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LEFOO

INTELLIGENT ELECTROMAGNETIC FLOWMETER

User Manual

CONTENTS

The intelligent electromagnetic flowmeter is a fully intelligent electromagnetic flowmeter developed by our company using advanced domestic and international technology. Its all-Chinese electromagnetic converter core uses a high-speed central processor, providing exceptionally fast computation speed, high accuracy, and reliable measurement performance. The converter circuit design incorporates internationally advanced technology, featuring an input impedance as high as 10^{12} ohms and a common-mode rejection ratio better than 100 dB. Its ability to suppress external interference and 60Hz/50Hz noise exceeds 90 dB, enabling the measurement of fluid media with even lower conductivity. The sensor employs non-uniform magnetic field technology and a specialized magnetic circuit structure, ensuring a stable and reliable magnetic field while significantly reducing the size and weight, making the flowmeter compact and lightweight. Our mission: Quality for survival, service for reputation.

PRODUCT FEATURES

▲ No moving parts or flow obstructions inside the pipeline, resulting in minimal additional pressure loss during measurement.

▲ Measurement results are independent of flow velocity distribution, fluid pressure, temperature, density, viscosity, and other physical parameters.

▲ The measuring range can be modified online according to the actual needs of the user.

▲ High-definition backlit LCD display with full Chinese menu operation; easy to use, simple to operate, and user-friendly.

▲ Utilizes SMD components and surface mount technology (SMT) for high circuit reliability.

▲ Equipped with a 32-bit high-performance microprocessor, offering fast computation speed and high accuracy. The programmable low-frequency rectangular wave excitation improves flow measurement stability and reduces power consumption.

▲ Fully digital processing ensures strong anti-interference capability, reliable measurement, high accuracy, and a flow measurement range of up to 150:1.

▲ Ultra-low EMI switching power supply allows for a wide range of power supply voltage variations with excellent EMC performance.

▲ Internal counters include three totalizers that can respectively display forward total, reverse total, and difference total.

▲ Optional digital communication outputs include RS485, Hart, and Modbus protocols.

▲ Features self-check and self-diagnosis functions.

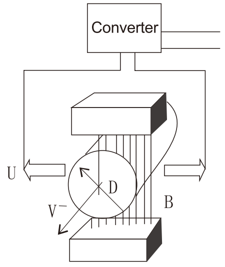
I.OVERVIEW

WORKING PRINCIPLE

The measurement principle of the electromagnetic flowmeter is based on Faraday's Law of Electromagnetic Induction. The flowmeter's measuring tube is a short section of non-magnetic alloy lined with an insulating material. Two electrodes are fixed along the diameter of the measuring tube, penetrating the tube wall, with the electrode heads nearly flush with the inner surface of the lining. When the excitation coil is energized with a bidirectional square wave pulse, it generates a magnetic field with a magnetic flux density B, perpendicular to the axis of the measuring tube. When a conductive fluid flows through the measuring tube, it cuts through the magnetic field lines, inducing an electromotive force (E). The electromotive force E is proportional to the product of the magnetic flux density B, the inner diameter d of the measuring tube, and the average flow velocity v. The electromotive force E (flow signal) is detected by the electrodes and transmitted via cables to the converter. The converter amplifies and processes the flow signal, displaying the fluid flow rate, and can output pulse, analog current, and other signals for flow control and regulation.

$$E=KBdv$$

In the equation:
E -----represents the signal voltage between the electrodes (V)
B -----represents the magnetic flux density (T)
d -----represents the inner diameter of the measuring tube (m)
v -----represents the average flow velocity (m/s)



In the equation, k and d are constants. Since the excitation current is constant, B is also constant. Thus, from the equation \(E = KBdv\), we can see that the volumetric flow rate Q is directly proportional to the signal voltage E, meaning that the flow-induced signal voltage E has a linear relationship with the volumetric flow rate Q. Therefore, as long as E is measured, the flow rate Q can be determined. This is the basic working principle of the electromagnetic flowmeter. From the equation \(E = KBdv\), it is evident that parameters such as the temperature, density, pressure, conductivity, and the ratio of liquid to solid components in a liquid-solid two-phase fluid do not affect the measurement results. As long as the flow state conforms to axisymmetric flow (e.g., laminar or turbulent flow), the measurement results will not be affected. Therefore, the electromagnetic flowmeter is truly a volumetric flowmeter. For both manufacturers and users, as long as the device is calibrated with ordinary water, it can measure the volumetric flow of any other conductive fluid without requiring any correction. This is a significant advantage of the electromagnetic flowmeter, unmatched by any other flowmeter. Additionally, since there are no moving or flow-obstructing parts inside the measuring tube, there is virtually no pressure loss, and the device boasts extremely high reliability.

APPLICATIONS

Due to its unique advantages, the electromagnetic flowmeter is widely used across various industrial sectors, including chemical and fiber industries, food processing, paper manufacturing, sugar refining, mining and metallurgy, water supply and drainage, environmental protection, hydraulic engineering, steel production, oil industry, and pharmaceuticals. It is employed to measure the volumetric flow of various conductive liquid media, such as acids, alkalis, saline solutions, slurries, mineral slurries, paper pulp, coal slurry, corn slurry, fiber slurry, grain slurry, lime slurry, wastewater, cooling raw water, water supply and drainage, brine, hydrogen peroxide, beer, wort, various beverages, black liquor, and green liquor.

II.PRODUCT PARAMETER

- Nominal Diameter Series DN (mm)

Pipeline Type with PTFE Lining: 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600

Pipeline Type with Rubber Lining: 80, 100, 125, 150, 200, 300, 350, 400, 500, 600, 800, 1000, 1200

Note: Special sizes can be customized.*

- Flow Direction: Forward, reverse, net flow; Range

Ratio: 150:1; Repeatability Error: ±0.1% of the measured value

- Accuracy Class: Pipeline Type: Class 0.5, Class 1.0
- Measured Medium Temperature

Standard Rubber Lining: -20°C to +80°C ; PFA: -20°C to +180°C ; PTFE Lining: -20°C to +120°C ; F46 Lining: -20°C to +160°C

- Rated Operating Pressure

Pipeline Type: DN10-DN200: ≤1.6 MPa; DN250-DN1000: ≤1.0 MPa

- Flow Measurement Range

The flow measurement range corresponds to a flow velocity range of 0.1-15 m/s. The optimal range for actual flow velocity measurement is 2-4 m/s.

- Conductivity Range:

Measured fluid conductivity ≥50 μS/cm (integrated type).

Most water-based media, with conductivity ranging from 200 to 800 μS/cm, can be measured using an electromagnetic flowmeter.

