HIKMICRO

Electromagnetic Flowmeter

User Manual

Symbols

The symbols that may be found in this document are defined as follows.

Symbol	Description
Danger	Indicates a hazardous situation which, if not avoided, will or could result in serious injury.
Caution	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results.
Note	Provides additional information to emphasize or supplement important points of the main text.

Safety Instruction

Electrical safety

- Installation and wiring of the electromagnetic flowmeter must be performed by a specialist technician.
- Always unplug the device before plugging and unplugging all terminals and connections.
- When measuring hot fluids, the sensor housing can become very hot and be careful not to burn people.
- When the device is removed from the pipe of toxic or corrosive medium, the worker must avoid contact with the medium or inhaling residual gas, and clean the medium that remains in the sensor after removal.

Incoming acceptance

When unboxing the meter, please check the following contents in a timely manner:

- Appearance: This device has been carefully checked before it is shipped from the factory. If damage is caused during transport (Please pay special attention to lining and housing), please contact us.
- Nameplate: Check if the product matches the order according to the content of the nameplate.
- Accessories: Check if the accessories in the box are complete according to the packing list.

⚠ **Caution**

Please save all the original packing materials of your device so that if there is a problem, you can use the packing materials to pack the device and send it to the service center for disposal. The Company shall not be liable for accidental damage in transit caused by non-original packaging materials.

Storage

For long-term storage of the device after delivery, please note the following points:

- The device must be stored in the original packaging.
- The place of storage must be dry, vibration-free and at a suitable ambient temperature.

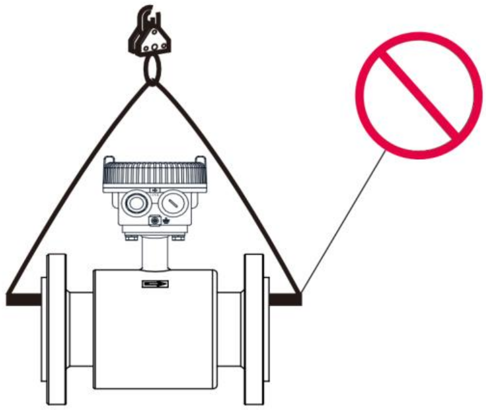
Transporting

Handle all parts carefully to prevent damage and transport the device in the original box to the place of installation. The PTFE lining has a protective cover on both sides of the sensor to prevent mechanical damage to the lining sealing surface and loose deformation. Remove the cover only before the meter is installed on the pipe.

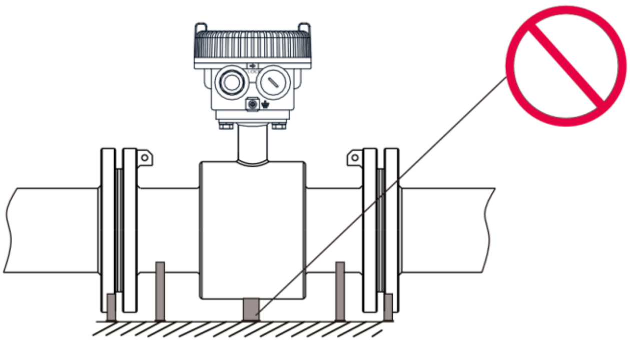
⚠ **Caution**

- Damage to the lining will result in scrapped sensor.
- Failure to properly select cables, tighten cable sealing plug or device covers may result in scrap of the meter due to water ingress or moisture in the device housing.

Linings are easily damaged during shipping. Do not pass any rope, rod, etc. through the measuring tube for ease of handling, as this will cause damage to the lining.



The device housing must be protected against external force, heavy pressure or load, and the internal coil and electrodes may be damaged by a dent in the sensor housing, making the product unrepairable.



Contents

1. Overview

An electromagnetic flowmeter (hereafter referred to as “device”) is to measure the flow of conductive liquid in a circular pipe.

The principle of operation is based on Faraday's electromagnetic induction law: When a conductor moves in a magnetic field and cuts a magnetic line, the conductor ends produce induction electromotive force perpendicular to the direction of motion and the magnetic field, which is proportional to the conductor's speed of motion (V), i.e. E = BLV (B is the field strength. L is the electrode distance). After the field current drives the coil, a magnetic field is formed in the measuring tube. When the medium flows along the measuring tube and cuts the magnetic line, the resulting induction electromotive force is transmitted to the transmitter through two electrodes on the inside wall of the measuring tube. The measured flow value is obtained after signal processing and operation through the transmitter.

The measured data is displayed on the transmitter display screen in the form of 4 to 20 mA, pulses, fieldbus (RS-485), etc.

