet inserted at the bottom of the register, apply it to the label "MODE" on the LCD counter face and the display will scroll forward through the available readings as shown.



⚠ CAUTION:
Do not fail to install the selector magnet in its holder after use lest you will not lose it. It uses an intensive magnet; never hold it close to floppy disks or other magnetic storage media.

5.2.2 Display Functions

The display can show four different kinds of flow information - total flow, instantaneous actual flowrate, percent instantaneous flowrate, and 8-division percent bar graph.
It also shows the following error messages:

Sensor error	: ErrorSE
Full scale exceeded	: ErrorFS
Upper-limit flowrate exceeded	: ErrorOF

➡ NOTE : Multiple errors will be indicated in priority order below: ErrorSE > ErrorOF > ErrorFS

5.2.3 Display Selection

Two ways are available to select displays - with a display select switch inside the register, or through communications with the Smart Communication Unit Model EL2310 (or HHC: Model EK10).
If your option is through communications, follow the instructions outlined in the Smart Communication Unit EL2310 (or HHC: EK10) instruction manual.

➡ NOTE : Show "Transmitter Info." window at "Configure" menu on the PC screen.

Selection with display select switch requires access to the display select switch SW1 by opening the register cover facing its internal assembly and pressing this switch (see page 25). The display scrolls forward through available information each time you press this switch as shown in Fig. 5.1.

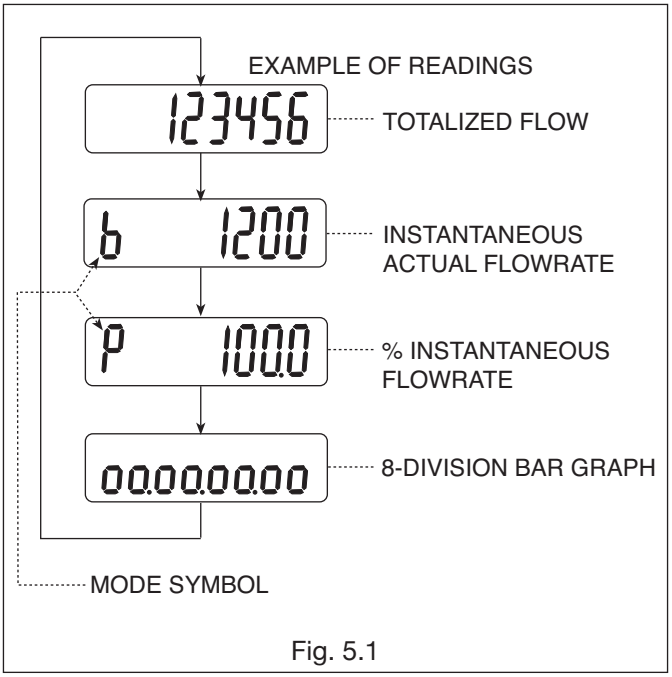


Fig. 5.1

5.2.4 Total Flow Reset

Displayed total flow can be reset either by the display select switch SW1 (see Fig. 12-1 on page 34) or through communications with the Smart Communication Unit. If your option is through communications, follow the instructions outlined in the instruction manual of Smart Communication Unit EL2310.

➡ NOTE : Show "Measure" window at "View" menu on the PC screen.

With the display select switch, you can reset the totalizer by holding the display select switch SW1 depressed for more than 3 seconds while the total flow is shown.

5.2.5 Precautionary Notes on Pulse Output Type

(1) If your model is of pulse output type, the pulse output and total counter remain inoperative for 15 seconds approx. after power on while communicating with the Smart Communication Unit. For 15 seconds approx. after termination of communications, the pulse output and total counter also remain inoperative.

(2) Requirements for validating communications
Communication is valid only when the following requirements are met:
・Flowrate at zero (There is no pulse output.)
・Within 15 seconds after power on

➡ NOTE : The period of 15 seconds immediately after power on is called "Communication standby mode." (The built-in indicator, if so equipped, will display as shown in (1) in the figure below.)
If communications are started during this period, a switchover to "Communication mode" takes place, permitting you to communicate until power is turned off. (The built-in indicator will display as shown in (2) in the figure below.)
To start flow measurement routine, turn power on again. (After power cycling, the pulse output and total counter will also remain inoperative for 15 seconds.)

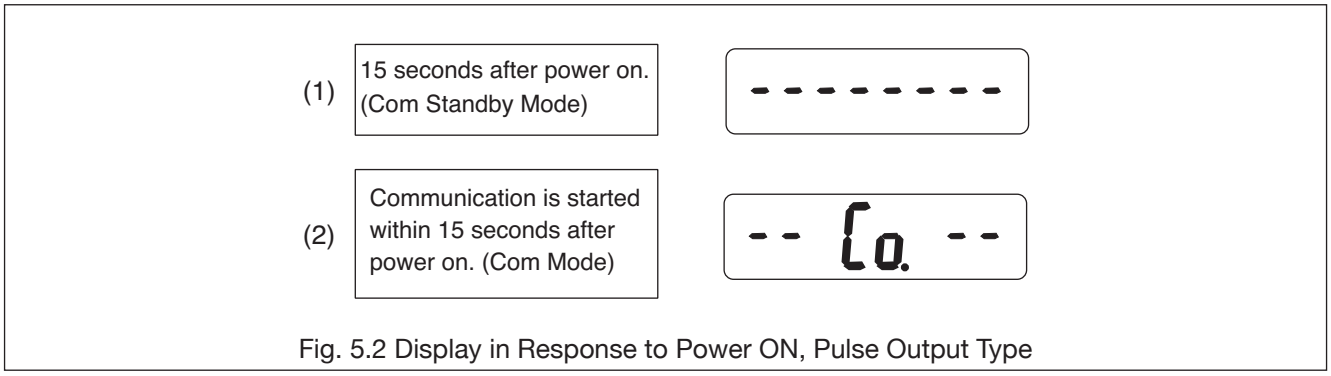


Fig. 5.2 Display in Response to Power ON, Pulse Output Type

(3) While communications continue, the receiving instrument (total counter, etc.) may overcount under certain circumstances. To eliminate the possibility of such erratic extra counting, precautions should be taken by either disconnecting the receiving instrument before starting communications, or putting on paper the most recent total reading and other important data.

(4) Except for communications, do not connect the probe of the smart communication unit to the signal lines. With the probe connected, the waveform of output pulse signal may possibly be distorted due to the influence of the capacitive impedance the interface has, making the receiving instrument fail to receive incoming pulses properly.

⚠ CAUTION: Precautionary Notes on Analog Output Type

Analog output type permits communications at all times. However, erroneous setting of parameters not compatible with the specification may result in erratic receiving instrument operation due to abrupt output changes. We recommend therefore to reconfigure parameter setting at zero flow.

6. INSTALLATION

➡ See "TYPICAL INSTALLATION" on page 13.

6.1 Transit Considerations

(1) To safeguard the two air vent valves (134) on the rear cover against damage, two eyebolts (123) are provided on the rear cover before shipment from factory. At installation or removal, use these eyebolts by installing them on top as shown in Fig. 6.1.
When you return the meter to the factory for servicing or other purposes, install these top two eyebolts back on the rear cover before shipment.

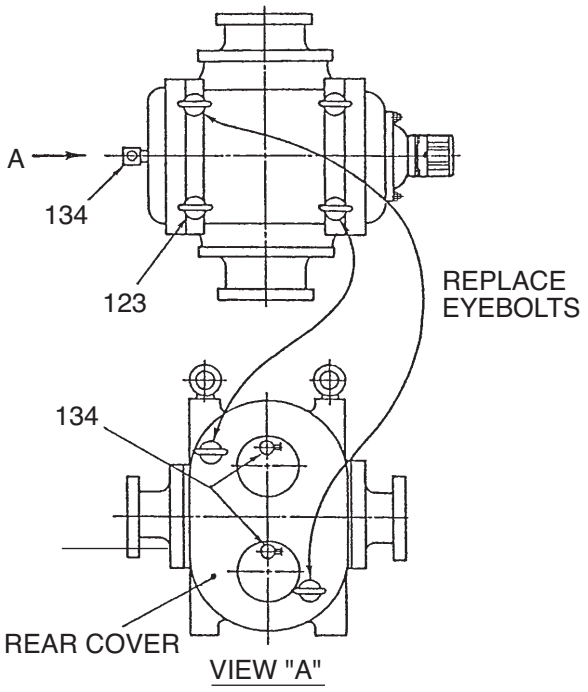


Fig. 6.1

(2) Transport the meter to the installation location, exercising care not to give impact shocks, by hoisting with a wheel crane, or similar device (capacity 2.5 tons min.). See Fig. 6.2.

➡ NOTE : Total mass of the flowmeter weighs 2.3 tons approx. A 30k model has a total mass of 2.7 tons approx., requiring a wheel crane capable of lifting 3 tons or greater.

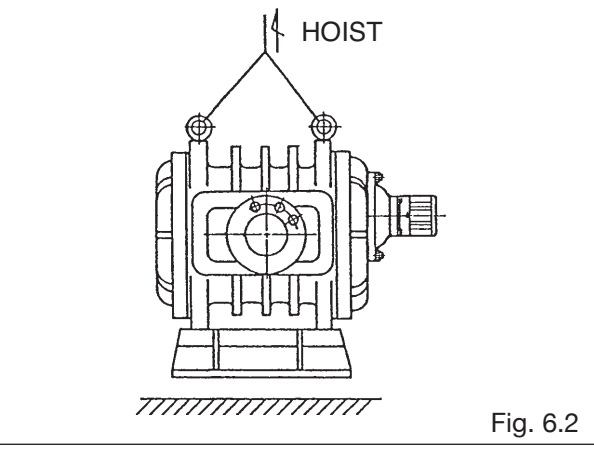


Fig. 6.2

6.2 Flowmeter Installation

(1) The meter must be installed on the discharge side of the pump.
(2) Concrete the foundation at the installation location and install anchor bolts as shown in Fig. 6.3. Select anchor bolts from "JIS B 1178L type".
(3) Avoid pipe strains when installing the meter.
(4) Secure a working space for disassembly and servicing the flowmeter. A space one meter min. around the flowmeter is necessary.
(5) A newly assembled piping system requires flushing of the entire piping assembly to remove construction debris thoroughly before connecting the flowmeter.
➡ See "Flushing the Piping Assembly" on page 13.
(6) If heat retention is desired, lagging material should not be applied to the register and its adapter (see Fig. 4.1).

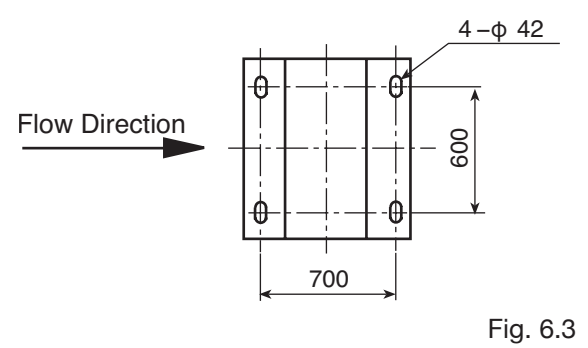


Fig. 6.3

⚠ **CAUTION: Do not fail to adjust air release vent before allowing the process fluid for the first time.**

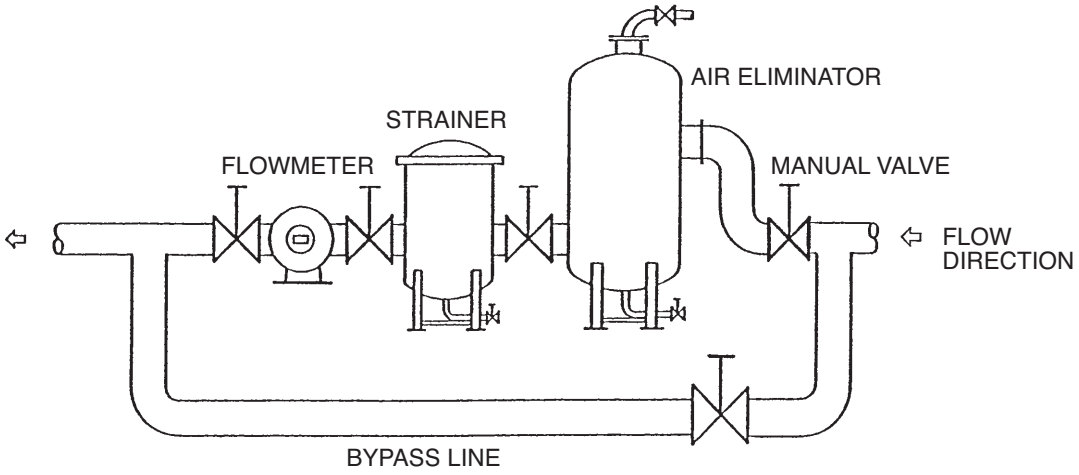
6.3 About the Strainer

(1) Install directly coupled to, or in close proximity of, the meter.
(2) To make strainer net cleaning easy, secure a space about the same height of the meter above it.
(3) To facilitate disassembly and inspection, provide a drain valve and a pipe for drainage.
(4) A clogged strainer may cause to produce bubbles when measuring volatile liquids.
(5) Provide a pressure gage upstream and downstream of the strainer. They will serve as a differential pressure gage with which you can detect a clogged strainer net and take precautionary measures to protect the net from damage. If ruptured, a damaged net can jam with the rotor teeth and lead to a costly downtime.

6.4 About the Air Eliminator

(1) Install on the discharge side of the pump and upstream of the meter.
(2) The rule to follow is not to provide any device that will restrict the free flow of the process fluid, such as a reducing valve or an orifice, between the air eliminator and flowmeter. Such a device may cause bubbles when metering volatile liquids.

6.5 Typical Installation



NOTE: WE SUGGEST TO PROVIDE A CRANE ABOVE THE EQUIPMENT FOR TRANSPORTATION.

Fig. 6.4

6.6 Flushing the Piping Assembly (See the figure below.)

Do not fail to remove the meter from the piping assembly and install a short pipe section in place of the meter before you attempt to flush the piping assembly.
Costly damage to the meter could result if you attempt to flush away construction debris and other foreign matter with the meter in place.

⚠ CAUTION:

(1) Do not flow water across the meter, or it will cause rust inside the meter, hindering smoothe rotation of the rotors.
(2) Following the flushing, be sure to clean the strainer net. Scale or other foreign matter in the net can damage the flowmeter while in operation.

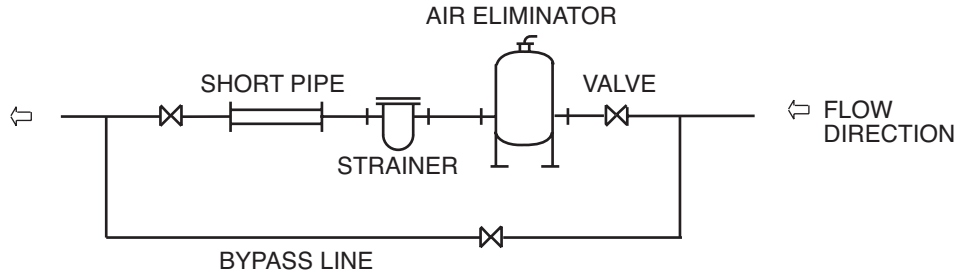
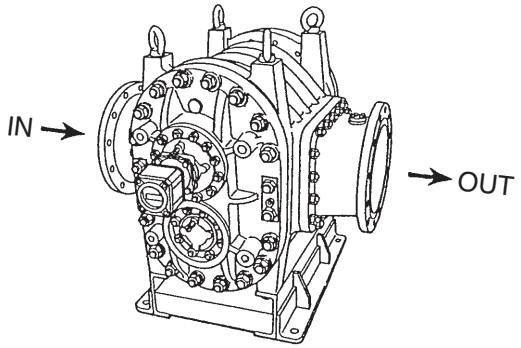


Fig. 6.5

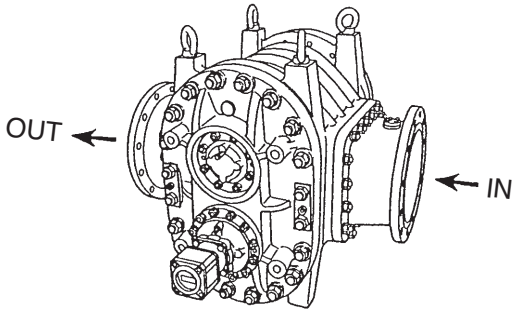
7. HOW TO CHANGE FLOW DIRECTIONS

(1) Register Location Relative to Flow Direction and Meter Body

➡ NOTE : If the process fluid flows from left to right, the register is above the centerline of pipeline. If it flow from right to left, the register is below the centerline.