- Current Output

Load Resistance: 0~10 mA: 0~1.5 kΩ; 4~20 mA: 0~750 Ω

- Protection Level: Standard type:IP65;

Special custom type: Standard type:IP68, Submersible Type:IP68

- Power Supply: 85~265V, 45~63 Hz, 18~28 VDC
- Straight Pipe Length: Pipeline Type: Upstream ≥10 DN,

Downstream ≥5 DN

- Connection Method: The flowmeter and piping are connected via flanges. The flange connection dimensions should comply with the requirements of GB/T9119-2000.
- Ambient Temperature: -25°C to +60°C
- Relative Humidity: 5% to 95%
- Total Power Consumption: Less than 20W

III.ELECTROMAGNETIC FLOWMETER MODEL SELECTION

The correct selection of an electromagnetic flowmeter is a prerequisite for ensuring its optimal use. The configuration of the electromagnetic flowmeter should be determined based on the physical and chemical properties of the fluid being measured. This ensures that the flowmeter's diameter, flow range, lining material, electrode material, and output current are all suitable for the fluid's characteristics and flow requirements.

Measurable Fluids

According to the working principle of the electromagnetic flowmeter, the fluid to be measured must be conductive. Strictly speaking, any fluid with a conductivity greater than 50 μS/cm, except for high-temperature fluids, can be measured using an appropriate electromagnetic flowmeter. Therefore, non-conductive substances such as gases, steam, oils, and acetone cannot be measured using an electromagnetic flowmeter.

Determining Sensor Diameter

The optimal flow velocity for the flowmeter is within the range of 2-4 m/s. In this case, the flowmeter's diameter can be selected to match the diameter of the user's pipeline. If the flow velocity is below 0.5 m/s, it is advisable to locally increase the flow velocity at the instrument's location by using a pipe reduction method.

Selection of Integrated or Remote Type

Integrated Type:

The integrated type, where the sensor and converter are assembled together, is generally selected when the site environment is relatively favorable.

Remote Type:

The remote type, where the sensor and converter are installed separately in different locations, is typically chosen in the following scenarios:

(1)When the ambient temperature or the surface temperature of the flowmeter converter exceeds 60°C due to radiation.

(2)In situations where the pipeline is subject to significant vibrations.

(3)In environments where the aluminum housing of the converter may be severely corroded.

(4)In locations with high humidity or the presence of corrosive gases.

(5)When the flowmeter is installed at high altitudes or underground, making on-site debugging inconvenient.

When placing an order, the distance between the sensor and converter should be specified, generally not exceeding 100 meters. The converter is typically installed as a wall-mounted unit.

SELECTION OF ELECTRODE AND GROUNDING RING MATERIALS

The selection of electrode materials should be based on the corrosiveness of the fluid being measured. Please consult relevant corrosion manuals, and for special fluids, testing should be conducted to ensure compatibility.

Materials	Materials
316L	Domestic sewage, drilling mud, syrup, green liquor from paper production, acetic acid with a concentration of 5-10%, beer.
Hc (Hastelloy C)	Resistant to oxidative acids and similar environments.
Ti	Textile dyeing wastewater, industrial wastewater, seawater, and other mildly acidic or alkaline liquids with a pH of 6-8.
Ta	Nitric acid, phosphoric acid, hydrochloric acid, and other acidic liquids, limestone slurry with a pH < 5 (excluding hydrofluoric acid and fuming sulfuric acid).
Pt	Various acids, alkalis, salts, and hydrofluoric acid (but not suitable for aqua regia and ammonium salts).

Note: For selection of electrodes for special media, please consult our company.

LINING MATERIAL SELECTION GUIDE

The lining material should be selected based on the corrosiveness, abrasiveness, and temperature of the measured medium.

Lining Material	Name	Symbol	Properties	Maximum Operating Temperature	Suitable Liquids
Rubber	Neoprene Rubber		Moderate wear resistance, not resistant to any corrosive media	≤80℃	Tap water
	Polyurethane		Excellent wear resistance, poor resistance to acids and alkalis	≤60℃	Pulp, slurry, and other suspensions
Fluoroplastic	Polytetrafluoroethylene (PTFE)	F4 or PTFE	Chemically stable, resistant to corrosion by hydrochloric acid, sulfuric acid, aqua regia, and concentrated alkalis.	≤120℃	Highly corrosive acidic, alkaline, and saline liquids
	Tetrafluoroethylene-hexafluoropropylene copolymer	F46	Slightly inferior chemical properties compared to F4 (PTFE)	F46≤160℃	Corrosive acidic, alkaline, and saline liquids
	Teflon™ PFA (Perfluoroalkoxy)	PFA		PFA≤180℃	

SELECTION OF FLOW RANGE

The maximum and minimum flow rates must comply with the values specified in the table below.

Inner Diameter(mm)	10	15	20	25	32	40	50	65
Qmin(m3/h)	0.0283	0.0636	0.12	0.176	0.29	0.452	0.7	1.19
Qmax(m3/h)	4.24	9.54	16.96	26.5	43.42	67.85	106.0	179.0
Inner Diameter(mm)	80	100	125	150	200	250	300	350
Qmin(m3/h)	1.8	2.82	4.41	6.36	11.3	17.6	25.4	34.6
Qmax(m3/h)	271.0	424.0	662.0	954.0	1696	2650	3810	5190
Inner Diameter(mm)	400	450	500	550	600	700	800	900
Qmin(m3/h)	45.2	57.2	77.6	85.8	101.0	138.0	180.0	229.0
Qmax(m3/h)	6780	8570	10600	12800	15200	20700	27100	34300
Inner Diameter(mm)	1000	1100	1200	1400	1600	1800	2000	2200
Qmin(m3/h)	282.0	342.0	407.0	554.1	723.7	916.0	1131.0	1368.4
Qmax(m3/h)	42400	51300	61000	83121	108566	137404	169635	205258

SELECTION OF INSTALLATION LOCATION

To ensure the reliable and stable operation of the flowmeter, the following requirements should be considered when selecting the installation location:

(1)Avoid proximity to ferromagnetic objects and equipment with strong electromagnetic fields (such as large motors, large transformers, etc.) to prevent interference with the sensor's magnetic field and flow signal.

(2)The installation site should be as dry and well-ventilated as possible; avoid installing in damp or water-prone areas.

(3)Avoid direct exposure to sunlight and rain; ensure the ambient temperature does not exceed 60°C and the relative humidity does not exceed 95%.

(4)Choose a location that is convenient for maintenance and easy to access.

(5)The flowmeter should be installed downstream of the pump and must not be installed on the suction side; valves should be installed on the downstream side of the flow.

INSTALLATION REQUIREMENTS

To ensure accurate measurement, the following points should be considered when selecting the installation location on the pipeline:

(1) The sensor can be installed on vertical, horizontal, or inclined pipelines, but the line connecting the two electrodes must be in a horizontal position.

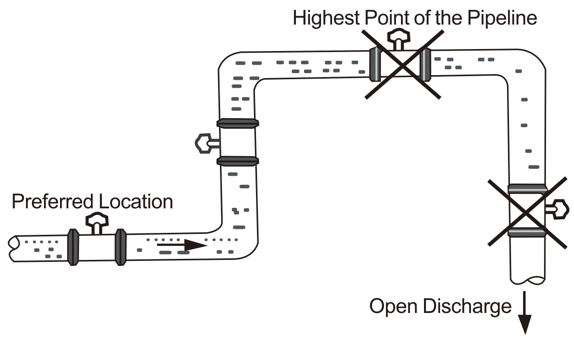
(2) The medium at the installation location should flow fully within the pipe, avoiding partial filling and preventing gas from adhering to the electrodes.

(3) For liquid-solid two-phase fluids, it is best to install the sensor vertically to ensure even wear on the sensor lining, thereby extending its service life.

(4) If the flowmeter is installed where the medium is not fully filling the pipe, you can raise the downstream pipeline to ensure full pipe flow. It is strictly prohibited to install the flowmeter at the highest point of the pipeline or at the outlet. (Refer to the diagram)

(5) Modifying the pipeline installation method: If the medium's flow rate does not meet the requirements, a smaller diameter flowmeter should be selected. In this case, use a reducing conical pipe or modify part of the pipeline to match the sensor's diameter, ensuring that the straight pipe sections meet the following minimum lengths: upstream straight pipe section ≥10DN, downstream straight pipe section ≥5DN (where DN is the pipe diameter).

(6) The straight pipe sections before and after the flowmeter should be at least: upstream ≥10DN, downstream ≥5DN.



▲ If a custom-made signal cable is used for remote installation, the cable should be kept as short as possible.

▲ The excitation cable can use a Yz-type medium rubber-sheathed cable, with the same length as the signal cable.

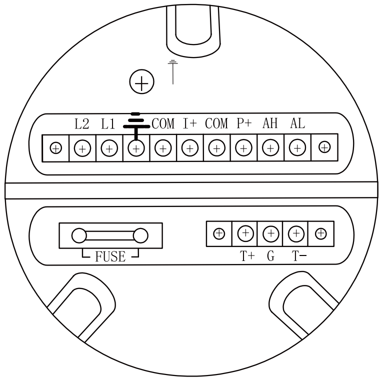
▲ The signal cable must be strictly separated from other power cables; it should not be laid in the same conduit, laid parallel, or twisted together. It should be routed separately inside a steel conduit.

▲ The signal cable and excitation cable should be as short as possible. Excess cable should not be coiled; instead, it should be cut off, and the connections should be re-soldered.

▲ When the cable enters the electrical interface of the converter, form a U-shape at the port to prevent rainwater from seeping into the converter.

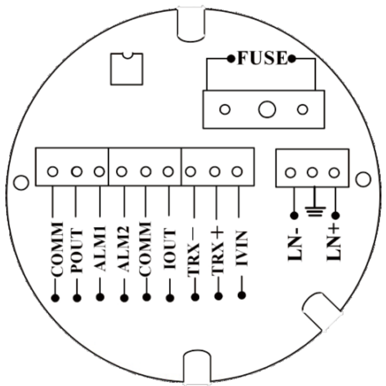
Wiring Terminals and Labels for the Blue Integrated Converter

I+:	Flow Current Output
COM:	Current Output Ground
P+:	Bidirectional Flow Frequency (Pulse) Output
COM:	Frequency (Pulse) Output Ground
AL:	Lower Limit Alarm Output
AH:	Upper Limit Alarm Output
COM:	Alarm Output Ground
FUSE:	Input Power Fuse
T+:	Communication Input (RS485-A)
T-:	Communication Input (RS485-B)
L1:	220V (24V) Power Input
L2:	220V (24V) Power Input



Wiring Terminals and Markings for Gray Integrated Convert

COMM:	Pulse Ground
POUT:	Bidirectional Flow Frequency/Pulse Output
ALM1:	Upper Limit Alarm Output
ALM2:	Lower Limit Alarm Output
COMM:	Current Ground
IOUT:	Flow Current Output/Two-Wire Current Output
IVIN:	Two-Wire 24V Voltage Input (Optional)
TRX+:	Communication Input (RS485-A)
TRX-:	Communication Input (RS485-B)
LN+:	220V (24V) Power Input
LN-:	220V (24V) Power Input



Wiring Terminals and Markings for Square Separate Converter

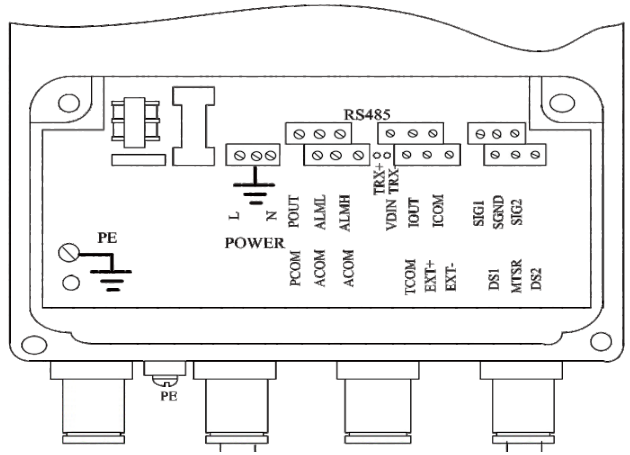
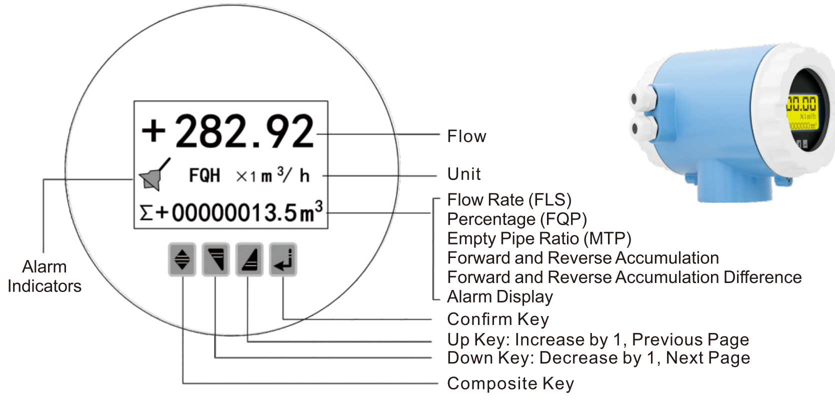
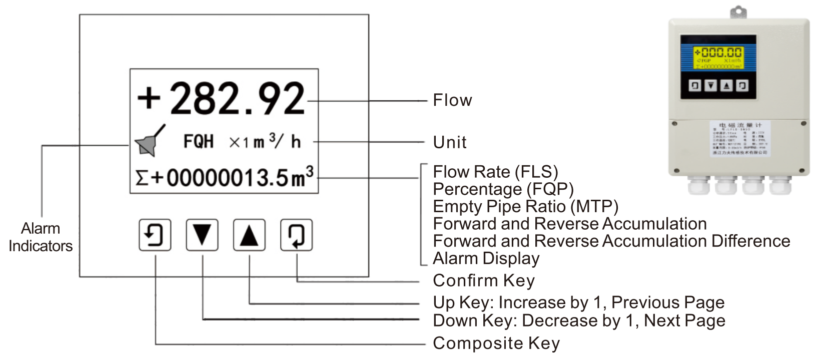