<Flow direction: Left → Right>



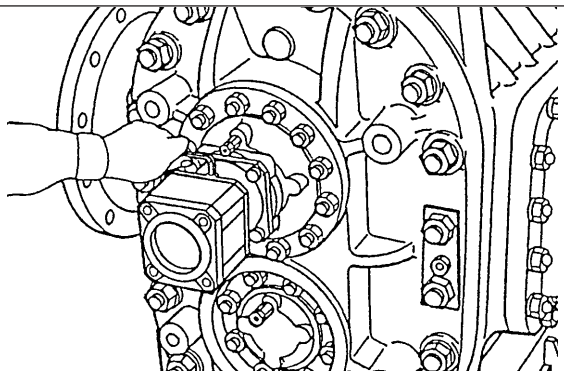
<Flow direction: Right → Left>

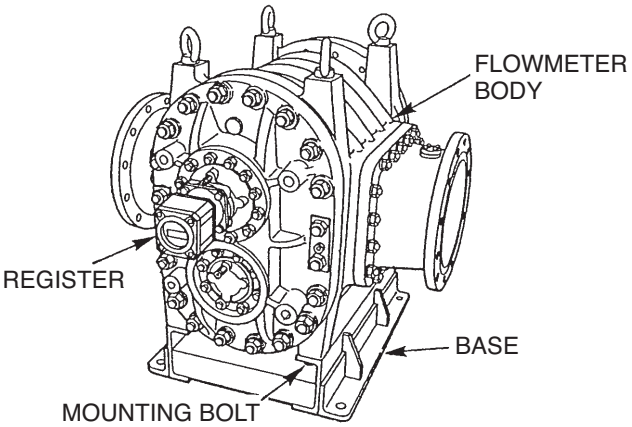
(2) Procedure to Change Flow Directions

Change the register and flowmeter body orientation to the new flow direction.

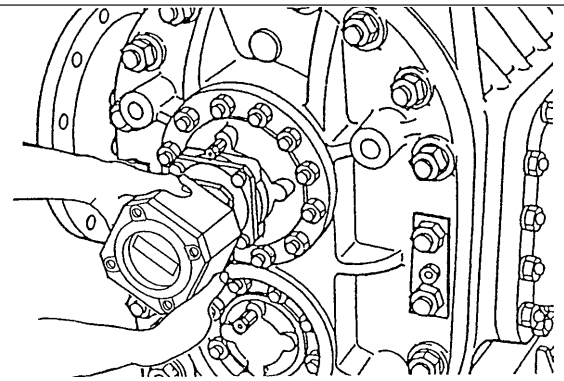
a) Take off four bolts securing the flowmeter to the base and separate the flowmeter from the base.

b) To change flow directions from "right to left" to "left to right", turn the meter the other way round and reinstall it on the base.



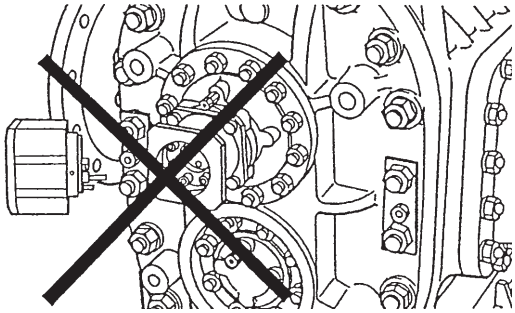


c) Using hex wrench, take off four hex socket head bolts (M6).



d) Holding the register assembly in both hands, carefully turn it round and secure it with hex socket head bolts in line with the new flow direction.

DON'T DO THIS!



Do not attempt to separate the register like this to change flow directions.

⚠ CAUTION:

(1) Rotate the register assembly without separating from its adapter.

(2) Do not attempt to rotate the register assembly more than one complete revolution.

8. WIRING INSTRUCTIONS

(⇨Refer also to the wiring instructions of respective receiving instrument instruction manual.)

8.1 Wiring Guidelines

(1) Cables for field wiring

The following cables should be used unless otherwise specified:
Cables 1.25mm^2 in conductor area and 8.5 to 12 mm in finished O.D. As to the number of conductors, select 2 to 4 according to your particular application. It is recommended that their shield be grounded at the receiving instrument.

⚠ **CAUTION: Register Model UA; In case of TIIS explosionproof type used under the ambient temperature of 45°C or higher, use a cable resistant to the temperature of 75°C or higher.**
Register Model U8; In case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher.

(2) Transmission length

The maximum transmission length is typically one kilometer.

➡ NOTE : If it exceeds one kilometer, consult factory.

(3) Inductive interference prevention

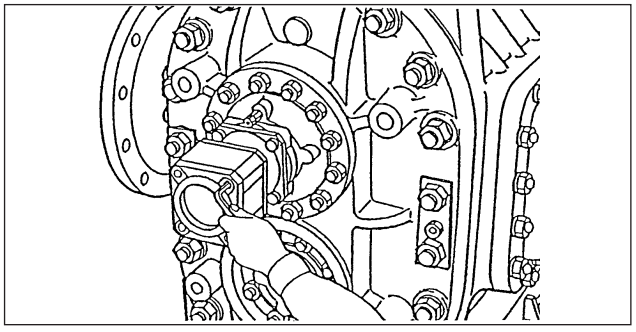
To minimize the possibility of stray current pickup, the field wiring should be routed sufficiently away from existing power cables or power circuits.

(4) Considerations on connections

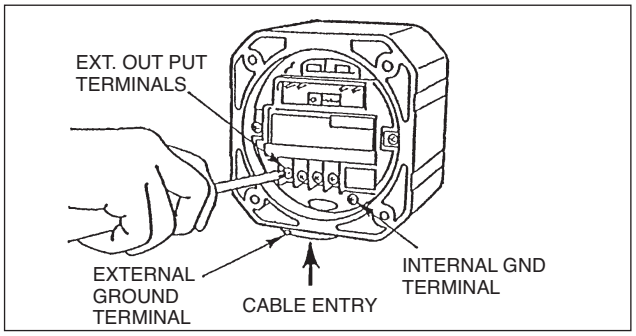
1) The terminal block is of M3.5 screw; use crimp-type terminal that fits cable end.
2) Do not fail to earth ground the preamplifier GND terminal.
3) The cable should extend downward from cable entrance to prevent rainwater from entering the equipment.
4) If lightning strikes are anticipated, provide a surge arrestor.

⚠ CAUTION:
Make sure of the validity of meter (register) and receiving instrument combination by referring to their model numbers, serial numbers, etc. before you make electrical connections.

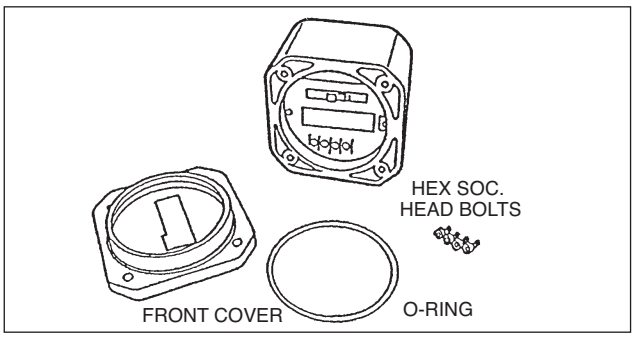
8.2 Terminal Connections



(1) Take off four hex socket head bolts on the front of register assembly and remove the front cover.



(3) Using crimp-style terminals, ensure good electrical connections.



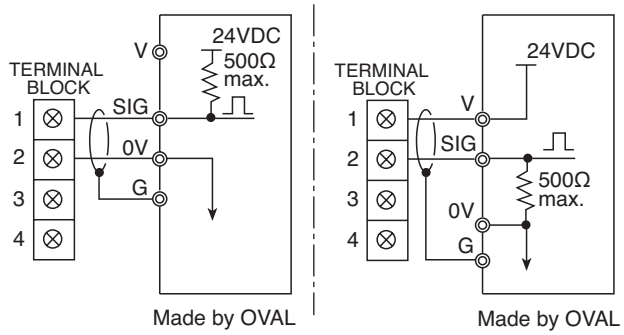
(2) Removing the front cover provides access to a 4-post terminal block. Terminal identification label is found on the back of front cover.

➡ NOTE : Connect the external earth ground terminal to instrumentation earth ground before use.

➡ NOTE : Pressuretight packings are not furnished for nonexplosionproof models and no output models (page 5).

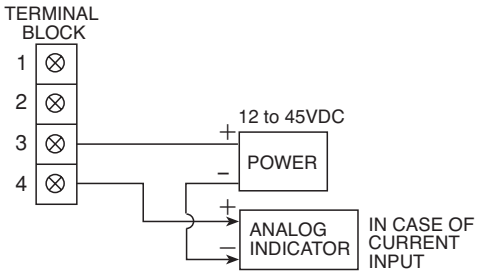
8.3 Wiring Connections, Register Type UA

(1) Current Pulse Output (2-wire system)



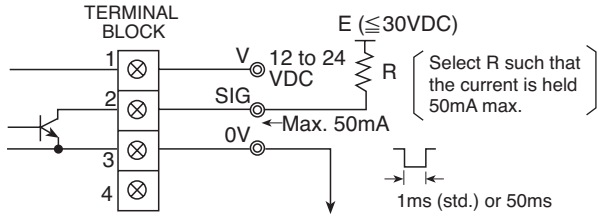
➡ NOTE : The circuit with OVAL products to accept current pulses comes in two configurations as shown above. Refer to the receiving instrument instruction manual before making connections.

(2) Analog Output (2-wire system)



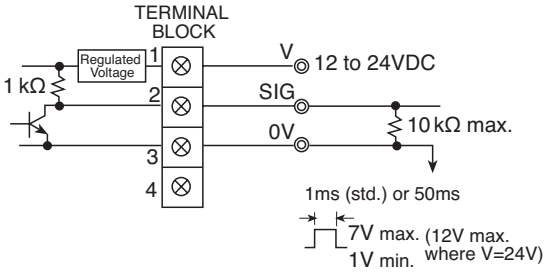
➡ NOTE : In case of voltage input, couple an external load resistance (see the load resistance range in Section 8.4).

(3) Open Collector Output (3-wire system)

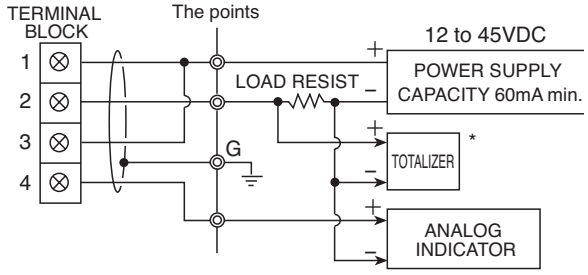


➡ NOTE : Select load resistance R such that the current flowing into the transistor held within 50mA in relation with source voltage E.

(4) Voltage Pulse Output (3-wire system)



(5) Current Pulse + Analog Output (4-wire system)



* Select the voltage input for the totalizer.
Make sure of the trigger level of voltage input and determine the supply voltage and load resistance value.

➡ NOTE :

(1) In OVAL receiving instruments, signal conversion is performed with an internal load resistance. If you build a system like the one shown here with a commercially available totalizer, make sure of the signal levels to the totalizer since signal is converted from current pulses into voltage pulses according to the formula of 4/20mA × load resistance.

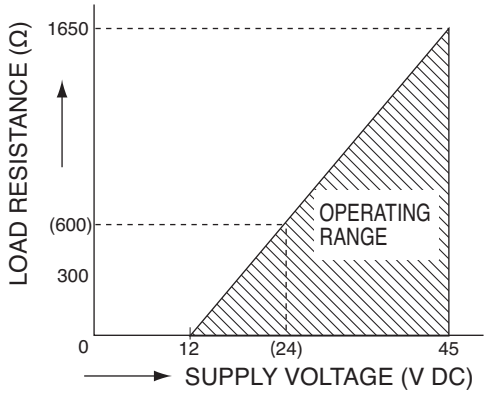
(2) If you use an OVAL receiving instrument in the configuration shown here, make sure of the current carrying capacity of receiving instrument's power supply. If it has a problem in current carrying capacity, a separate power supply should be provided for the analog indicator.

8.4 About Acceptable Load Resistance Range, Register Type UA

In the specification of two-wire transmission system for analog and pulse signals, the power lines also serve as signal lines.

The transmission loop requires a DC power supply. If it is desired to connect an instrument in a loop, the load resistance of both the instrument and conductors must fall within the operating range as shown in the graph at right.

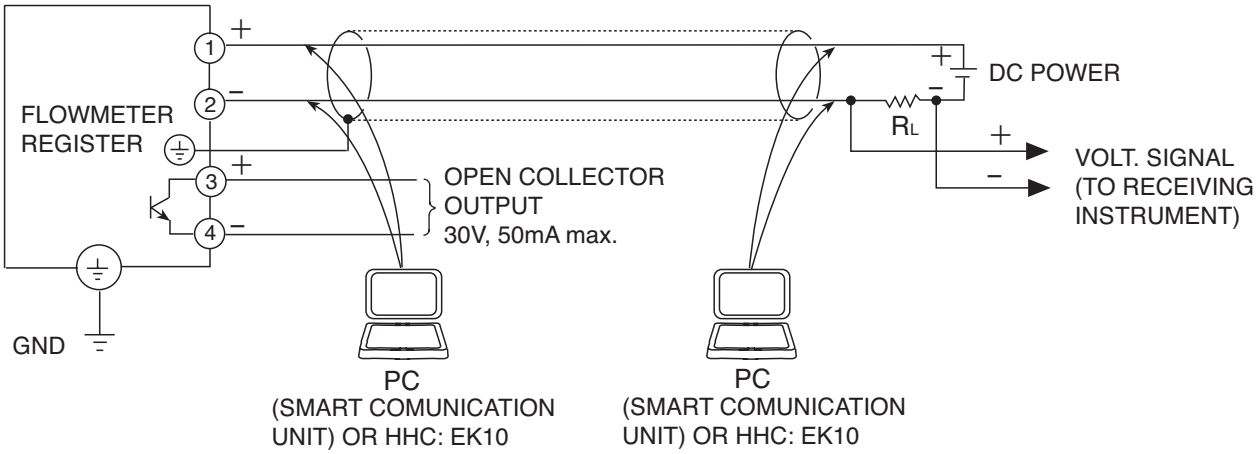
Standard: Power supply voltage = 24 VDC
Load resistance = 250 Ω



● 8.5 Preamplifier-to-Receiving Instrument Hookup, Register Type U8

The 2-wire signal transmission system used in this flowmeter furnishes DC power to the meter. It serves as the power line and signal line as well with pulse or analog current output.
An OVAL receiving instrument can be coupled directly, but general instruments designed to accept a voltage signal input require a load resistor RL connected in series for voltage conversion. Since the voltage signal level varies with the load resistance value, determine the load resistance value by referring to the receiving instrument specifications and the acceptable load resistance range shown below.
Communications with a PC (Smart Communication Unit) requires a load resistance of 250 to 1000Ω.

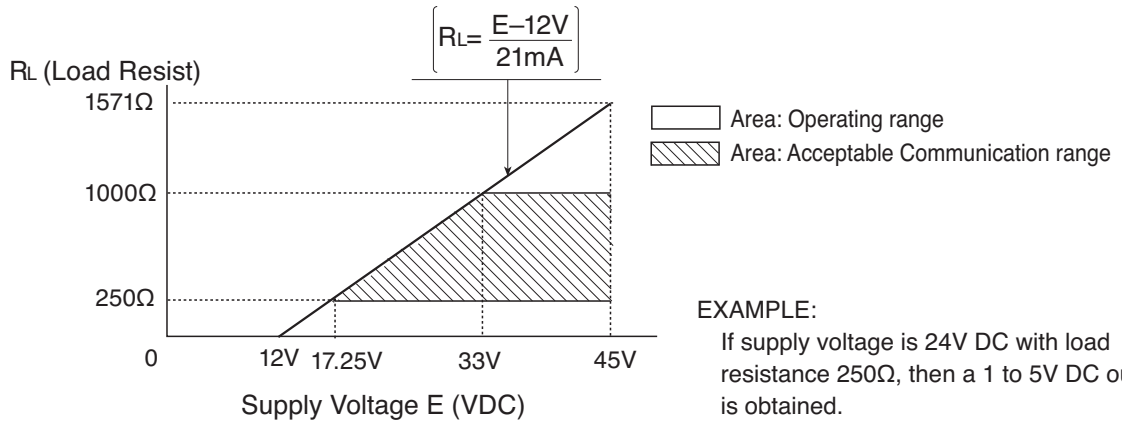
I In case a voltage input is fed to the receiving instrument



Output	Voltage Signal (V)
Pulse Output	ON / OFF (20mA×RL) / (4mA×RL)
Analog Output	(4mA×RL)–(20mA×RL) at 0 to FS

➡ NOTE : With the relationship with supply voltage E, select the load resistance value RL such that the current flowing into the transistor is held below 50mA.