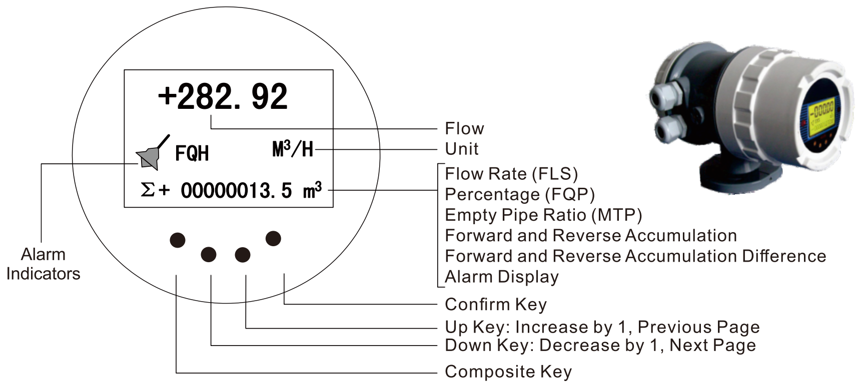
Table of Terminal Markings and Corresponding Names for Square Split-Type Converter

SIGI	Signal 1	Connect to Split-Type Sensor
SGND	Signal Ground	
SIG2	Signal 2	
DS1	Excitation Shield 1	
DS2	Excitation Shield 2	
EXT+	Excitation Current +	
EXT-	Excitation Current -	
VDIN	24V Two-Wire Current Connection	Analog Current Output
IOUT	Analog Current Output	
ICOM	Analog Current Output Ground	
POUT	Flow Frequency (Pulse) Output	Frequency or Pulse Output
PCOM	Frequency (Pulse) Output Ground	
ALMH	Upper Limit Alarm Output	Dual Alarm Outputs
ALML	Lower Limit Alarm Output	
ACOM	Alarm Output Ground	
TRX+	Communication Input	Communication Input
TRX-	Communication Input	
L	220V (24V) Power Input	Power Supply Terminal
N	220V (24V) Power Input	

KEYBOARD DEFINITION AND DISPLAY







INSTRUMENT PARAMETER SETTINGS

The instrument has two operating modes:
Automatic Measurement Mode
Parameter Setting Mode
When the instrument is powered on, it automatically enters the measurement mode. In this mode, the instrument performs all measurement functions automatically and displays the corresponding measurement data. In the parameter setting mode, users can use the four panel keys to configure the instrument settings.

5.1 Key Functions

5.1.1 Key Functions in Automatic Measurement Mode

- Up Key: Cycles through the displayed content on the screen.
- Composite Key + Confirm Key: Enters the parameter setting mode.
- Confirm Key: Returns to automatic measurement mode.

In measurement mode, the LCD display contrast can be adjusted by pressing the "Composite Key + Up Key" or "Composite Key + Down Key" to set the desired contrast level.

5.1.2 Key Functions in Parameter Setting Mode

Down Key: Decreases the number at the cursor by 1.
Up Key: Increases the number at the cursor by 1.
Composite Key + Down Key: Moves the cursor to the left.
Composite Key + Up Key: Moves the cursor to the right.
Confirm Key: Enters or exits submenus.
Confirm Key:In any state, pressing and holding for two seconds will return to automatic measurement mode.

Note:

1. When using the "Composite Key," press the Composite Key first, then simultaneously press the "Up Key" or "Down Key."
2. In parameter setting mode, if no keys are pressed within 3 minutes, the instrument automatically returns to measurement mode.
3. To select the flow direction for zero-point correction, move the cursor to the leftmost "+" or "-," and use the "Up Key" or "Down Key" to switch it to the opposite of the actual flow direction.

5.2 Parameter Setting Function Key Operation

To set or modify instrument parameters, the instrument must be in parameter setting mode. In measurement mode, press the "Composite Key + Confirm Key" to display the status change password (00000). Modify the password according to the security level using the password provided by the manufacturer. After entering the correct password and pressing the "Composite Key," you will enter the required parameter setting mode.

FUNCTION SELECTION SCREEN

Press the "Composite Key + Confirm Key" to enter the function selection screen. Then use the "Up Key" or "Down Key" to choose from the available options. There are 3 functions to select from on this screen:

Parameter No.	Function Content	Description
1	Parameter Setting	Selecting this function will enter the parameter setting screen.
2	Total Reset	Selecting this function will perform a total reset of the instrument.
3	Coefficient Change Record	Selecting this function will allow you to view the flow coefficient modification records.

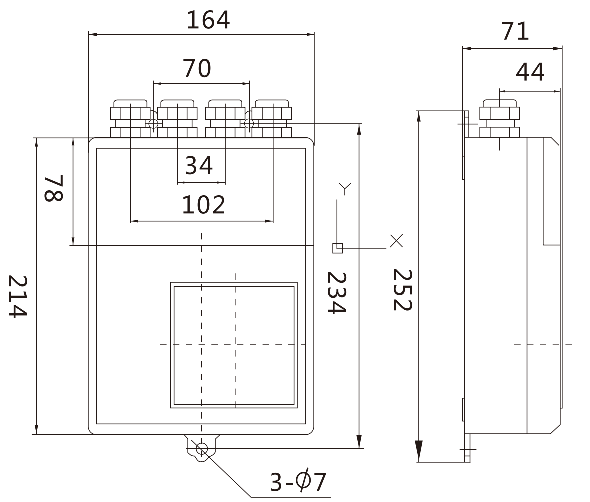
The electromagnetic flowmeter converter has a total of 56 parameters. Users should set each parameter according to their specific requirements. Below is the list of parameters:

Parameter Setting Menu Overview

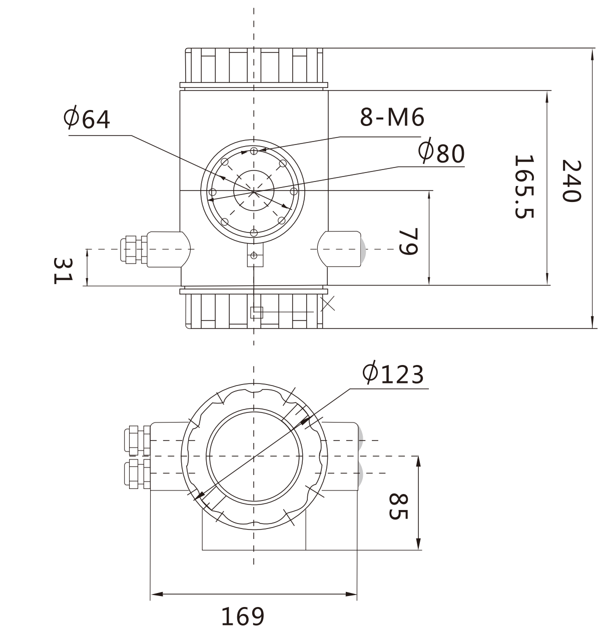
Parameter No.	Parameter Text	Setting Method	Parameter Range	Password Level
1	Language	Select	Chinese, English	2
2	Instrument Communication Address	Set Value	0-99	2
3	Instrument Communication Spee	Select	300-38400	2
4	Pipe Diameter	Select	3~3000	2
5	Flow Unit	Select	L/h, L/m, L/s, m^2/h, m^2/m, m^2/s, T/h, T/m, T/s	2
6	Instrument Range Setting	Set Value	0-99999	2
7	Measurement Damping Time	Select	1~64	2
8	Flow Direction Option	Set Value	Forward, Reverse	2
9	Flow Zero-Point Correction	Select	0~±9999	2
10	Small Signal Cutoff Point	Select	0-599.99%	2
11	Allow Display Cutoff	Set Value	Allow/Disallow	2
12	Flow Accumulation Unit	Set Value	0.001 m^2-1 m^2, 0.001 T-1 T, 0.001 L-1 L	2
13	Fluid Density	Select	0-3.999 T/m^2	2
14	Reverse Output Allowance	Select	Allow, Disallow	2
15	Current Output Type	Select	4~20 mA	2
16	Pulse Output Mode	Select	Frequency/Pulse	2
17	Pulse Unit Equivalent	Select	0.001 m^2~1 m^2, 0.001 L~1 L, 0.001 T~1 T	2
18	Frequency Output Range	Select	1-5999 Hz	2
19	Empty Pipe Alarm Allowance	Set Value	Allow/Disallow	2
20	Empty Pipe Alarm Threshold	Select	59999%	2
21	Upper Limit Alarm Allowance	Set Value	Allow/Disallow	2
22	Upper Limit Alarm Value	Select	000.0-599.09%	2
23	Lower Limit Alarm Allowance	Select	Allow/Disallow	2
24	Lower Limit Alarm Value	Select	0000-59999	2
25	Excitation Alarm Allowance	Select	Allow/Disallow	2
26	Total Reset Password	Select	0-99999	3
27	Transmitter Code	User Settings	Factory Year, Month (10-99999)	4

Parameter No.	Parameter Text	Setting Method	Parameter Range	Password Level
28	Sensor Code 2	User Settings	Product Number (0-99999)	4
29	Excitation Method Selection	Select	Method 1, 2, 3	4
30	Sensor Coefficient Value	Set Value	0.0000-5.9999	4
31	Flow Correction Allowance	Select	Enable/Disable	2
32	Flow Correction Point 1	User Settings	Set by Flow Rate	5
33	Flow Correction Value 1	User Settings	0.0000~1.9999	5
34	Flow Correction Point 2	User Settings	Set by Flow Rate	5
35	Flow Correction Value 2	User Settings	0.0000~1.9999	5
36	Flow Correction Point 3	User Settings	Set by Flow Rate	5
37	Flow Correction Value 3	User Settings	0.0000~1.9999	5
38	Flow Correction Point 4	User Settings	Set by Flow Rate	5
39	Flow Correction Value 4	User Settings	0.0000~1.9999	5
40	Forward Total Low Limit	Editable	00000~99999	5
41	Forward Total High Limit	Editable	0000~9999	5
42	Reverse Total Low Limit	Editable	00000-99999	5
43	Reverse Total High Limit	Editable	0000-9999	5
44	Spike Suppression Allowance	Select	Allow/Disallow	3
45	Spike Suppression Coefficient	Select	0.010~0.800m/s	3
46	Spike Suppression Time	Select	400-2500ms	3
47	Password 1	User Editable	00000-99999	5
48	Password 2	User Editable	00000-99999	5
49	Password 3	User Editable	00000 99999	5
50	Password 4	User Editable	00000 99999	5
51	Current Zero-Point Correction	Set Value	0.00001 9999	5
52	Current Full-Scale Correction	Factory Settings	0.0000 3 9999	5
53	Factory Calibration Coefficient	Factory Settings	0.0000 5 9999	5
54	Instrument Code 1	Factory Settings	Year, Month (0-99999)	6
55	Instrument Code 2	Factory Settings	Serial Number (10-999991)	6
56	Communication Verification Mode	Factory Settings	No Pamy, Odo Party. Fve- Pariy	2

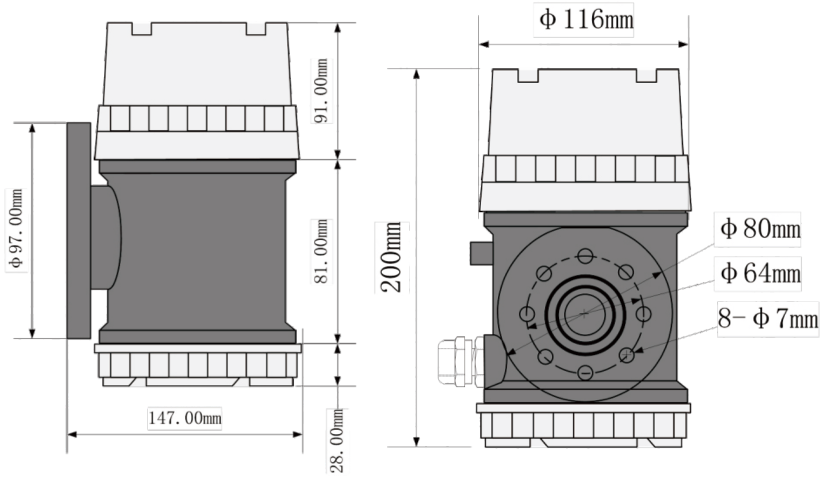
CONVERTER APPEARANCE AND INSTALLATION DIMENSIONS



Square Housing Split-Type Outline Dimensions Diagram

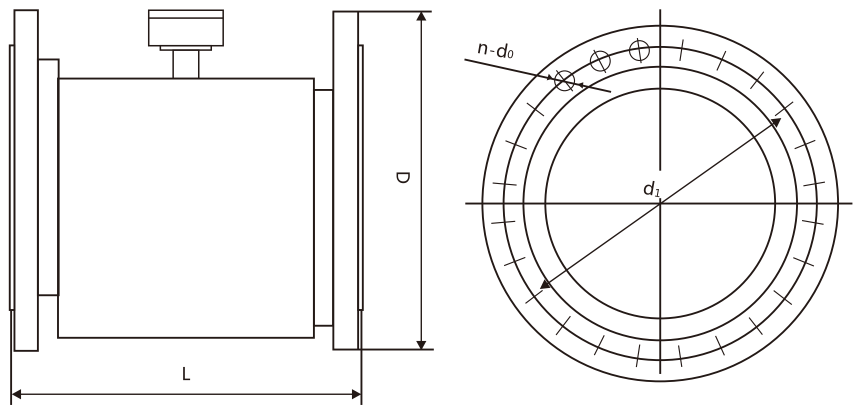


Blue Circular Housing Integrated Outline Dimensions Diagram



Gray Circular Housing Integrated Outline Dimensions Diagram

FLOWMETER OUTLINE DIMENSIONS



Sensor Outline Dimensions Diagram

Standard Connection Dimensions:
(For special pressure or connection types, please consult the manufacturer) Unit: mm

Nominal Diameter	Pressure	L (Length)	D(Flange Diameter)	d1(Center Distance)	n-d0 (Number of Bolt Holes)
DN15	1.6MPa	200	95	65	4
DN20	1.6MPa	200	105	75	4
DN25	1.6MPa	200	115	85	4
DN32	1.6MPa	200	135	100	4
DN40	1.6MPa	200	145	110	4
DN50	1.6MPa	200	160	125	4
DN65	1.6MPa	200	180	145	8
DN80	1.6MPa	250	195	160	8
DN100	1.6MPa	250	215	180	8
DN125	1.6MPa	250	245	210	8
DN150	1.6MPa	300	280	240	8
DN200	1.6MPa	350	335	295	12
DN250	1.0MPa	450	390	350	12
DN300	1.0MPa	500	440	400	12
DN350	1.0MPa	500	500	460	16
DN400	1.0MPa	500	565	515	16
DN450	1.0MPa	550	615	565	20
DN500	1.0MPa	550	670	620	20
DN600	1.0MPa	600	780	725	20
DN700	1.0MPa	700	895	840	24
DN800	1.0MPa	800	1010	950	24
DN900	1.0MPa	900	1110	1050	28
DN1000	1.0MPa	1000	1220	1160	28

VI.SELF-DIAGNOSIS INFORMATION AND FAULT HANDLING

The electromagnetic flowmeter converter's printed circuit board uses surface-mount technology and is not user-serviceable. Therefore, users should not open the converter enclosure.