Fig. 8.1



EXAMPLE:
If supply voltage is 24V DC with load resistance 250Ω, then a 1 to 5V DC output is obtained.

<Acceptable Load Resistance Range>

Fig. 8.2

9. OPERATING INSTRUCTIONS

9.1 Operating Considerations

(1) Read well the information stated on the nameplate before commencing operation and make sure the operating conditions conform to the specification.

(2) At first time operation with actual fluid, let air out from air vent valve for each bearing (see Fig. 9.1 below).

⚠ CAUTION: Do not fail to adjust air vent valve before allowing the process fluid for the first time.

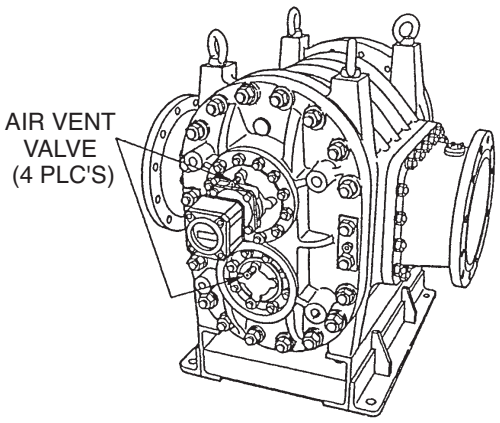


Fig. 9.1

(3) Carefully follow the valve operations sequence given below keeping the flowrate within the rate specified. (See the piping diagram below ⇩.)

a) Shut off upstream valves (A) and downstream valve (B), and then open bypass line valve (C) allowing the process fluid in the bypass line to remove all scale and other foreign matter present in the line.

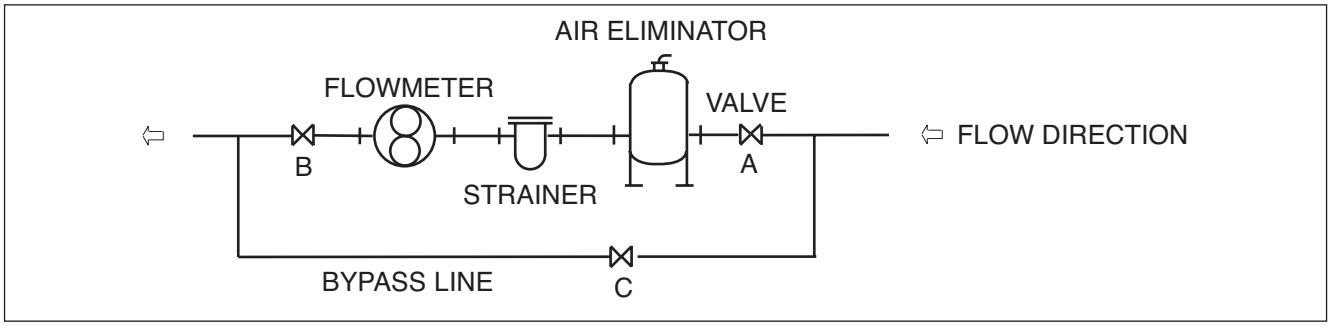
⚠ CAUTION: This process is particularly important for a newly installed pipeline.

b) Slightly and progressively open upstream valves (A) and then slightly and progressively open downstream valve (B).

c) By progressively close bypass line valve (C), make sure to see that the total counter in the register assembly counts in response.
Keep the flowrate at about 10 to 20% of the maximum flowrate at this time.
(Confirm it by placing the register in the instantaneous flowrate mode.)
Allow the process fluid to run for more than 15 minutes and ensure that air in the pipeline has escaped.
In applications where temperature exceeds 60°C, run the flowmeter at least for 30 minutes to ensure uniform heat distribution in the measuring chamber.

d) Following the preheating period above, close valve (C) in the bypass line completely and progressively open upstream valves (A) until fully open, and slowly open downstream valve (B) until the rated flow is reached.

e) BY adjusting the flowrate with downstream valve (B) and confirming it with the register reading in the instantaneous flowrate mode, place the flowmeter in service within the rated flow.



(4) The strainer net should regularly be inspected for condition and cleaned as necessary.
A newly assembled piping system in particular requires daily inspection for the first few days. Inspection intervals may be reduced progressively in accordance with the result of net inspection, to once in two or three days, and so on.

9.2 Precautions for Models Less Battery Pack (Register Type UA)

(1) Totalized data is written for storage in a non-volatile memory several seconds after the fluid flow is stopped. Accordingly, a precaution to remember is not to turn off power while the process fluid is being delivered, or turn off power simultaneously with shutoff of process fluid.

(2) If you shut off power after the flow is stopped, good practice is to turn it off 10 seconds minimum after the stop. Where a sudden power shutdown or instantaneous power interruptions is expected during metering, it is desirable to provide an optional battery pack.

(3) If the meter is to be used in the accounting field, we recommend you to provide the battery pack.

9.3 About the Register Life

(1) Because of the life expectancy of components incorporated, such as the LCD and non-volatile memory, the internal electronics is designed to be replaced in about 10 years. The electronics life depends on the environment in which it is used; if any of the following operating conditions applies, we recommend you to replace it as an assembly in five to six years:

- **High temperature environment.**
- **High temperature process fluid measurement.**
- **Field installation with widely varying temperatures.**
- **LCD counter display is exposed to the direct rays of the sun.**
- **Frequent process fluid flows and interruptions.**

(2) Models with optional battery pack have a storage life of 10 years approx. after shipment, whether the battery is consumed or not. In other words, even in applications where the register is powered from an external source for most of the time and the battery current drain is considered negligibly small, battery replacement is yet required due to its storage life.
Storage life may be reduced even more under such adverse environmental conditions as:

- **High temperature environment**
- **High temperature process material measurement**
- **Cold region**

10. DISASSEMBLY AND INSPECTION

10.1 Disassembly and Inspection

⚠ CAUTION:
Service intervals may vary with the given operating conditions, but we suggest that the flowmeter be disassembled and inspected regularly - once a year - in normally encountered conditions. (See Exploded Views and Parts List, pages 40 thru 43.)

(1) a) Shut off valves upstream and downstream of the flowmeter.
b) Remove drain plugs (117) in the rear cover (103) (top and bottom) of the flowmeter to drain the remaining fluid.

➡ NOTE : The flowmeter body has an internal capacity of 262 liters approx.

c) Separate the register assembly. To do this, take off four bolts (A) with hex wrench key and, holding the register assembly, separate it horizontally.
d) Remove the flowmeter body from the piping assembly.
e) Of the eight nuts (141) found in three blind covers (104) on front cover (102) and rear cover (103), leave two tentatively fixed and take off the remaining six (Fig. 10.1).

(2) Using the four eyebolts (123) furnished, place the flowmeter body upright with front cover (102) up (Fig. 10.2).

➡ NOTE : Securing a clearance of 30 centimeters approx. between the rear cover and the floor, position the flowmeter on a level plane.

(3) a) Taking off 12 bolts (141), remove adapter (105).

⚠ CAUTION: While removing the adapter, exercise care not to damage the signal generating magnet assembly.

b) Uniformly draw out the pressuretight sealing plate in the signal generating magnet assembly (230) and remove this assembly.

(4) a) Remove reduction gear assembly (300): take off four fitting bolts (310) and thread two of them into the jack screw holes provided to assist in removing the assembly

⚠ CAUTION: The reduction gear assembly is gear coupled; exercise care not to distort or otherwise damage gears, shafts and other related members when removing the assembly.

b) Remove uniform-motion drive gear (204): take off two bolts (213) and remove uniform-motion drive gear (204) complete with its boss (205).
c) Draw bearing holder (206) out: take off two bolts and thread two of them into the jack screw holes (M12) provided to assist in removing the bearing holder (see Fig. 10.3).

➡ NOTE : Bolts (M12) longer than 130 millimeters in threaded area are required for jacking the bearing holder off.

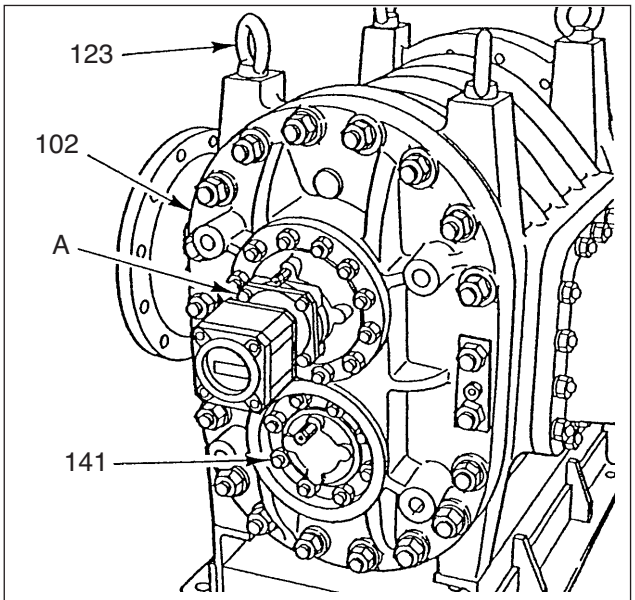


Fig. 10.1

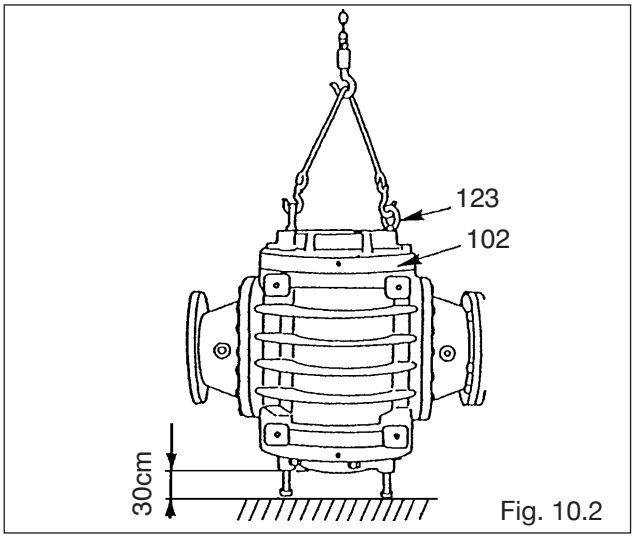


Fig. 10.2

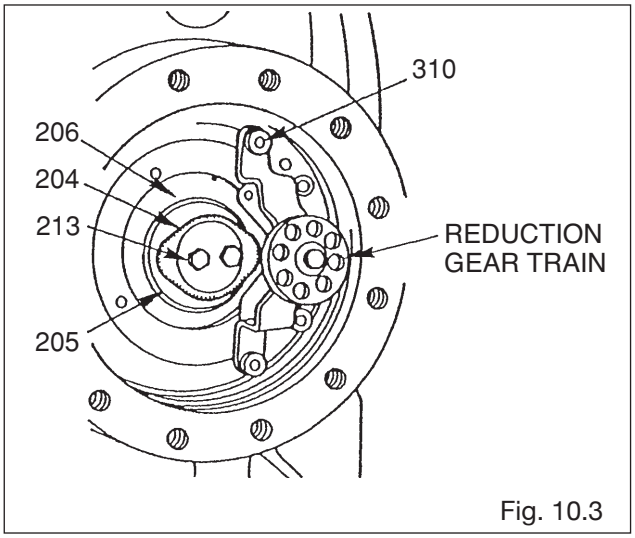


Fig. 10.3

(5) Draw front and rear bearings (207) out: secure the jacking tool (G3) to the bearing holder with four bolts.
At this time, install the jacking tool such that the end of jack screw comes concentric with the center hole in the rotor shaft.
Turning the handle clockwise will force the bearing holder to come off (see Figs. 10.4 and 10.5).

(6) Draw rear cover bearing holder (207) out: take off the two bolts (116) tentatively holding blind cover (104) in place and the blind cover and bearing holder will be ready to come off.

⚠ **CAUTION: Be careful in pulling out the blind cover and bearing holder which together weighs 22 kilograms. It is good practice to spread a cushioning sheet over the floor and allow them to come off and drop on it.**

(7) Remove front cover (102). First, take off 20 nuts (129) and remove locating straight pin retainer (109). Of the two nuts, use one on the straight pin retainer as shown in the figure and screw it on until the straight pin completely comes off (see Figs. 10.6 and 10.7).

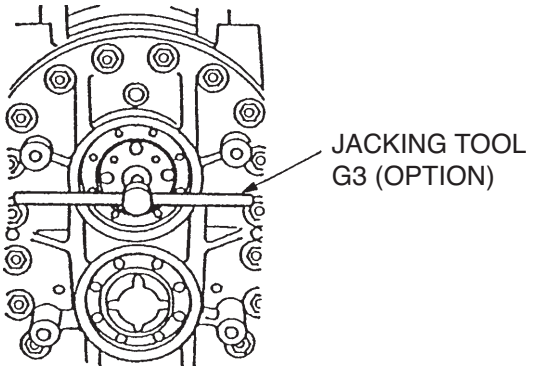
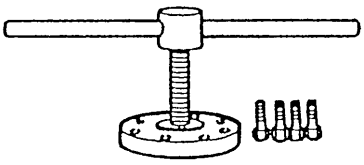


Fig. 10.4



<Jacking Tool G3 (option)>

Fig. 10.5

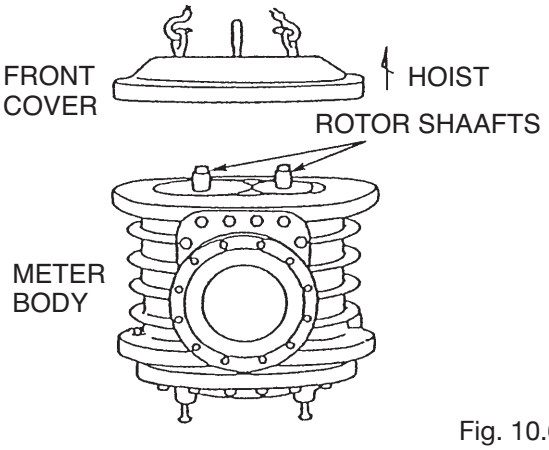
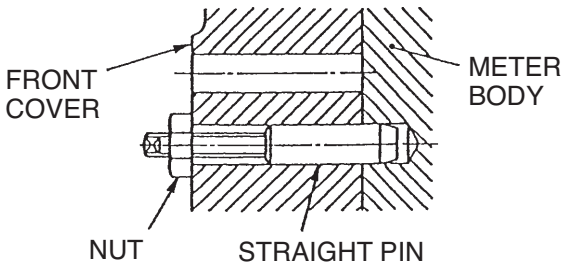


Fig. 10.6



<Locating Straight Pin>

Fig. 10.7

(8) Remove oval rotors (201). Install eyebolts (M10) into the end face of rotor shafts (202 and 203) and, using a wheel crane or similar equipment, carefully lift them out (Fig. 10.8).

➡ NOTE : 1. Each rotor weighs 182 kilograms approx.
2. Put identification marks on thrust rings and their locations to ensure correct installation at assembly.
3. Thrust rings on the rear cover may come sticking to the rotors; be careful not to damage them.
4. To safeguard rotor bushings against damage, remove bearing holders on the rear cover before you pull out the rotors.

Internal components are now ready for inspection.

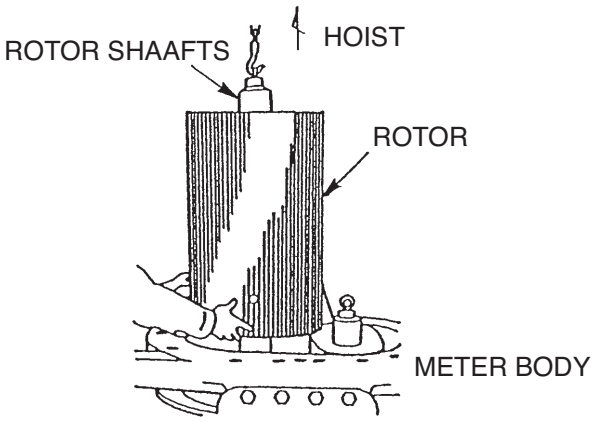


Fig. 10.8

⚠ CAUTION: This process is particularly important for a newly installed pipeline.

10.2 Assembly

l **The assembly procedure is reverse of the removal procedure. But careful attention must be paid to the following instructions:**

(1) Bearings (207) and blind covers (104) on the rear cover should be installed before the rotors are installed.

➡ NOTE : 1. Rotors can best be installed with the meter body placed sideways.
2. The orientation of oil grooves (V-grooves) in the rotor bearings should conform to Fig. 10.9.
3. Install rotors in line with non-turn bolts (213) of the bearing holder.