The intelligent converter features self-diagnostic capabilities. It can generally provide accurate alarm information for faults occurring during normal operation, except for power supply and hardware circuit failures. These alarms are indicated by a “ ” symbol in the upper right corner of the display. In measurement mode, the instrument will automatically display the following fault information:

FQH - Flow Upper Limit Alarm - FGP - Fluid Empty Pipe Alarm
FQL - Flow Lower Limit Alarm - SYS - System Excitation Alarm

FAULT HANDLING

1) No Display on the Instrument
a) Check if the power supply is connected.
b) Check if the power fuse is intact.
c) Verify that the supply voltage meets the requirements.
d) Check if the display contrast is adjustable and set appropriately.

2) Excitation Alarm
a) Check if the excitation wiring EXT+ and EXT- is open.
b) Check if the total resistance of the sensor excitation coil is less than 150 Ω.
If both items a and b are normal, the converter may be faulty.

3) Empty Pipe and Electrode Alarm
a) Check if the fluid fully fills the sensor measurement tube.
b) Short-circuit the signal input terminals SIG1, SIG2, and SGND on the converter with a wire. If the “Empty Pipe Alarm” indication is removed, the converter is functioning correctly. The issue may be due to low conductivity of the measured fluid or electrodes being covered by gas.
c) Check if the signal connections are correct.
d) Electrode Testing:
- When the sensor is filled with fluid, use an analog multimeter set to the 1kΩ resistance range to check the resistance of the sensor electrodes.
- Connect the red probe to the electrodes and the black probe to the liquid electrode (liquid ring or metal pipe). The meter's needle should move from left to right, indicating a resistance of about 3~50kΩ, then discharge from right to left. The difference between the two electrodes' readings should not exceed 20%. If it does, the electrodes may be contaminated or covered.
- Measure the DC voltage between SIG1 and SIG2 and the liquid contact point (liquid electrode, liquid ring, metal pipe) with a digital multimeter. The voltage should be less than 500mV, and the DC voltage difference between the two electrodes should be under 50mV. If not, the sensor electrodes may be polarized.

4) Upper Limit Alarm

The upper limit alarm occurs when the output current and output frequency (or pulse) exceed the limit. Increasing the flow range can remove the upper limit alarm.

5) Lower Limit Alarm

The lower limit alarm occurs when the output current and output frequency (or pulse) fall below the limit. Decreasing the flow range can remove the lower limit alarm.

6) System Setting Error

The system has made intelligent judgments and provided prompts regarding errors in flow range settings, flow accumulation unit settings, and pulse equivalent settings. Modify the settings as needed.

7) System Self-Test Alarm

If a system self-test alarm occurs, please send the converter to the manufacturer for repair.

8) Measurement Flow Inaccuracy

a) Check if the fluid fully fills the sensor measurement tube.

b) Verify that the signal connections are normal.

c) Check if the sensor coefficient and sensor zero-point settings match the sensor nameplate or factory calibration certificate.

9) Transportation and Storage

To prevent damage during operation, keep the instrument in the packaging condition it was shipped in until it reaches the installation site. During storage, the storage location should meet the following indoor conditions:

a) Rainproof and moisture-resistant.

b) Low mechanical vibration and avoid impacts.

c) Temperature range: -20 to +60°C.

d) Humidity not exceeding 80%.

○ Frequency (Pulse), Upper and Lower Limit Alarms, and Flow Direction Indicators are all open-collector current output signals. They require an external power supply and load. When using inductive loads, a flyback diode should be added as shown in the diagram.

1) Grounding

The converter enclosure terminal PE should be connected to ground with a copper wire of at least 1.6 mm². The grounding resistance should not exceed 10Ω.

2) Digital Output

Digital outputs refer to frequency and pulse outputs. Since frequency and pulse outputs use the same output terminal on the wiring, users can only choose one of them at a time and cannot use both simultaneously.

VII.SENSOR INSTALLATION LOCATION

The sensor can be installed horizontally, vertically, or at an angle. For the electromagnetic flowmeter to operate correctly, the measurement tube must always be filled with the measured medium. When installed horizontally, it may be necessary to position the sensor slightly lower than the pipe's elevation, as shown in Figure 7-1, or ensure that there is sufficient back pressure downstream of the sensor, as shown in Figure 7-2.

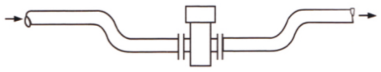


Figure 7-1: Sensor Installed Below the Pipeline

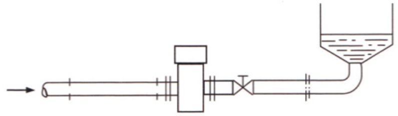


Figure 7-2: Sensor Installed with Downstream Back Pressure

In vertical installations, the flow direction should be from bottom to top to ensure that the sensor remains filled with the medium. The recommended installation positions are shown in Figure 7-3, sections c and d.

Whether installed horizontally or vertically, in continuous production process pipelines, to avoid disrupting production and facilitate instrument maintenance and disassembly, the sensor should be installed in parallel with the main process pipeline (bypass pipe) whenever possible, especially for liquids that require frequent cleaning due to severe contamination.

Figure 7-4 shows an example of an installation where the sensor is cleaned online without being removed.

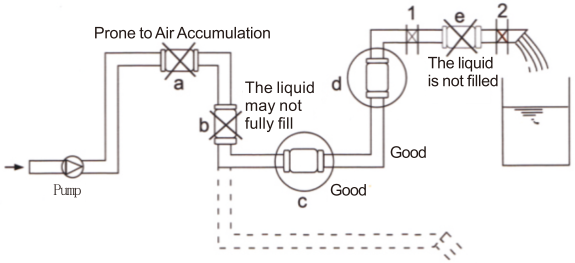


Figure 7-3: Sensor Installation Positions

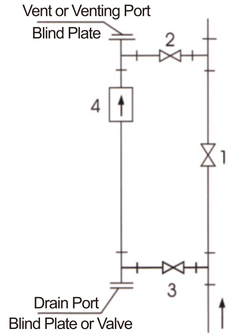


Figure 7-4: Connection for Easy Pipe Cleaning

INSTALLATION OF LARGE-DIAMETER SENSORS

Due to large-diameter pipelines often being buried underground, a cement pit should be prepared before installing large-diameter sensors. Figure 7-5 illustrates a common installation form in water supply and drainage systems. The cement pit should provide ample space for movement, with steel pipes for cable routing embedded in the sidewalls. It should have a cover to prevent rain from entering and a drainage pipe to avoid water accumulation in the pit that could submerge the sensor. For ease of installation and removal, the sensor should be placed on a base and a flexible telescopic pipe should be installed on the downstream side. Figure 7-6 shows an example of the electromagnetic flowmeter installation in an underground cement pipe sewage discharge system.

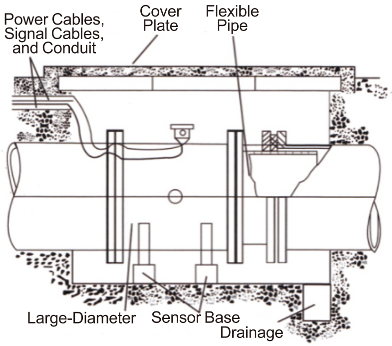


Figure 7-5: Installation Diagram of Large-Diameter Sensor

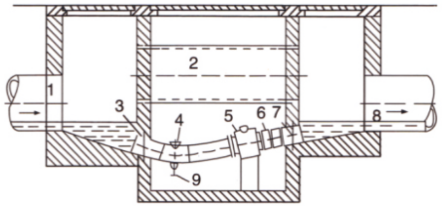


Figure 7-6: Sensor Installation in Underground Sewage Pipeline

1 - Inlet Pipe 2 - Overflow 3 - Inlet Flange
4 - Cleaning Port 5 - Sensor 6 - Removable Component
7 - Wall Seal 8 - Outlet Pipe 9 - Discharge Valve

INSTALLATION OF PTFE-LINED SENSORS

Electromagnetic flow sensors lined with Polytetrafluoroethylene (PTFE) are sensitive to vacuum pressure because the PTFE lining generally does not adhere to the sensor's measurement tube wall. A vacuum inside the pipeline can cause the PTFE lining to collapse and form a wavy, arched shape, a typical sign of negative pressure damage (M), which disrupts the electrode seal and can render the sensor inoperable. Therefore, PTFE-lined sensors should not be used in vacuum systems and should be installed away from locations where momentary vacuum conditions might occur. For instance, the sensor should not be installed at the suction side of a pump, and a gate valve should be installed downstream of the sensor, as shown in Figure 7-7.

Additionally, the PTFE flange surface should not be damaged or cut, as this could allow the medium to enter the backside of the lining and damage the insulation. To protect the lining flange, some manufacturers install grounding rings on the flanges of PTFE-lined sensors to prevent accidental damage. These grounding rings should not be removed during installation. The material of the protective grounding rings can be chosen based on the corrosiveness of the measured fluid.

In long pipelines, the gate valve should be installed downstream of the sensor (vacuum condition)

The sensor should not be installed at the suction side of a pump (vacuum condition)

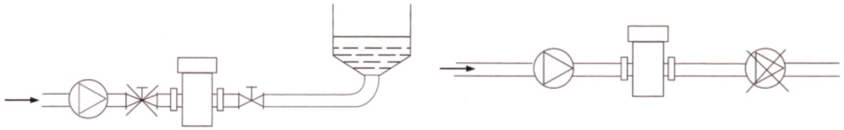


Figure 7-7: Sensor Installation

VIII.SENSOR GROUNDING

1) Grounding of the Sensor Installed on Metal Pipelines

Since most metal pipelines are electrically connected to the earth and the flowing medium is also electrically connected through the metal pipeline to the ground, this requirement is generally met. Therefore, an electromagnetic flowmeter does not necessarily require a separate grounding device, especially for small-diameter electromagnetic flow sensors. However, installing a separate grounding device can contribute to the reliable operation of the instrument.

2) Grounding of the Sensor Installed on Plastic Pipelines or Metal Pipelines with Insulating Coatings, Linings, or Paint Layers

When the sensor is installed on an insulated pipeline, metal short pipes or grounding rings must be installed at both ends, and these must be connected by wires to ensure electrical continuity with the fluid, as shown in Figure 8-1. If the measured fluid is highly corrosive, making it difficult to install metal short pipes and grounding rings, grounding electrodes can be installed by drilling holes on the insulated pipeline at both ends of the sensor. The grounding electrodes should be made of corrosion-resistant alloy material and connected to the sensor’s grounding screw using wires.

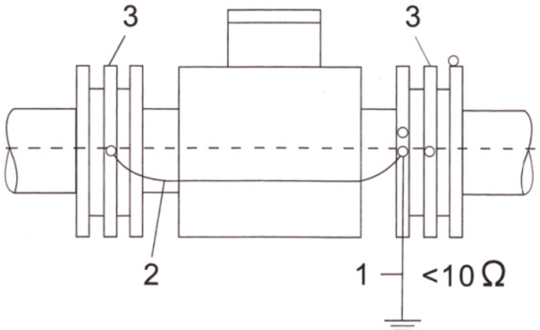


Figure 8-1 Installation of the Sensor on a Cathodic Protection Pipeline
1- Measurement Grounding 2- Grounding Wire (16mm² Copper Wire) 3- Grounding Ring

3) Grounding of the Sensor Installed on Cathodic Protection Pipelines

For pipelines with cathodic protection, the sensor must be insulated from the pipeline. The following points should be observed during installation (see Figure 8-2):

- The sensor must be insulated from the pipeline with cathodic protection to ensure that the electromotive force in the flowing medium does not affect the measurement results.
- Appropriate grounding rings should be installed at both ends of the sensor, and both the sensor and grounding rings must be insulated from the pipeline flanges. The grounding rings on both sides should be connected to the sensor but should not have any electrical connection to the pipeline.
- The flanges on both sides of the pipeline should be connected by a 16mm² copper wire bypassing the sensor. The connecting bolts passing through the flanges should be equipped with sleeves and washers made of insulating material to isolate the bolts from the flanges. See Figure 8-3.

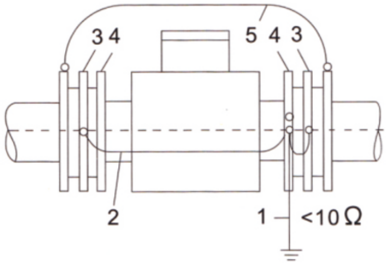


Figure 8-2 Installation of the Sensor on a Cathodic Protection Pipeline

1- Measurement Grounding
2- Grounding Wire (16mm² Steel Wire)
3- Grounding Ring 4- Bolt (Insulated)
5- Connecting Wire (16mm² Copper Wire)

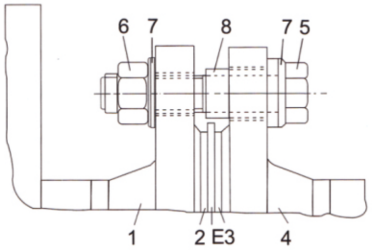


Figure 8-3 "Insulated" Bolt on a Cathodic Protection Pipeline E- Grounding Ring

1- Sensor Flange 2- Lining (PTFE) 3- Seal Ring
4- Pipeline Flange 5- Bolt
6- Nut 7- Washer 8- Insulating Sleeve

4) Grounding of the Sensor Installed in Areas with Strong Stray Currents in the Pipeline

In environments where stray currents in the pipeline are strong, such as when measuring the flow of electrolytes in pipelines near electrolysis cells, these currents can cause significant interference. In such cases, the installation and grounding method shown in Figure 8-4 can be used. Insulated pipeline sections should be connected at both ends of the sensor, with grounding rings installed between the sensor and the insulated pipeline. As in standard installation and grounding methods, the grounding rings and the sensor flange are connected together to a well-grounded grounding rod. The process pipelines on both sides of the insulated pipeline are additionally short-circuited using connecting wires. The leakage current is primarily diverted through the connecting copper wire, significantly reducing the interference introduced into the sensor signal circuit by the measured fluid.