(2) Be sure to align match marks on the tooth end face when installing the oval rotors (see Fig. 10.10).

(3) Apply grease to thrust rings for attachment before their installation on the rear cover.

➡ NOTE : Be sure to install thrust rings with match marks aligned. Incorrect installation might result in an inaccurate measuring chamber-to-rotor clearance (see NOTE (8) in DISASSEMBLY AND INSPECTION).

(4) Inspect O-rings (106) of the covers for condition. We recommended their replacement every six months of service operation.

(5) Install the front cover before bearing holders are inserted into place. Drive the front cover locating tapered pin with wooden mallet until the screw end of straight pin is 21 millimeters approx. from the exterior surface of retainer.

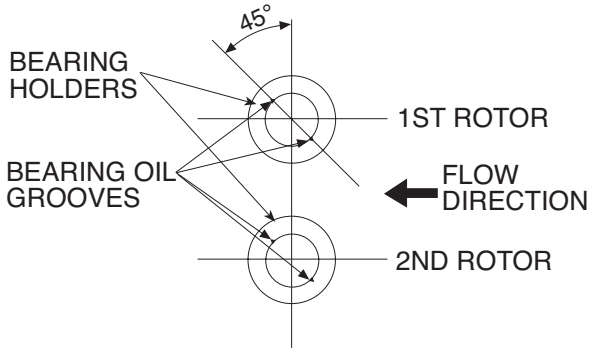


Fig. 10.9

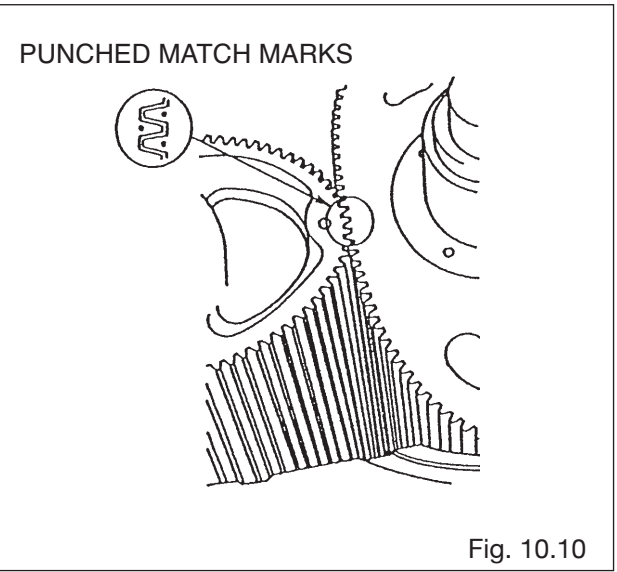


Fig. 10.10

(6) When installing the reduction gear train (300), be sure to align the match marks on the uniform-motion gears (Fig. 10.11).

(7) Do not fail to test for proper gear engagement by manually making at least one complete revolution to ensure smooth rotation of oval rotors and uniform-motion gears.

⚠ **CAUTION: Be careful so as not to get your fingers tucked down between the rotors.**

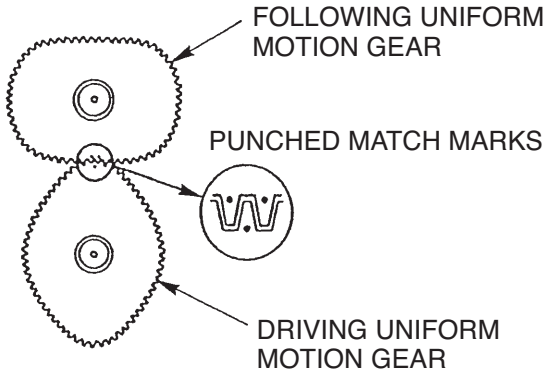
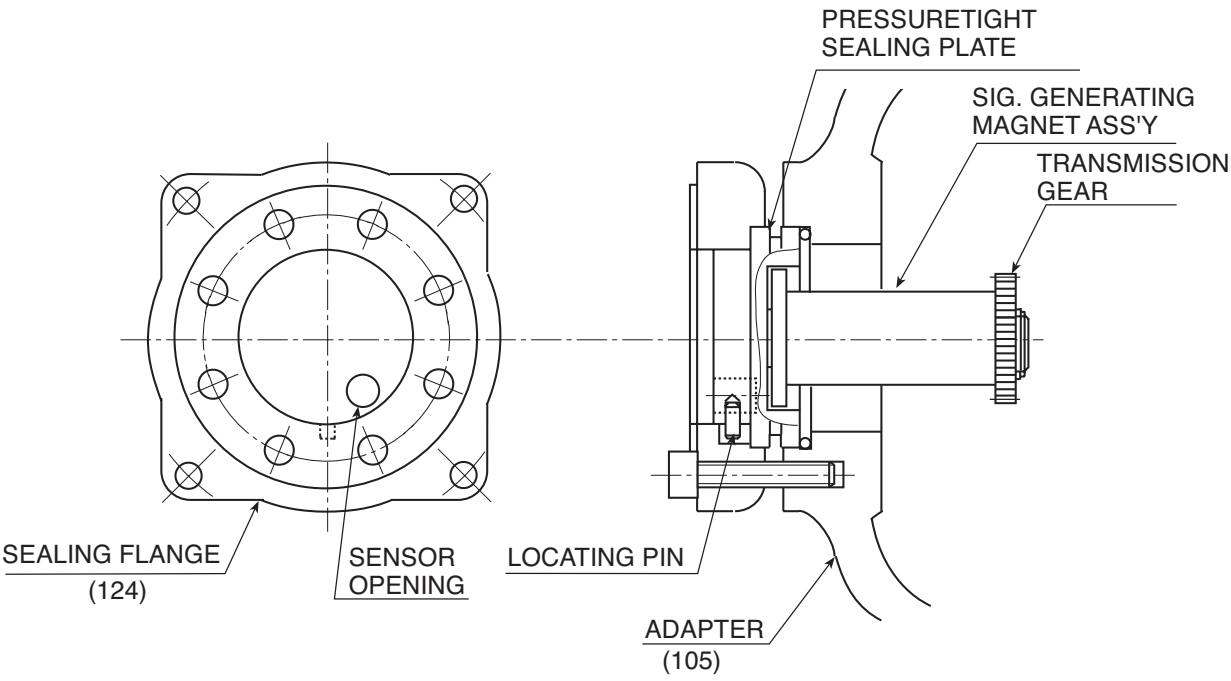


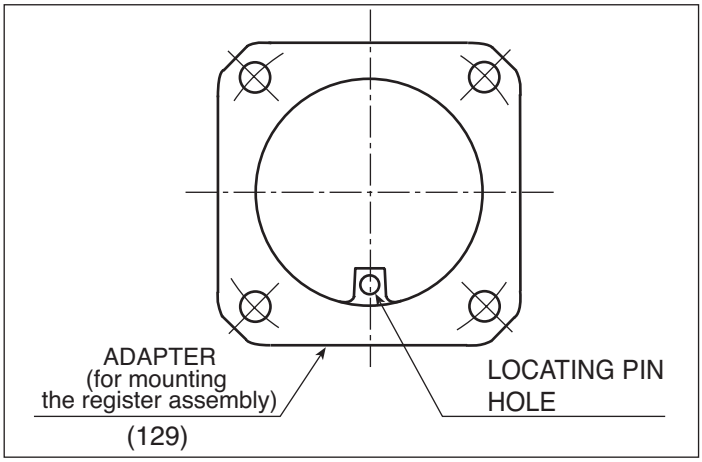
Fig. 10.11

10.3 Signal Generating Magnet Disassembly and Reassembly Notes

Phase observation is required for the signal generating magnet assembly. If installed out of phase at assembly, the total counter will fail to count. Install the generating magnet assembly with the locating pin always right under the assembly.

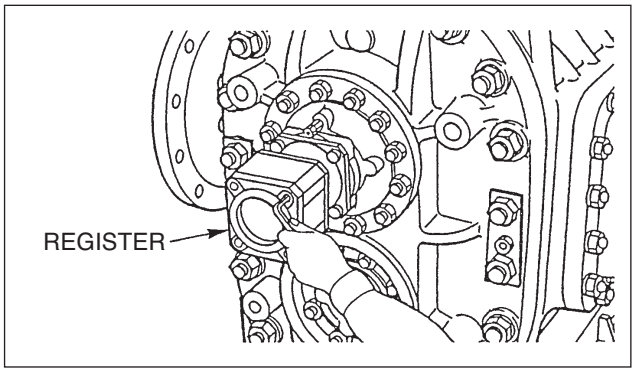


➡ NOTE : Install the adapter (for mounting the register assembly) as shown in the figure at right (pin slot is down).

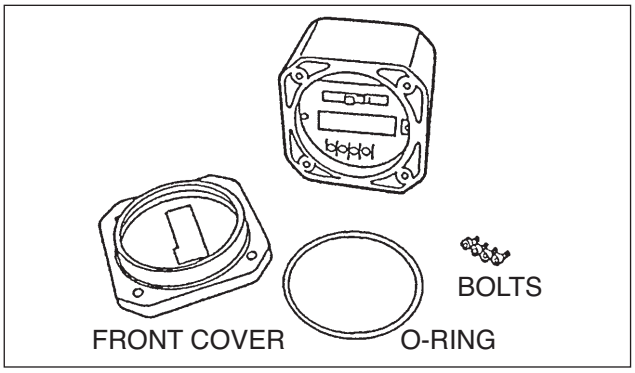


11. SWITCH FUNCTIONS AND PARAMETER SETUP, Register Type UA

11.1 Switch Names and Functions



(1) Using hex key, remove four hex socket head bolts securing the front cover.



(2) Removing the front cover provides access to the electronics unit.

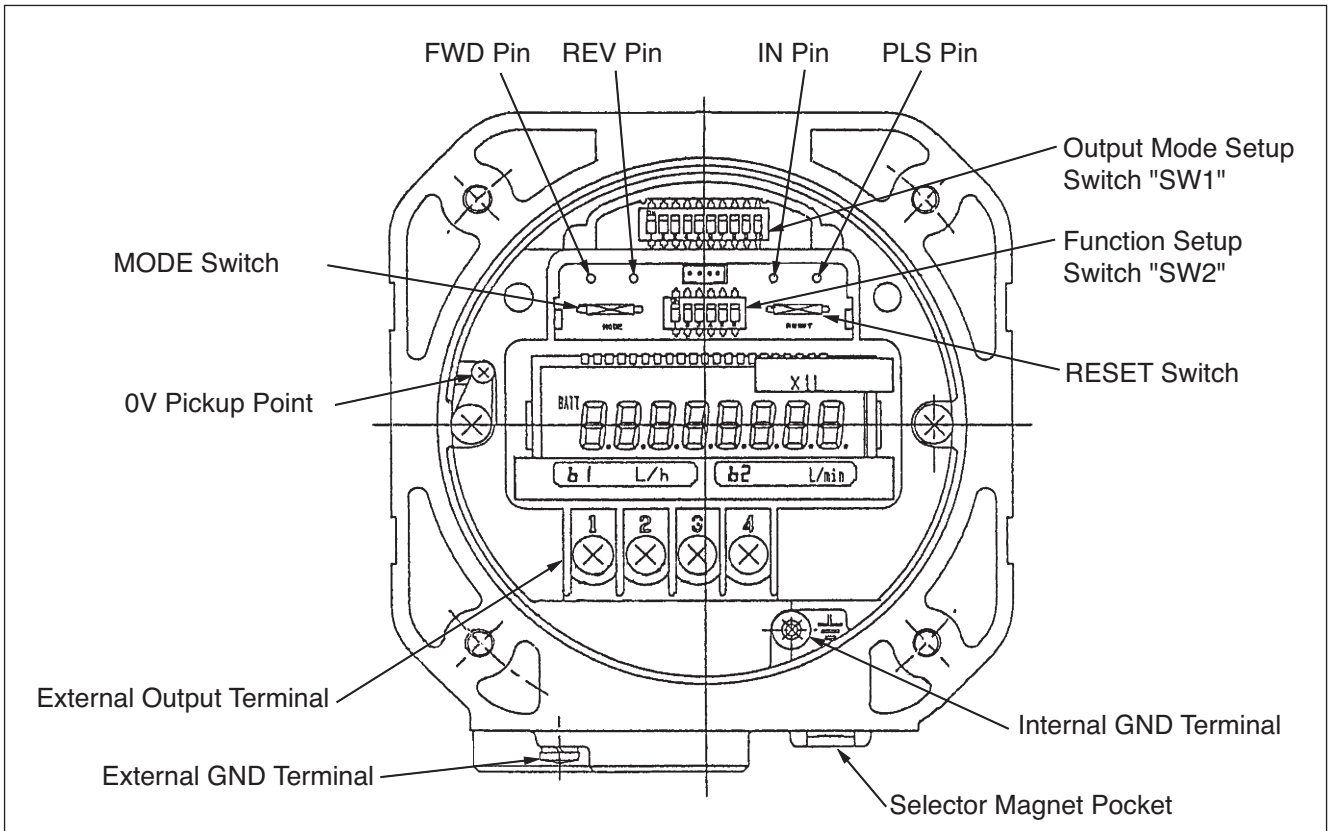


Fig. 11.1 Part Names of Electronics Unit

➡ NOTE : A seal plate and certification seal are provided for master oilmeters, special measuring instruments and flowmeters to be certified for products subject to tariffs and duties on spirits and alcohol (see figure at right).

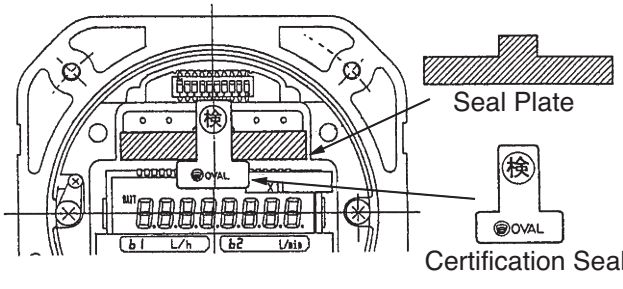


Fig. 11.2

11.1.1 Function Setup Switch "SW2"

DIP Switch No.	Description of Functions
SW2–1	Parameter write-protect OFF: Rewritable "Default" ON: Write protect * To seal, set to ON before pasting the seal.
SW2-2	Factored/unfactored pulse select OFF: Factored pulse ON: Unfactored pulse
SW2-3	Inhibit to reset the resettable total OFF: Resettable "Default" ON: Nonresettable
SW2-4	Accumulated total reset ON : OFF resets the accumulated total. * Set to OFF in normal use.
SW2-5	Unused * Always OFF
SW2-6	Battery power switch OFF: Battery power OFF ON: Battery power ON "Default"

➡ NOTE : [ ] shows default setting.

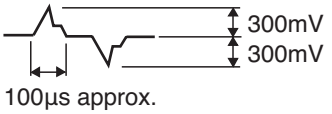
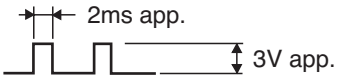
11.1.2 Output Mode Setup Switch "SW1"

Output Mode / DIP Switch No.	Power pulse/ analog	Open collector pulse	Voltage pulse	Remarks
SW1-1	OFF	OFF	ON	ON for voltage pulse only. All else OFF.
SW1-2	OFF	OFF	ON	
SW1-3	ON	OFF	OFF	ON for voltagepulse/analog output only. All else OFF.
SW1-4	ON	OFF	OFF	
SW1-5	ON	OFF	OFF	
SW1-6	ON	OFF	OFF	
SW1-7	OFF	ON	ON	ON for open collector output and voltage pulse output only. All else OFF.
SW1-8	OFF	ON	ON	
SW1-9	OFF	ON	ON	
SW1-10	OFF	ON	ON	

⚠ **CAUTION: To change SW1 settings, turn all switches in OFF and then turn only the required switch ON.**

11.2 Individual Test Pin Functions

➡ NOTE : Connect the 0V end to the left side fitting screw in the electronics unit (see Fig. 11.1).

Pin Name	Function	Waveform
FWD	Monitors the amplified output waveform from magnetic sensor for flow metering.	
REV	Monitors the amplified output waveform from magnetic sensor for discriminating between FWD and REV flow. (Only when the double sensor is used.)	Same as above
PLS	Monitors the rectangular waveform after FWD pulse waveshaping. Timing remains the same as that of FWD and its waveform is one before unfactored output amplification.	
IN	Accepts a simulated pulse train from OVAL pulse checker Model PC2201, or other signal source. Input mode is PG30 of Model PC2201. It also accepts pulses with levels "0": 1V max. and "1": 7 to 12V or open collector.	