When the installation environment has strong leakage currents and is influenced by electric fields, the sensor must be grounded separately. The grounding wire should be a multi-strand copper wire with a total cross-sectional area of no less than 16mm², connected to a grounding rod buried at a sufficient depth.

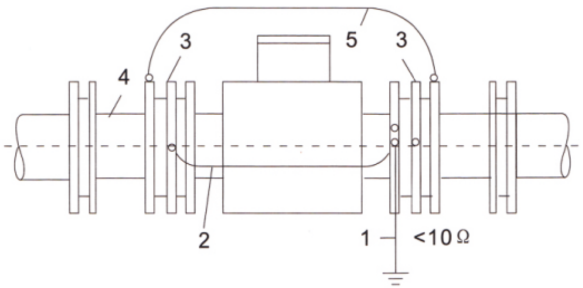


Figure 8-4 Installation of the Sensor on a Pipeline with Strong Stray Currents

1- Measurement Grounding 2- Grounding Wire (16mm² Copper Wire)
3- Grounding Ring 4- Insulated Pipeline 5- Connecting Wire (16mm² Copper Wire)

When transporting and lifting the sensor, the sling should be placed around the neck of the sensor at both ends or attached to the lifting rings. Never insert a rod through the measuring tube for lifting, as this could damage the lining (see Figure 9-1). During lifting and transportation, care must be taken to prevent the sensor's lining and junction box from being damaged by impacts.

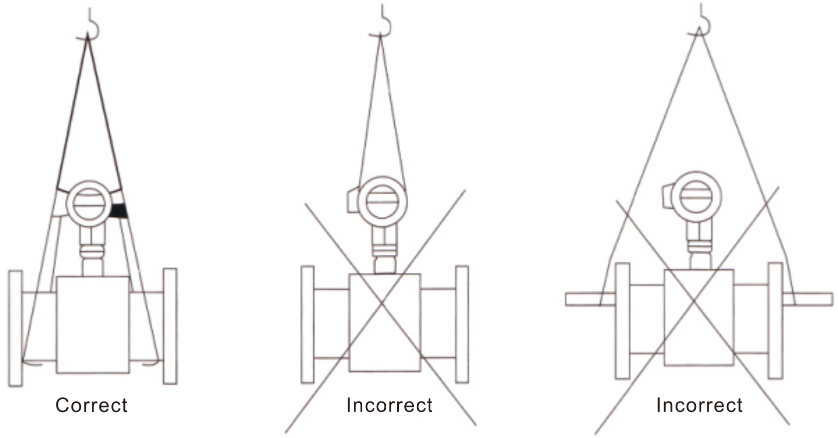


Figure 9-1

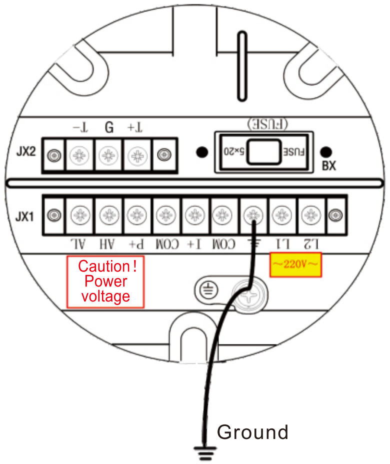
Before installation, the sensor's electrodes should be carefully wiped with alcohol swabs or clean cotton thread or gauze to remove any grease or contaminants caused by handling. Contaminants on the electrode surface can cause common-mode interference and zero drift of the instrument, leading to measurement errors.

When installing a new sensor, it is advisable to first secure the connecting pipes, fittings, or valves to both ends of the sensor with bolts on the ground at the installation site, and then install the entire assembly into the pipeline. This approach helps to prevent damage to the end face lining.

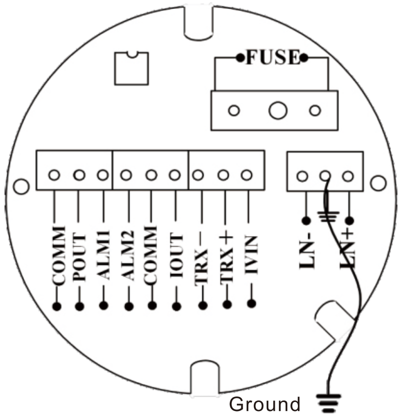
During the process of fastening the sensor to the pipeline, each bolt must be tightened securely. The thickness of the sealing gaskets should be relatively uniform, and after tightening the bolts, it is important to test the flow of liquid to ensure there are no leaks. The installation of the sealing gaskets also deserves attention. The diameter of the gasket holes should match the inner diameter of the conduit lining, and the holes must be aligned correctly during installation. If not properly aligned, any portion of the gasket that protrudes into the pipeline lining can act as a throttle element, and significant misalignment can disrupt the symmetrical distribution of the flow velocity, leading to unnecessary measurement errors. For sensors with PTFE linings, it is advisable to retighten the flange bolts once more after operating for half a day at working temperature.

X.LIGHTNING PROTECTION FUNCTION DESCRIPTION

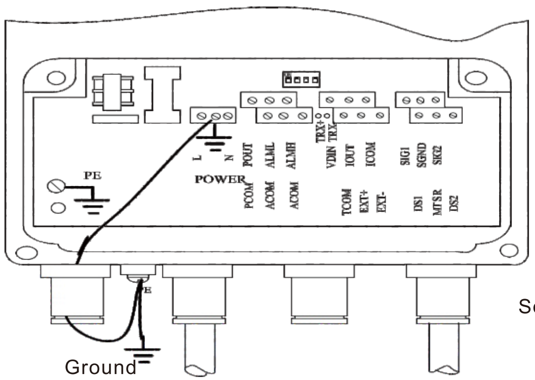
When installing the system, it is absolutely essential that the converter terminal grounding point be securely connected to the housing and then reliably grounded. This is crucial because the lightning arrestor discharges the lightning current into the ground through the housing. If the housing is not properly grounded, there is a risk of personal injury if someone operates the converter during a lightning strike. Please refer to the connection diagram for specific details.



Blue Integrated Converter



Gray Integrated Converter



Square Split-Type Converter