11.3 Accumulated Total and Instantaneous Flowrate Calculations

(1) Total flow - Both accumulated total and resettable total

$$Q=P\times F\times H$$

where
P: Number of incoming pulses
F: Meter factor
H: Conversion factor

(2) Instantaneous Flowrate - Valid only for input pulses of small periodic variation
The period of incoming pulses for the sample cycle number is measured in units of 30 µsec and substituted in the following formulas for readout:

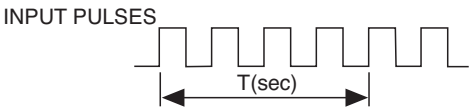
$$\text{Hourly Flowrate}=b1=\frac{3600\times F\times H\times A}{T\ (\text{sec})}$$

$$\text{Per-min. Flowrate } b2=\frac{b1}{60}$$

where
A: Sample cycle number
F: Meter factor
H: Conversion factor

(3) Sample Cycle Number
It shows the number of sampling pulses in instantaneous flowrate computation.
If indicated reading on the display fluctuates, an average reading may be obtained by selecting a larger number.
If the fluctuation of indicated reading is excessive, pulsation of the flow is suspected among possible causes and the pipeline should be inspected.

➡ NOTE : Sample Cycle Number



If a setting A = 4 is chosen, the time is measured for 4 cycles of incoming pulses and, based on the formulas above, calculation is made. Resolution of measurement is 30 µsec.

If the number of incoming pulses falls below the sample cycle number (A: Default 4) in the sampling time (At: Default 5 sec), the instantaneous flowrate reads 0.
Accordingly, if it is desired to read the instantaneous flowrate in small flows, select a smaller sample cycle number.

11.4 Parameter List

Parameter	Code	Default Setting	Initial Value	Description	Remarks
Meter factor	F	Depends on the customer specification. (Indicated on the parameter label.)	1.0000-2	• Meter factor (Unit: [□/Pulse]) • Setting range: 0.9999-9 to 9.9999E7	Ex.: Given meter factor 9.918mL/P. To change the indicated flowrate to [L] → 9.918[mL/P]=9.918×10^{-3}[L/P] Therefore, set to "F9.9180-3" (L/P)
Conversion factor	H	1.0000E0	1.0000E0	• Unit conversion factor (Unit: [Δ/L]) • Δ: Unit after conversion (without conversion Δ: = □) • Setting range: 0.9999-9 to 9.9999E7	Changes units of total flow and instant. flowrate to any units desired. (Without conversion, H1.0000E0) Ex.: At 1.5kg per 1 L, 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)
Pulse weight	Pu	Depends on the customer specification. (Indicated on the parameter label.)	1.00E0	• Weight of factored pulse output (Unit: [Δ/Pulse]) • Setting range: 0.99-9 to 9.99E7	Ex.: To change the weight of factored pulse from 1 L/P → 10L/P (=1.00×10^{+1}[L/P]) → Set to "Pu 1.00E1" (L/P). (Note2)
Indicated unit of registration	Un	———	——	———	This parameter is unused. (Do not set it up.)
Decimal point location in instantaneous flowrate	bP	Depends on the customer specification.	0	• Decimal point location in instantaneous flowrate b1 • 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 location in total flow	SP	Depends on the customer specification.	0	• Decimal point location in accumulated and resettable total • Setting range: 0, 1, 2, 3	Ex.: To change the indicated min. rdg. in total flow from 1L to 0.01 L (= 2 places below decimal point) → * Set to "SP .2".
Sampling time	At	5	5	• Upper limit in instant. flowrate sampling (Unit: [sec]) • Setting range: 1 to 999	If flow pulses fail to arrive for a duration At [sec], the instantaneous flowrate shows 0.
Sample cycle number	A	Depends on the customer specification. (Indicated on the parameter label.)	4	• Sampling frequency • Setting range: 1 to 999	Instantaneous flowrate is determined by measuring the time for incoming flow pulses A times. If the spread of instant. flowrate indicated is too great, choosing a larger A eases the problem.
Analog full scale (Note 3)	AF	Depends on the customer specification. (Indicated on the parameter label.)	3800	• Analog full scale flowrate (Unit: [Δ/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 (Note 3)	AdAn	2.5	0.0	• Analog time constant (soft) (Unit: [sec]) • Setting range: 0.01 to 99999	If ripples in analog output are too great, choosing a greater AdAn stabilizes the fluctuation of indicated reading. Ex.: To change the analog output time const. from 2.5 [sec] to [5 sec] → Set to "AdAn 5.0".
4mA trim (Note 3)	A04	———	(4.000)	Analog output 4mA trim	See "Parameter Setup Procedure" for detail.
20mA trim (Note 3)	A20	———	(20.00)	Analog output 20mA trim	See "Parameter Setup Procedure" for detail.
Pulse width	Pon	1 or 50 "An item shown on parameter label"	1	Factored pulse output "ON" width (Unit: [msec])	Ex.: To change pulse width from 1ms to 50ms → Set to "Pon 50" (msec). (Note 4)

⇨ to next page

Parameter	Code	Default Setting	Initial Value	Description	Remarks
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.	
Correcting function	Cor.F	oFF	oFF	Sequential line correction setup ON/OFF	• Only with "on", segmental line correction function related parameters (CP, C1P thru C4P, C1d thru C4d) can be set up. With "oFF," segmental line correction function related parameters do not appear on LCD. (Default is "oFF").
Decimal point, factored flowrate	CP	1	1	• Decimal point location in factored flowrate • Setting range: 0, 1, 2, 3	Factory-set parameters; not user serviceable.
Correction point 1 flowrate	C1P	0.0	0.0	• Flowrate at correction point 1 (Unit: [Δ/h]) • Setting range: 0 to 99999	
Correction 1 factor	C1d	0.00	0.00	• Corr. factor at correction point 1 (Unit: [%]) • Setting range: -99.99 to +99.99	
Correction point 2 flowrate	C2P	0.0	0.0	• Flowrate at correction point 2 (Unit: [Δ/h]) • Setting range: 0 to 99999	
Correction 2 factor	C2d	0.00	0.00	• Corr. factor at correction point 2 (Unit: [%]) • Setting range: -99.99 to +99.99	
Correction point 3 flowrate	C3P	0.0	0.0	• Flowrate at correction point 3 (Unit: [Δ/h]) • Setting range: 0 to 99999	
Correction 3 factor	C3d	0.00	0.00	• Corr. factor at correction point 3 (Unit: [%]) • Setting range: -99.99 to +99.99	
Correction point 4 flowrate	C4P	0.0	0.0	• Flowrate at correction point 4 (Unit: [Δ/h]) • Setting range: 0 to 99999	
Correction 4 factor	C4d	0.00	0.00	• Corr. factor at correction point 4 (Unit: [%]) • Setting range: -99.99 to +99.99	

NOTES 1. When conversion factor (H) has been set, the unit of pulse weight (Pu), indicated unit (Un), etc. must be changed also to the units after conversion.
2. Be sure to set up a value such that Pu>F × H/2.
3. Not shown on the LCD if the meter operates on the battery alone.
4. Be sure to set a value such that factored pulse "OFF" width > 1 ms.

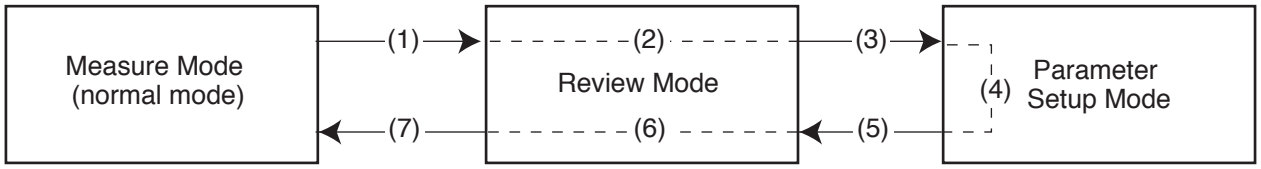
11.5 Parameter Setup Procedure

11.5.1 Reconfiguration Procedure

Given below is the parameter setup produre:

(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".
↓
(6) Using MODE and RESET switches, show the title (= one from bdAtA, AnA, PuLSE, or CorrEctCo).
↓
(7) Turn MODE switch ON for 5 seconds to go back to "Measure Mode".

A diagram to show parameter setup flow



➡ NOTE : For complete detail of MODE and RESET switch operations in steps (1), (2), (6) and (7), see "Table 11.2 Menu Trees and Switch Operation" on page 33.

11.5.2 Entering New Parameters

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:

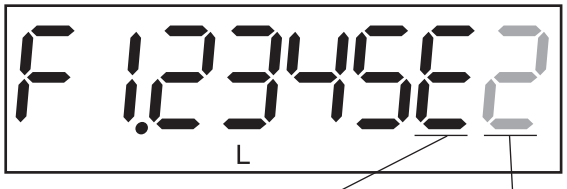
[Kind 1] Numerical setup parameters (F, H, Pu, At, A, AF, dAn, Pon, C1P to C4P, C1d to C4d)

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).

Example: Parameter "F"



Exponential sign (E: 10^{+n}, –: 10^{-n})
(The screen above reads F=1.2345×10^{+2}L)

Digit of interest (blinking)
- Turning MODE "ON" moves the blinking digit one place to the left ("E").
- Turning RESET "ON" increases the figure by one ("2" → "3").

[Kind 2] Decimal point setup parameters (bP, SP, and CP)

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 one place to the left and the figure increases by one.

→ When the decimal point appears at the desired location, hold MODE turned ON for 2 seconds.
(This establishes the setting and the window returns to review mode.)

Example: Parameter "bP" (decimal place in instantaneous flowrate)

Relative to the figure at right of decimal point, this point moves.

If a setting above (bP=2) is chosen, the instantaneous flowrate reads [b1□□□.□□].

A figure representing the decimal places of interest (flickers)

- Turning RESET button ON, the figure increases by one ("0"→"1"→"2").

[Kind 3] Analog output 4/20mA trim

- During the analog trim, keep on monitoring the analog output with a milliammeter or voltmeter.

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

(1) At "A04 4.000", hold "MODE" turned ON for 2 seconds to go into the parameter setup mode; the least significant rightmost digit "0" blinks on and off and a 4mA simulated output from the register appears.

(2) Set the milliammeter reading in the procedure below. (If it reads 3.988mA, for example, set to "A04 3.988".)

Example: Parameter "A04" (4mA trim)

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

RESET .... Each time the switch is turned ON, the figure of interest increases by one.

Digit of interest (blinking)

- Turning MODE "ON," the blinking digit moves to the left.
- Turning RESET "ON," the figure increases by one ("0" → "1").

Following entering the setting, hold MODE turned ON 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 rightmost digit blinking) now.)

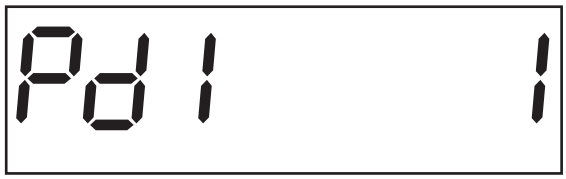
- If the reading is within the tolerance with respect to 4mA, by holding MODE turned ON for 2 seconds again, you can exit the setup mode. → Adjustment is complete. Returns to the review mode.
- If the reading is still outside the tolerance, repeat step (2) above.

11.5.3 About Dummy Output Features (special functions)

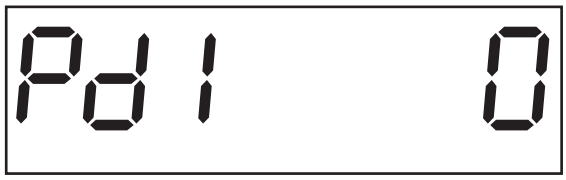
By the following steps, a 1 Hz or 10Hz simulated factored pulse train can be furnished irrespective of flowmeter measurement.

• 1Hz simulated output mode (dummy output 1 mode Code: Pd1)

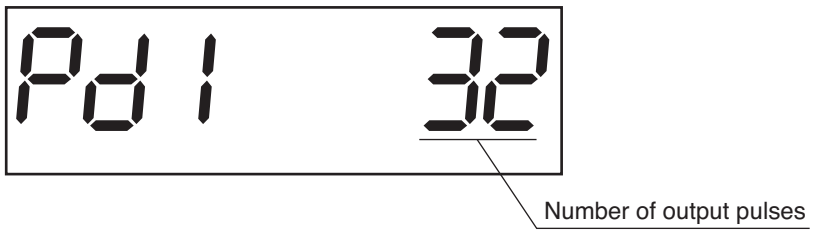
(1) According to the Table 11.2 "Menu Trees and Switch Operation" (page 33), show dummy output 1 ("Pd1 1") on the LCD.



(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.

11.5.4 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 being shown causes the modes to go to the measure mode without initialization.)

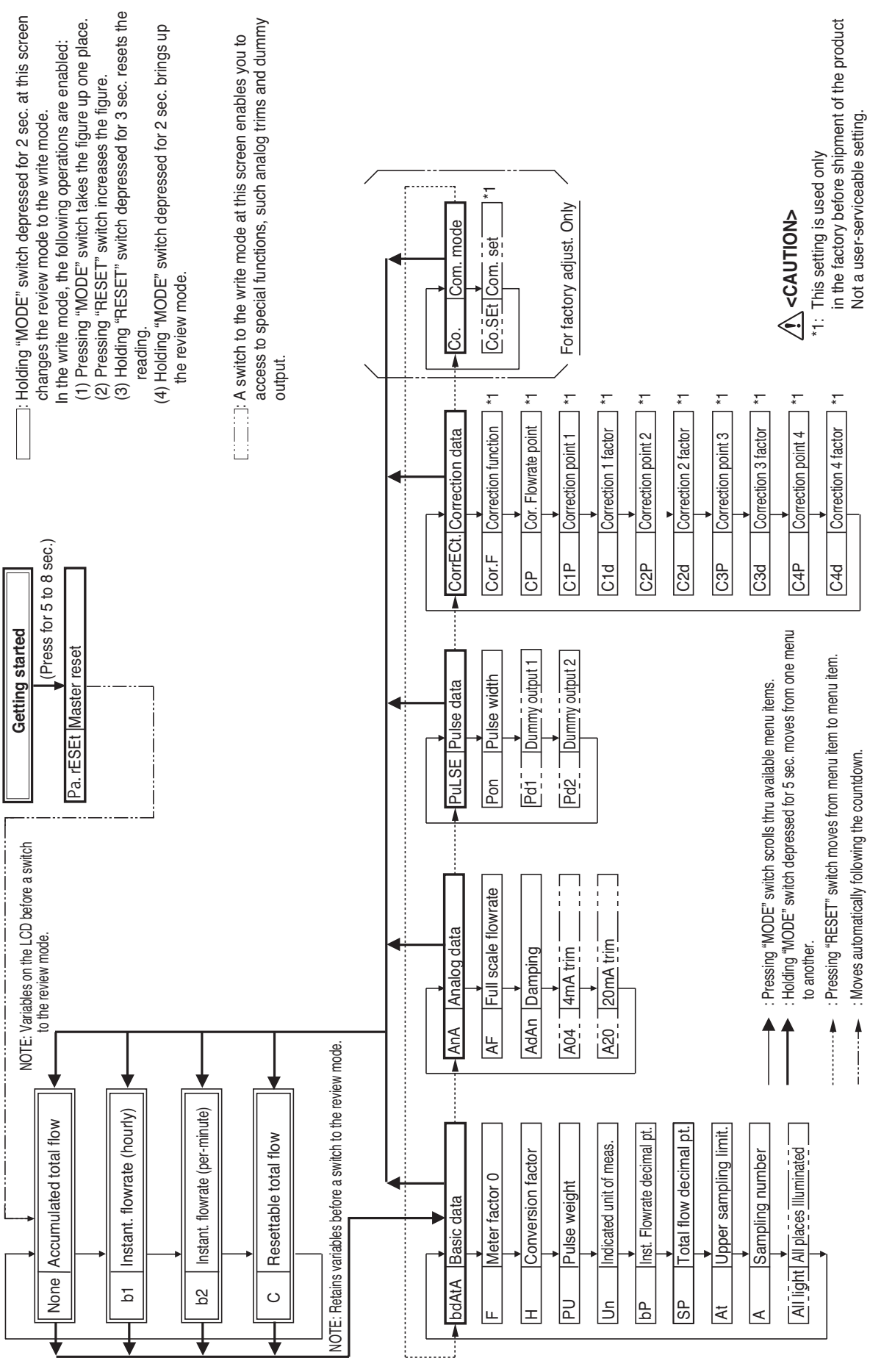
11.5.5 About Error Messages

The electronics unit 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 you with an error message from Table 11.1 below.

Table 11.1

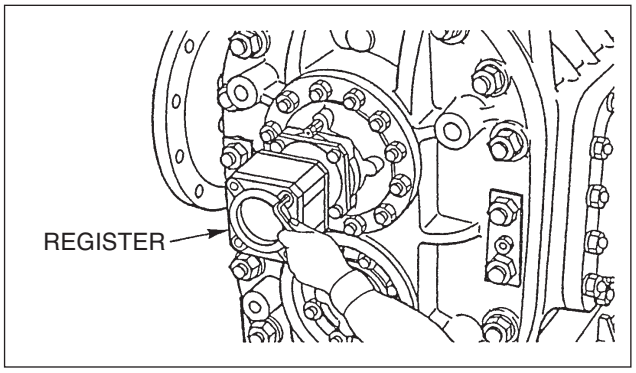
Message	Name	Description	Remedy
PA. Err	Parameter setup error	An attempt is made to rewrite a parameter while parameters are write-protected. (In the standard model, write-protect feature is set in OFF and will not appear.)	Can be reset by placing No. 1 of display board SW2 in OFF. (This enables you to change parameters.)
PA. Err. 1	Parameter error 1	Backup data retained for parameters has been damaged.	CPU initialization and then reconfiguration of parameters are required.
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 error	Pulse weight "Pu" setting is too small with respect to meter factor "F" and conversion factor "H".	Change the setting to an appropriate value that the relationship between F, H, and Pu satisfies the following formula: Pu≧FxH/2
AnA. Err	Analog output error	Analog output level is exceeded 120% of full scale for either reason: (1) Flowrate excessive (2) Analog full scale setting too small	(1): Reduce flowrate. (2): Select an appropriate analog full scale setting relative to the flowmeter specification.
Out. Err	Pulse output error	Pulse "OFF" width in the factored pulse output falls short of 1 msec for either reason: (1) Flowrate excessive (2) Factored pulse width setting too great	(1): Reduce flowrate. (2): Choose an appropriate factored pulse width "Pon" relative to the flowmeter specification
BATT	Battery life	Supply voltage has dropped.	Replace the battery with a new one.

Table 11.2 Menu Trees and Switch Operation

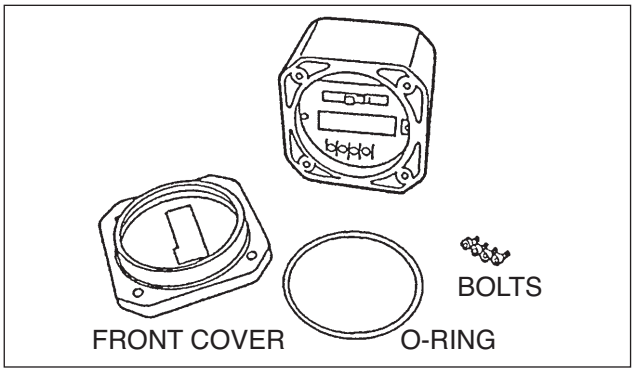


12. SWITCH FUNCTIONS AND PARAMETER SETUP, Register Type U8

12.1 Switch Names and Functions



(1) Using a hex key, take off four hex socket head bolts securing the front cover.



(2) Removing the front cover provides access to the electronics unit.

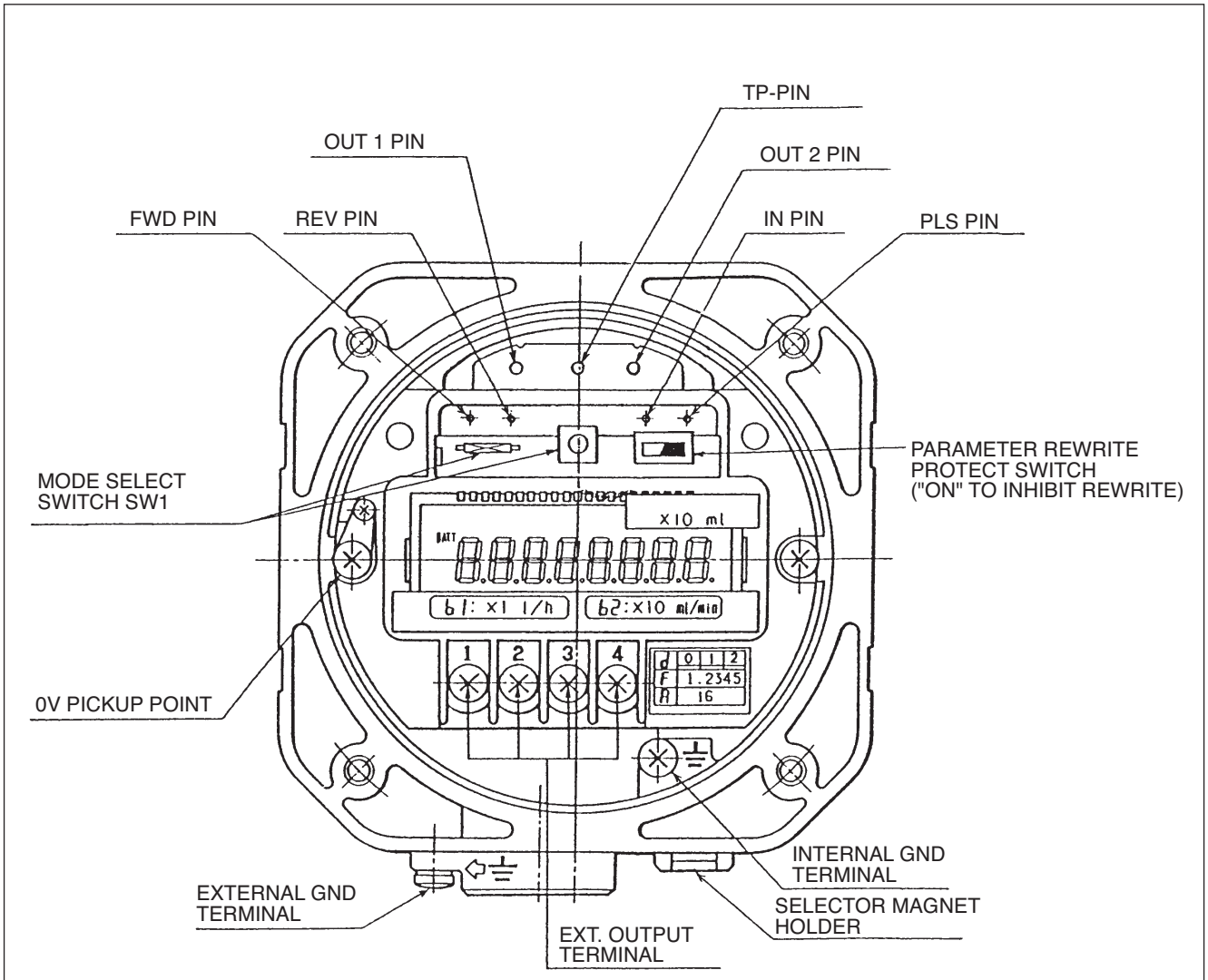
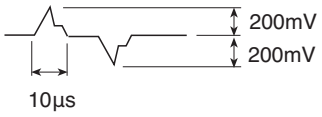
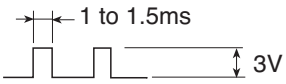
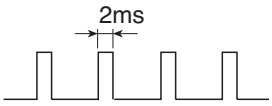
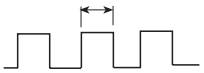
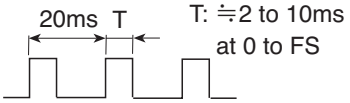


Fig. 12.1 Part Names of Electronics Unit

12.2 Individual Test Pin Functions

➡ NOTE : Connect the 0V and to “TP”-pin.le

PIN NAME	FUNCTION	WAVEFORM
FWD	An output of No. 1 amorphous sensor waveform appears.	
REV	An output of No. 2 amorphous sensor waveform appears. While the flowmeter is making forward revolutions, pulses are produced slightly behind the FWD pulses.	Same as above.
PLS	A rectangular waveform after FWD pulse waveshaping appears. Timing remains the same as that of FWD and its waveform is one before unfactored output amplification.	
IN	Accepts a square-wave pulse train from the pulse checker (OVAL Model PC2201, for example). Used for analog full scale adjustment, loop check, or other servicing. Input mode is Model PC2201's PG30 mode. Also accepts pulses with levels "0": 1V max. and "1": 7-12V min., or open collector.	
OUT1	Provides a waveform corresponding to the power signal which appears across remote output signal terminals 1 and 2.	(1) Unfactored pulse  (2) Factored pulse Depends on "Pulse width" setting.  (3) Analog output 
OUT2	Produces a waveform corresponding to the open collector output which appears across remote output terminals 3 and 4.	

12.3 About the Meter Factor

If it is desired to change meter factors in an instrumental error testing, for example, you may establish a new meter factor by the following procedure.
Instrumental error testing must be conducted with proper facilities and procedures specified in the Measurement Act, Japan Measuring Instruments Federation, JIS standards, or other established standards.

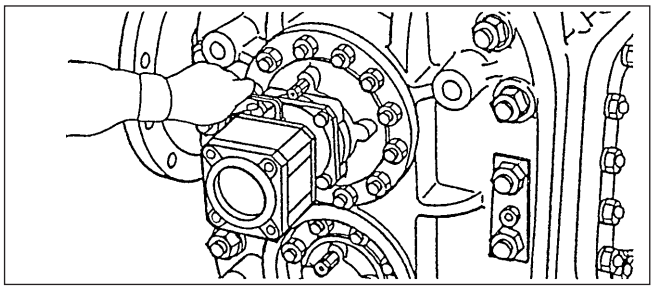
• How to Determine a New Meter Factor

$$\text{New Meter Factor} = (\text{Current meter factor}) \times \left(1 - \frac{E}{100}\right) \quad \text{(mL/P)}$$

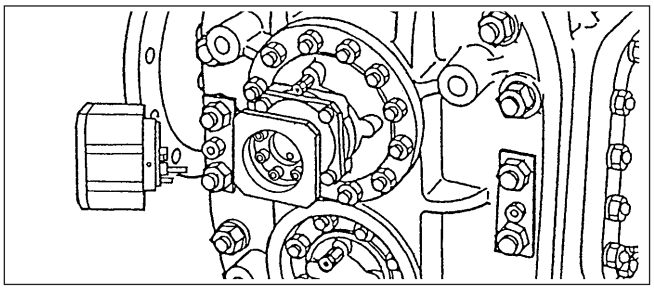
where current meter factor : Stated in the test report or on the tag of the product.
E : Instrumental error determined by the test (%)

⚠ CAUTION: The new meter factor should be preserved for later reference.

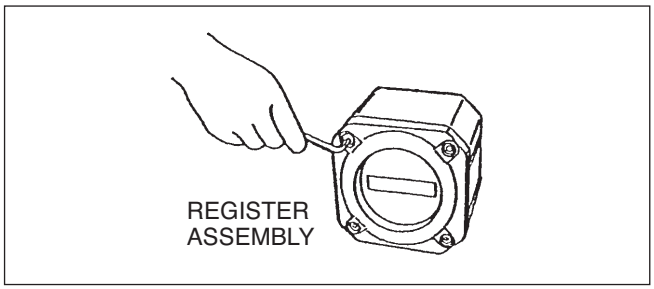
13. SENSOR REPLACEMENT PROCEDURE



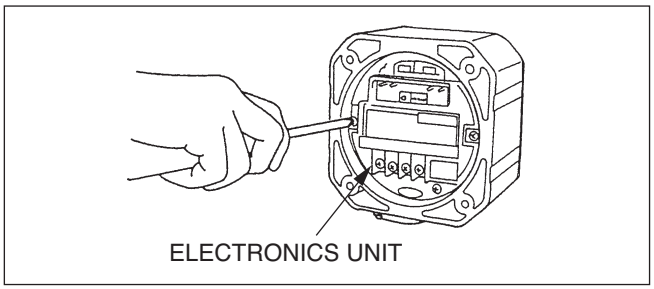
(1) Take off four hex socket head screws on the side of the register.



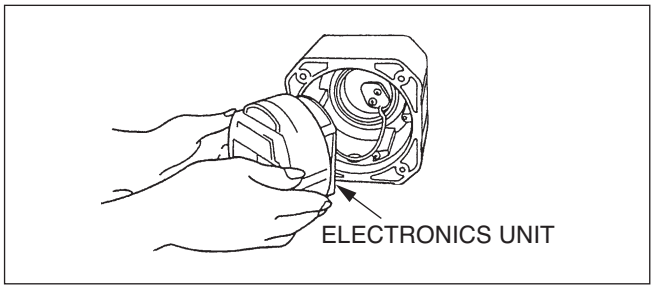
(2) Carefully draw the register assembly out. Exercising care not to bump the sensor against adjacent components, draw it out in the horizontal direction.



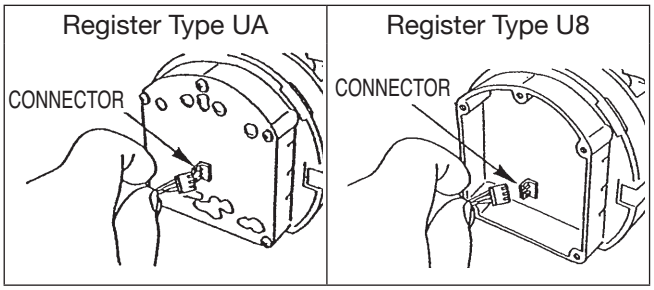
(3) Take off four hex socket head bolts and separate the cover.



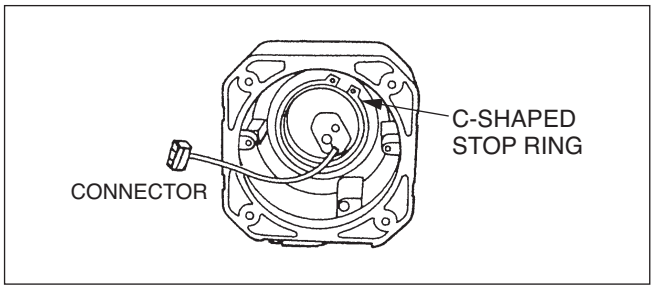
(4) With screwdriver, take off two fitting screws holding the electronics unit.



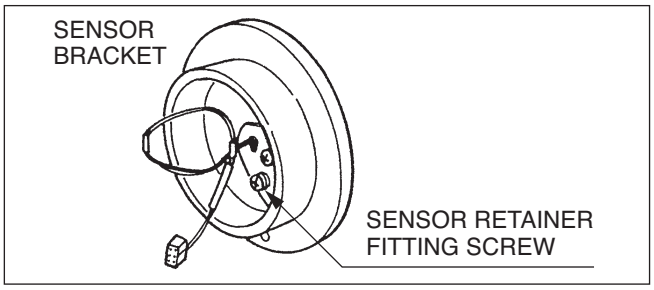
(5) Holding the electronics unit in both hands, carefully draw it out.



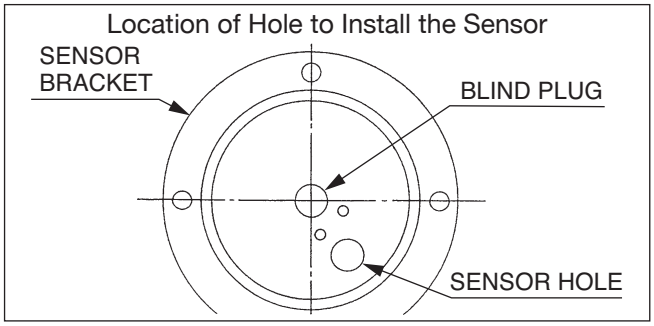
(6) Uncouple the connector from the sensor unit at back of the electronics unit.

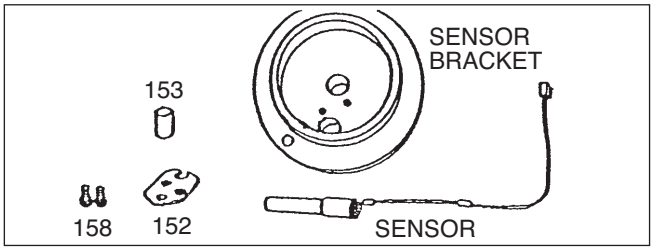


(7) Using C-shaped stop ring pliers, remove the C-shaped stop ring for the shat. The sensor unit is now separable from the register housing.



(8) Loosen the sensor retainer fitting screws (M4) with screwdriver, remove the sensor retainer and draw out the sensor unit.





(9) Install a new sensor unit through the opening through which the old sensor unit was removed and assemble in the reverse order of disassembly.

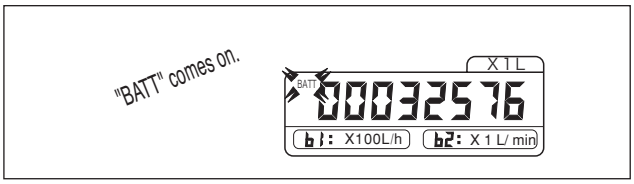
14. BATTERY REPLACEMENT PROCEDURE (Register type UA with battery pack)

14.1 About the Battery Pack

(1) When the batteries have weakened to nearly their end of life (*), a low battery warning message "BATT" appears on the register display. This message tells you of the time to replace the batteries within a week.

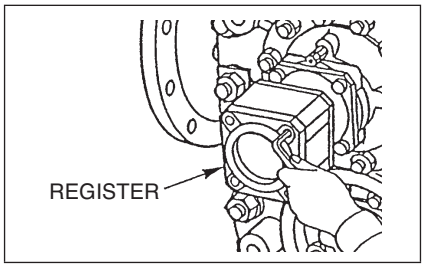
(2) This dedicated battery pack is provided with a connector. Other commercially available batteries cannot be used. Be sure to use the battery pack dedicated to this register.

➡ NOTE : (*) Battery pack is good for 8 years approx., continuous operation, with no external power supply (depends on operating, environmental, and other conditions).

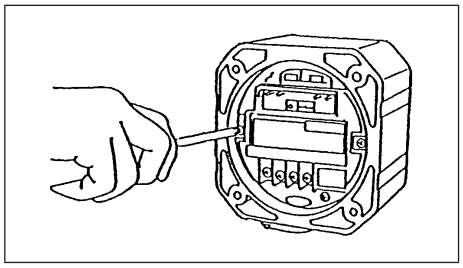


14.2 Battery Pack Replacement

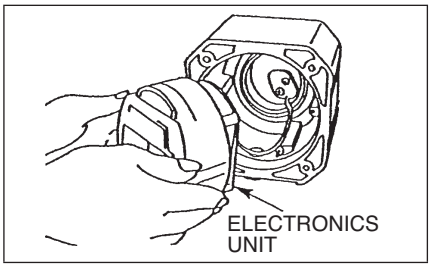
⚠ CAUTION: If your meter is of externally powered type, turn off power first.



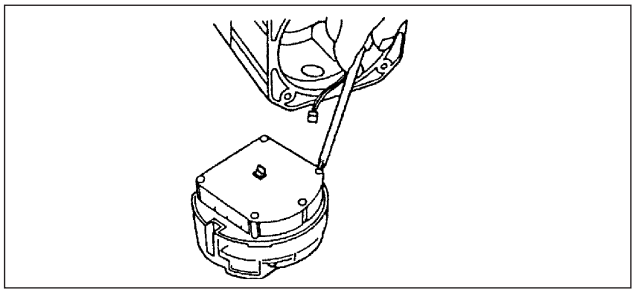
(1) Take off four hex socket head bolts on the front face of the register and remove the cover.



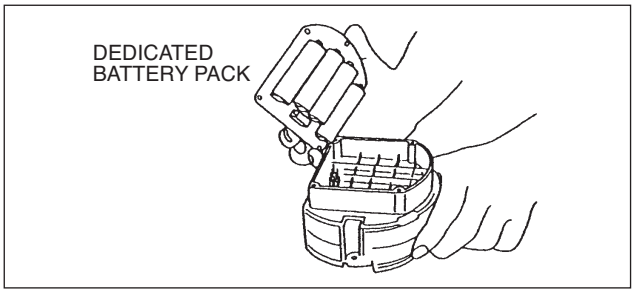
(2) Using screwdriver, take off two fitting screws fixing to electronics



(3) Holding the electronics unit in both hands, carefully draw it out. Be careful not to damage the sensor leads connected.



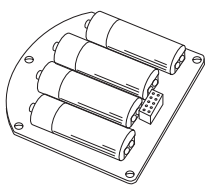
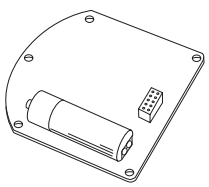
(4) Uncouple the connector from the sensor unit at back of the electronics unit and take off five screws as shown.



(5) Carefully draw the dedicated battery pack out.

(6) Install a new battery pack. Be sure to make sure of the connector location. Installing forcibly may damage the connector or cause poor electrical contact.

◎ **Two types of dedicated battery packs are available.**

	Battery pack without external output (4 batteries)	Battery pack without external output (1 battery)
Appearance		
Life (when operating on battery)	Approx. 8 years	Approx. 2 years
Applicable range	Applicable to the battery pack without external output (Usable for the battery pack with external output)	Applicable to the battery pack with external output (Not usable for the battery pack without external output)

IMPORTANT

When you replace batteries, contact your nearest OVAL service station and use dedicated battery packs.

⚠ WARNING

This dedicated battery pack is of intrinsic safety explosionproof configuration. Never attempt to disassemble it.

15. TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE	REMEDY
1. Totalizer remains inoperative.	1. Flowrate is low.	1. Open valves progressively.
	2. Insufficient pump pressure.	2. Taking pressure loss of entire piping assembly into consideration, correct pump pressure.
	3. Power line voltage is out of specification or current carrying capacity of power source is inadequate.	3. Provide a 14 to 45VDC power to the register. (12 to 24VDC for open collector or voltage pulse output.) Current carrying capacity 30mA min. is required for power. (With analog output option, 24VDC, 60mA min. is required.)
	4. Battery has run down. (battery powered models)	4. Referring to Section 14, replace battery pack.
	5. Oval rotors jammed with foreign solids; rotors locked; metered liquid fails to run.	5. Referring to Disassembly and Inspection Procedure (Sec. 10), disassemble meter body and clean the rotors, etc. thoroughly.
	6. Oval rotors installed the wrong way.	6. Refer to 10.2 Basic Meter Assembly Procedure in Disassembly and Inspection Procedure and reassemble correctly.
	7. Sensor installed out of position.	7. Refer to "How to Change Flow Directions" (Sec. 7) and reinstall the sensor.
2. Unusual noise.	1. Air is entrapped.	1. Decrease flowrate and eliminate air in the piping assembly.
	2. Vaporized metered liquid in the piping assembly.	2. Decrease flowrate and control metered fluid temperature and pressure to prevent vaporization.
	3. Oval rotors revolving in contact with measuring chamber.	3. Refer to Disassembly and Inspection Procedure (Sec. 10) and disassemble and inspect for condition.
3. "BATT" flickers. (Battery powered models)	1. Battery voltage is low.	1. Refer to Sec. 14 and replace battery pack.
4. Liquid leaks.	1. Incomplete seal of the pipeline.	1. Inspect bolts at pipe connections for tightness or replace gaskets.
	2. Incomplete seal on front and/or rear cover of meter body.	2. Retighten bolts at pipeline connections and replace O-ring with new one.
5. Counts while valves remain closed.	1. Valve and pipeline leaks.	1. Inspect valves and pipeline.
	2. Air pockets between valve and ULTRA OVAL; rotors in rocking motion in response to pump's pulsating pressure.	2. Vent air. Provide a check valve and accumulator.
	3. Supply power voltage fluctuates.	3. Eliminate voltage fluctuation.
6. Analog output unusual.	1. Load resistance too great.	1. Referring to "Load Resistance Range" on pages 16 and 17, check load resistance to power supply voltage relationship and keep them within the specified range.
7. Accumulated total too high.	1. Rotors in rocking motion in response to a pulsating flow.	1. Add a check valve and accumulator.
	2. Influenced by external magnetic fields (Meter sensor picks up external magnetic fields created by a motor, generator, etc.)	2. Keep out external magnetic fields.
	3. Air entrapped.	3. Provide an air vent.
8. Accumulated total too low.	1. Influenced by external magnetic fields.	1. Keep out external magnetic fields.

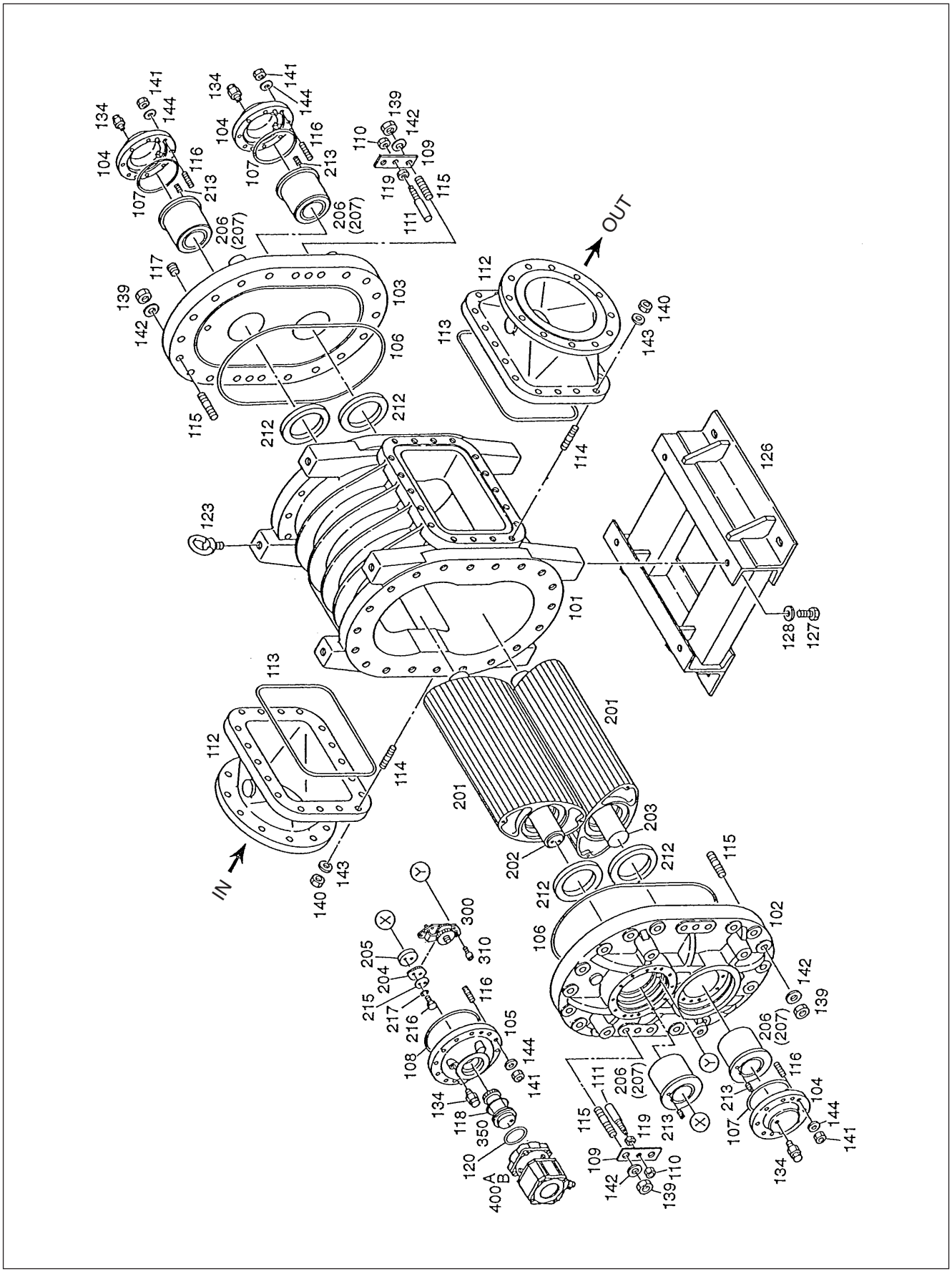
16. EXPLODED VIEWS AND PARTS LIST

- **When ordering replacement parts, please supply us with product number, flowmeter mode, instruction manual No., symbol No. , part name, and quantity desired.**

SUBINDEX

16.1 Meter Body Exploded View and Parts List

16.1.1 Exploded View



16.1.2 Parts List

<Meter Body>

Sym. No.	Part Name	Q'ty	Remarks
101	Meter Body	1	
102	Front Cover	1	
103	Rear Cover	1	
104	Blind Cover	3	
105	Adapter	1	
▲ 106	O-Ring, Front/Rear Cover	2	Special
▲ 107	O-Ring, Blind Cover	3	JIS G165
▲ 108	O-Ring, Adapter	1	JIS G230
109	Locating Pin Retainer	4	
110	Locating Pin Nut A	4	M16
111	Locating Pin	4	
112	Reducer	2	ϕ510
113	Reducer O-Ring	2	
114	Reducer Stud Bolt	36	M24×105
115	Stud Bolt, Meter Body Cover	40	M30×165
116	Stud Bolt, Blind Cover	36	M16×75
117	Drain Plug	2	Sunk plug
▲ 118	Sealing Cylinder O-Ring	1	JIS G75
119	Locating Pin Nut B	4	M16
120	Sealing Plate Gasket	1	
123	Eyebolt	4	M30×45
126	Base	1	
127	Base Mounting Hex Bolt	4	M30×50
128	Washer	4	M30, taper 5
134	Air Vent VAlve	4	Rc1/4 (vent plug)
139	Hex Nut	40	M30
140	Hex Nut	36	M24
141	Hex Nut	36	M16
142	Washer	32	M30
143	Washer	36	M24
144	Washer	36	M16

▲: Recommended replacement parts

<Inner Case Assembly>

Sym. No.	Part Name	Q'ty	Remarks
201	Rotor	2	
202	1st Rotor Shaft	1	
203	2nd Rotor Shaft	1	
204	Uniform Motion Drive Gear	1	
205	Boss, Uniform Motion Drive Gear	1	
206	Bearing Holder	4	
▲ 207	Bearing	8	
▲ 212	Thrust Ring	4	
213	Non-turn Bolt	4	M10×17
215	Retainer, Uniform Motion Gear	1	
216	Bolt	2	M10×30
217	Spring Washer	2	M10

▲: Recommended replacement parts

<Reduction Gear Train, Signal Generating Magnet Assembly, Register Assembly>

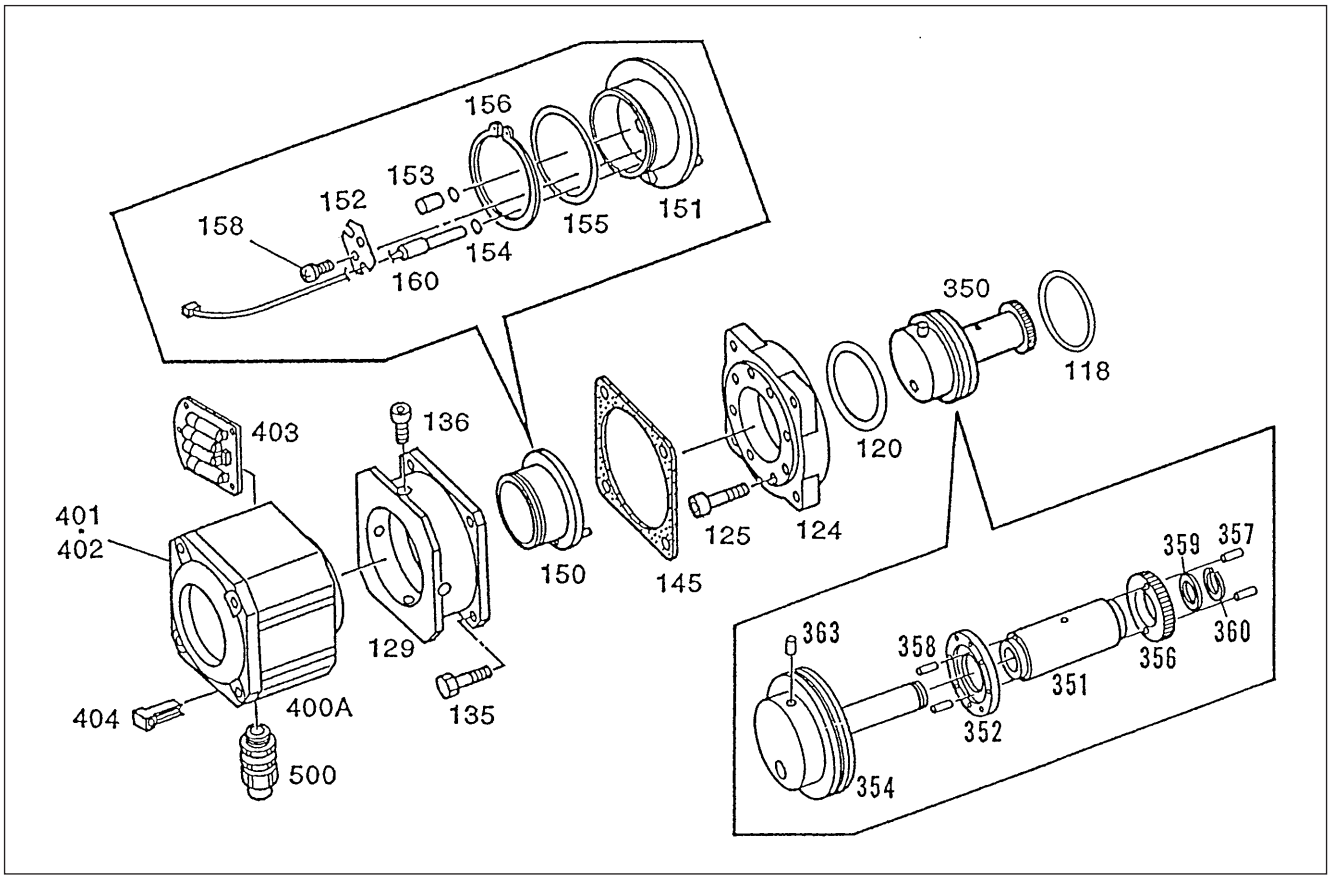
Sym. No.	Part Name	Q'ty	Remarks
300	Reduction Gear Train	1 set	
310	Bolt	4	M12
350	Signal Generating Magnet Ass'y	1 set	See page. 47, 48.
400A	Register Assembly	1 set	Register type: UA See page 42.
400B	Register Assembly	1 set	Register type: U8 See page 43.

16.2 Electronic Register, Signal Generating Magnet Assembly Exploded View and Parts List

- **When you order replacement parts, specify the stock No., flowmeter model, instruction manual No., symbol No., part name and the quantity desired.**

16.2.1 Register Type: UA

◇Exploded View◇



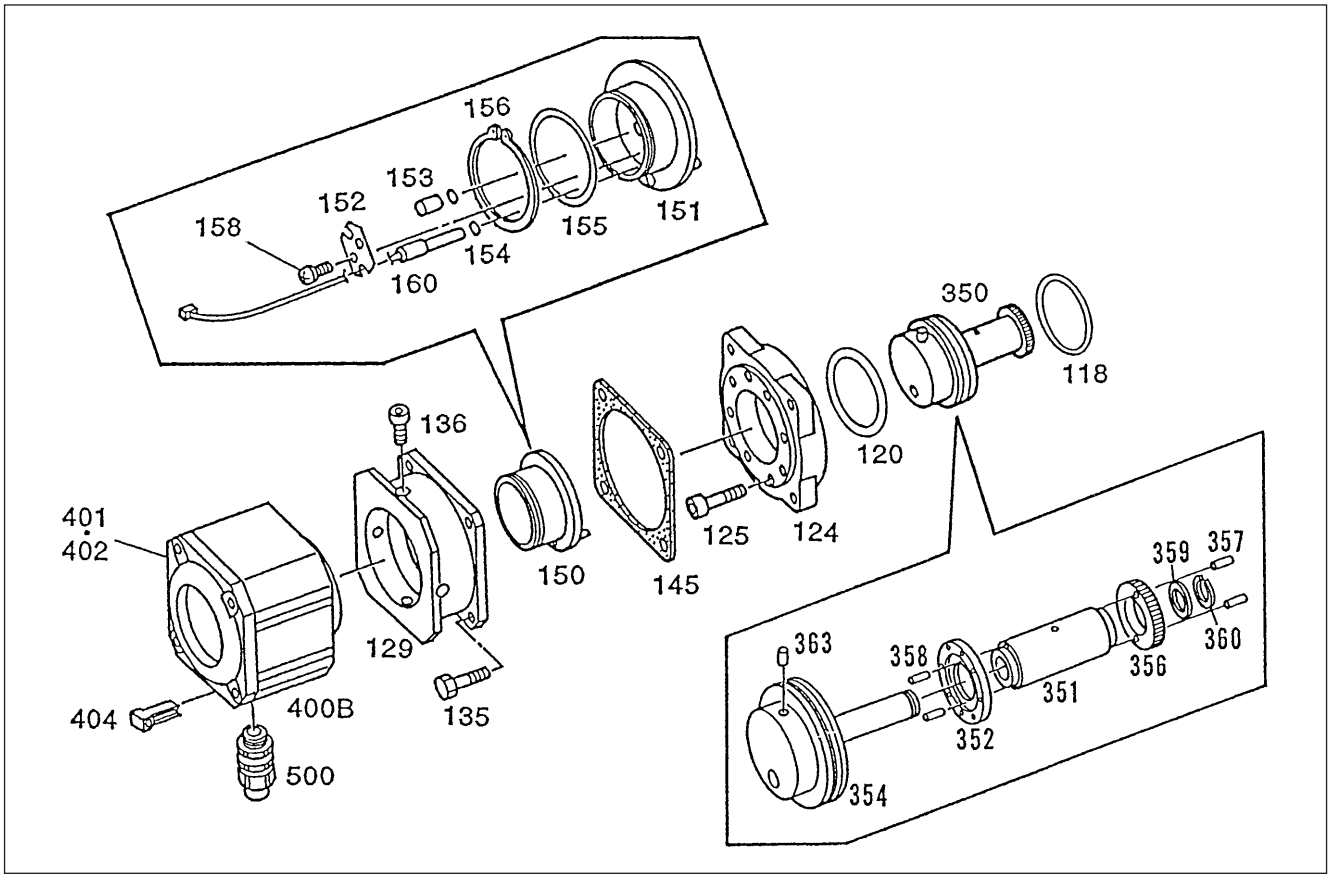
◇Parts List◇

Symbol No.	Part Name	Q'ty	Remarks
118	O-Ring, Sealing Cylinder	1	JIS G75
120	Sealing Gasket	1	
124	Sealing Flange	1	
125	Soc. Hd. Bolt, Sealing Flange	8	M10
129	Adapter (register fitting)	1	
135	Adapter Fitting Bolt	4	M10
136	Register Fitting Bolt	4	M6
145	Gasket	1	
150	Sensor Assembly	1 set	(151 to 158,160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	JIS S10
155	O-Ring C	1	JIS G65
156	C-shaped Stop Ring	1	
158	Pan Head Screw	2	M4 (with washer)
160	Sensor Unit	1	

Symbol No.	Part Name	Q'ty	Remarks
350	Signal Generating Magnet	1 set	(351 to 363)
351	Bearing Holder	1	Bearing inclusive
352	Magnet Retainer	1	Magnet inclusive
354	Pressuretight Sealing Plate	1	
356	Transmission Gear	1	
357	Pin	2	ϕ2×12
358	Pin	2	ϕ2×8
359	Thrust Spacer	1	
360	C-Ring	1	
363	Pin	1	ϕ2×8
400A	Register Assembly	1 set	Register type: UA
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
403	Battery Pack	1	Option
404	Selector Magnet	1	
405	Internal Assembly	1 set	Register type: U7
500	Pressuretight Packing	1 set	Option

●16.2.2 Register Type: U8

Exploded View



◇Parts List◇

Symbol No.	Part Name	Q'ty	Remarks
118	O-Ring, Sealing Cylinder	1	JIS G75
120	Sealing Gasket	1	
124	Sealing Flange	1	
125	Soc. Hd. Bolt, Sealing Flange	8	M10
129	Adapter (register fitting)	1	
135	Adapter Fitting Bolt	4	M10
136	Register Fitting Bolt	4	M6
145	Gasket	1	
150	Sensor Assembly	1 set	(151 to 158,160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	JIS S10
155	O-Ring C	1	JIS G65
156	C-shaped Stop Ring	1	
158	Pan Head Screw	2	M4 (with washer)
160	Sensor Unit	1	

Symbol No.	Part Name	Q'ty	Remarks
350	Signal Generating Magnet	1 set	(351 to 363)
351	Bearing Holder	1	Bearing inclusive
352	Magnet Retainer	1	Magnet inclusive
354	Pressuretight Sealing Plate	1	
356	Transmission Gear	1	
357	Pin	2	ϕ2×12
358	Pin	2	ϕ2×8
359	Thrust Spacer	1	
360	C-Ring	1	
363	Pin	1	ϕ2×8
400B	Register Assembly	1 set	Register type: U8
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	Register type: U8
500	Pressuretight Packing	1 set	Option

17. GENERAL SPECIFICATIONS

17.1 Register Specifications, Register Type UA

Item \ Meter Size				6 5
Local Indicator (LCD) (Note 1)		Grand total (8 digits)		0.01 m^3 (standard), 0.1 m^3, 1 m^3
		Resettable total (7 digits)	C mode	Total flow unit remains the same as that of accumulated total flow.
		Instantaneous flowrate, 4-digit	b1 mode	0.1 m^3/h (standard)
			b2 mode	0.001 m^3/min (standard)
Output	–	None		None
	Current	Analog		4 to 20mA DC See acceptable load resistance range on page 16.
		Pulse (Note 2)	Category	Factored or unfactored: 0/1 = 4/20mA DC
			Pulse width	Factored: 1 ms (standard); 50 ms Unfactored: 2 ms
			Factored pulse units	Same as the units of reading displayed
	Open collector	Pulse (Note 2)	Category	Factored or unfactored: Max. voltage impressed 30V DC; Max. allowable current 50 mA
			Pulse width	Factored: 1 ms (standard); 50 ms Unfactored: 2 ms
			Factored pulse units	Same as the units of reading displayed
	Voltage	Pulse (Note 2)	Category	Factored or unfactored: NPN transistor output (Max. voltage impressed: 30V DC; Allowable current: 50mA; Transistor "ON" voltage: 1.5V DC max.)
			Pulse width	Factored: 1 ms (standard), 50 ms Unfactored: 2 ms
			Factored pulse units	Same as the unit of reading displayed (Note 1)
Power Supply		Output Not Provided		Built-in dedicated lithium battery. Good for 8 years approx. (Depends on operating conditions.)
		Output Provided		External power 12 to 45V DC (analog, current pulse) 12 to 24V DC (open collector pulse, voltage pulse) 12 to 45V DC (analog, current pulse combined) Current drain 30mA DC max. (See acceptable load resistance range on page 16.) (Note 1)
Signal Transmission Cable				Shielded cabtyre cable (VCIF 1.25 mm^2) Finished O.D. 8.5 to 12 mm (Note 3)
Transmission Length				One kilometer max.
Transmission Line System			2-wire	Analog or current pulse
			3-wire	Open collector pulse or voltage pulse
			4-wire	Analog + current pulse
Operating Temperature Range				-10 to +60°C
Explosionproof Rating				Select either one of the following: ① Non-explosionproof type ② TIIS : Ex d ⅡB T4/Ex ia ⅡB T4 ③ KCs : Ex d ⅡB T4
Applicable EU Directives				RoHS : 2011/65/EU+(EU)2015/863 EMC : 2014/30/EU
Applicable EN standard				RoHS : EN IEC 63000 EMC : EN61326-1 Class A
Enclosure Protection Rating				IP66 (dustlight / watertight) IEC/EN60529, JIS C 0920
Enclosure Material				Aluminum die cast
Finish				Munsell 2.5PB5/8, baked melamine resin coating

➡ NOTE : 1. When powered by the battery pack, the register provides local readout only with no remote output.
2. If pulse width in excess of 1 ms is desired with minimum factored pulse unit, the max. flowrate can possibly be restricted; consult the factory.
3. For wiring of explosionproof type (output available models), do not fail to use the ancillary pressure-resistant packing.
Also, in case of TIIS explosionproof type used under the ambient temperature of 45℃ or higher, use a cable resistant to the temperature of 75℃ or higher.

● 17.2 Register Specifications, Register Type U8

Item \ Meter Size			6 5
Local Indicator (LCD) Mode select	Grand total (8 digits)	—	× 10 L (standard), × 100 L, × 1000 L
	Instant flowrate (4-digit)	b mode	× 1m³/h
		P mode	0 to 100 %
		Bar graph	8-segment bar graph display
Output: Current	Analog		4 to 20mA DC Damping: 0 to 100 sec. (See Acceptable Load Resistance Range on page 17.)
	Pulse (Note 4)	Category	Factored or unfactored: 0/1 = 4/20mA DC (Note 1)
		Pulse width	Factored: 1 to 1000 ms (std: 1ms); Unfactored: 2 ms
		Factored pulse units	Same as the units of reading displayed
Output: Open collector	Pulse (Note 4)	Category	Factored or unfactored: Max. volt. impressed 30VDC; Allowable current 50 mA (Note 1)
		Pulse width	Factored: 1 to 1000 ms (standard 1 ms), Unfactored: 2 ms
		Factored pulse units	Same as the units of reading displayed
	Alarm output status		Max. voltage impressed 30VDC; Allowable current 50 mA
Communication			Current output 4 to 20mA: BELL 202 communication standard FSK (frequency modulation) signal is superimposed on instantaneous flowrate signal.
Power Supply			12 to 45VDC: Current drain 30mA max. See acceptable load resistance range on page 17.)
Operating Temperature Range			-10 to + 60 °C
Function	3α correction		Corrects for volumetric expansion coeff. of meter's measuring chamber material.
	Meter error correction		Meter error correction coeff. at each flowrate point (in a 4-point broken line graph) is entered in % meter error.
	Instant rate span setting		Any point more than 3 times the minimum flowrate and less than 2 times the maximum flowrate within the accuracy guaranteed range for each model.
	4 to 20mA DC trim		
	Communication		Permits configuring and reading of parameters with EL2310 in HART protocol.
	Alarm		Normally: Transistor OFF; In error: Transistor ON (Tells the operator sensor error, full scale exceeded, or preset flowrate exceeded.) (Note 3)
	Self-diagnosis loop check		
Accuracy			Grand total ±0.01% ±1 count Instantaneous flowrate ± 0.3% of F.S.
Transmission Cable			Signal transmission cable: 1.25mm² shielded cable (finished O.D. 8.5 to 12mm) (Note 2)
Transmission Length			One kilometer max.
Transmission Lines		2-wire system	Analog or current pulse
		4-wire system	Analog or current pulse + open collector
Explosionproof Rating			Select one of the following enclosures: ① Non-explosionproof type ② Explosionproof type: TIIS Ex d ⅡB T4/Ex ia ⅡB T4 ③ Explosionproof type: KCs Ex d ⅡB T4
Finish			Munsell 2.5PB5/8 (baked melamine resin coating)

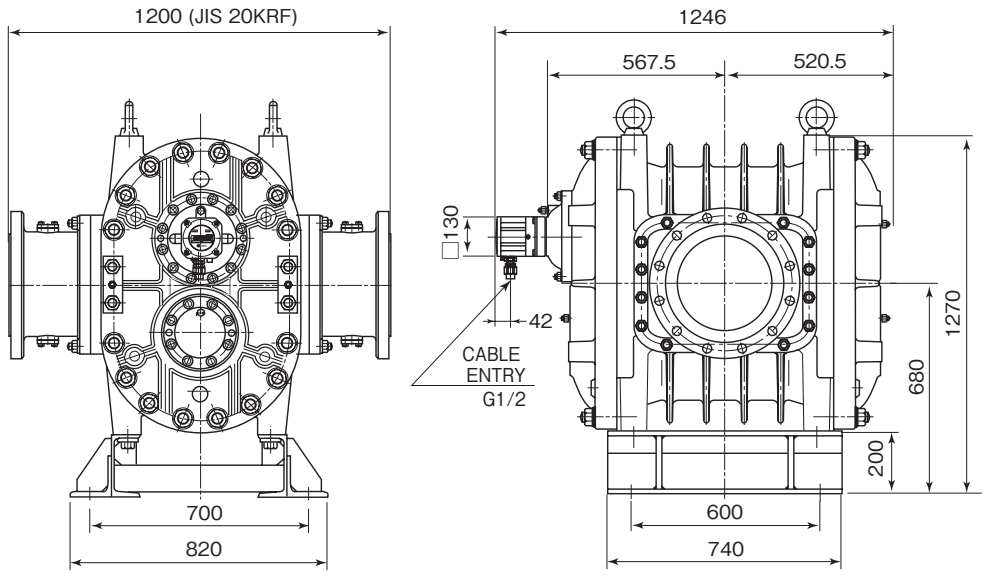
➡ NOTE :
1. Current pulse and open collector pulse are in the same category for setting. A combination of factored and unfactored pulses is unacceptable.
2. For wiring of explosionproof type, do not fail to use the ancillary pressure-resistant packing. Also, in case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher.
3. In an alarmed condition, the register shows an error message and flow information alternately.
4. If pulse width in excess of 1 ms is desired with minimum factored pulse unit, the max. flowrate can possibly be restricted; consult the factory.

17.3 Nominal Meter Factor

Meter Size	P/r	Nominal Meter Factor
65	12	6423.1 mL/P

18. OUTLINE DIMENSIONS

All dimensions in millimeters



<NOTE>

For outline dimensions and pipeline connection dimensions, see approval drawings.

OVAL Corporation

Head Office : 10-8, Kamiochiai 3-chome, Shinjuku-ku, Tokyo, Japan
Phone: 81-3-3360-5121 FAX: 81-3-3365-8605