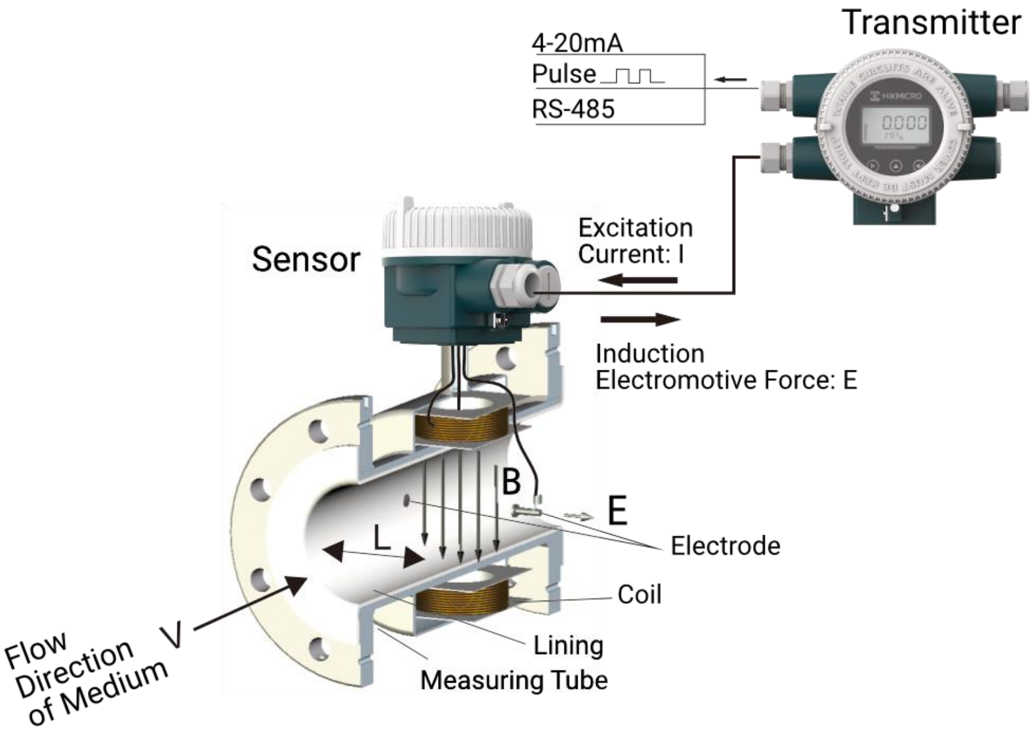


Figure 1-1 Electromagnetic Flowmeter Operating Principle

2. Appearance

2.1 Device Appearance

The electromagnetic flowmeter consists of a sensor and a transmitter. According to the way the sensor is connected to the transmitter, the device is divided into integral electromagnetic flowmeter and remote electromagnetic flowmeter.

2.1.1 Integral Electromagnetic Flowmeter

The transmitter of the integral electromagnetic flowmeter is integrated with the sensor and the internal electrical connection is made at the factory. Depending on the connection form of the sensor to the pipe, the device can be divided into flanged, wafer, hygienic etc.

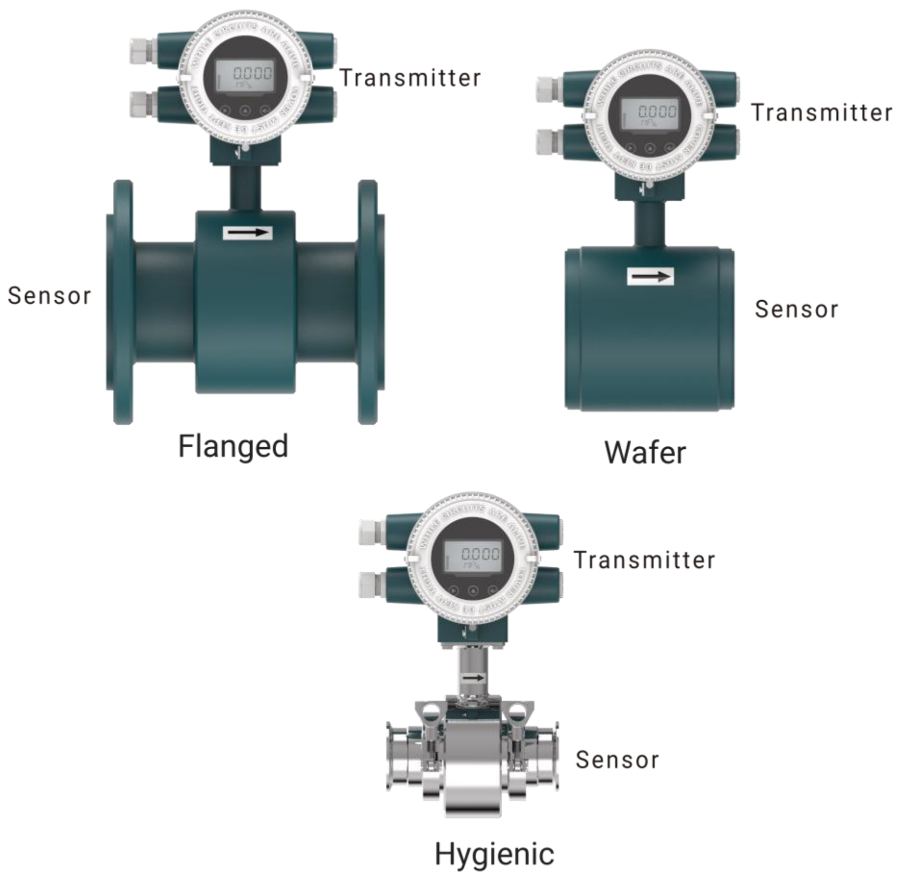


Figure 2-1 Integral Electromagnetic Flowmeter

2.1.2 Remote Electromagnetic Flowmeter

The transmitter of remote electromagnetic flowmeter is mounted independently of the sensor, and is connected via a dedicated signal cable. Depending on the connection form of the sensor to the pipe, the device can be divided into flanged, wafer, hygienic etc.

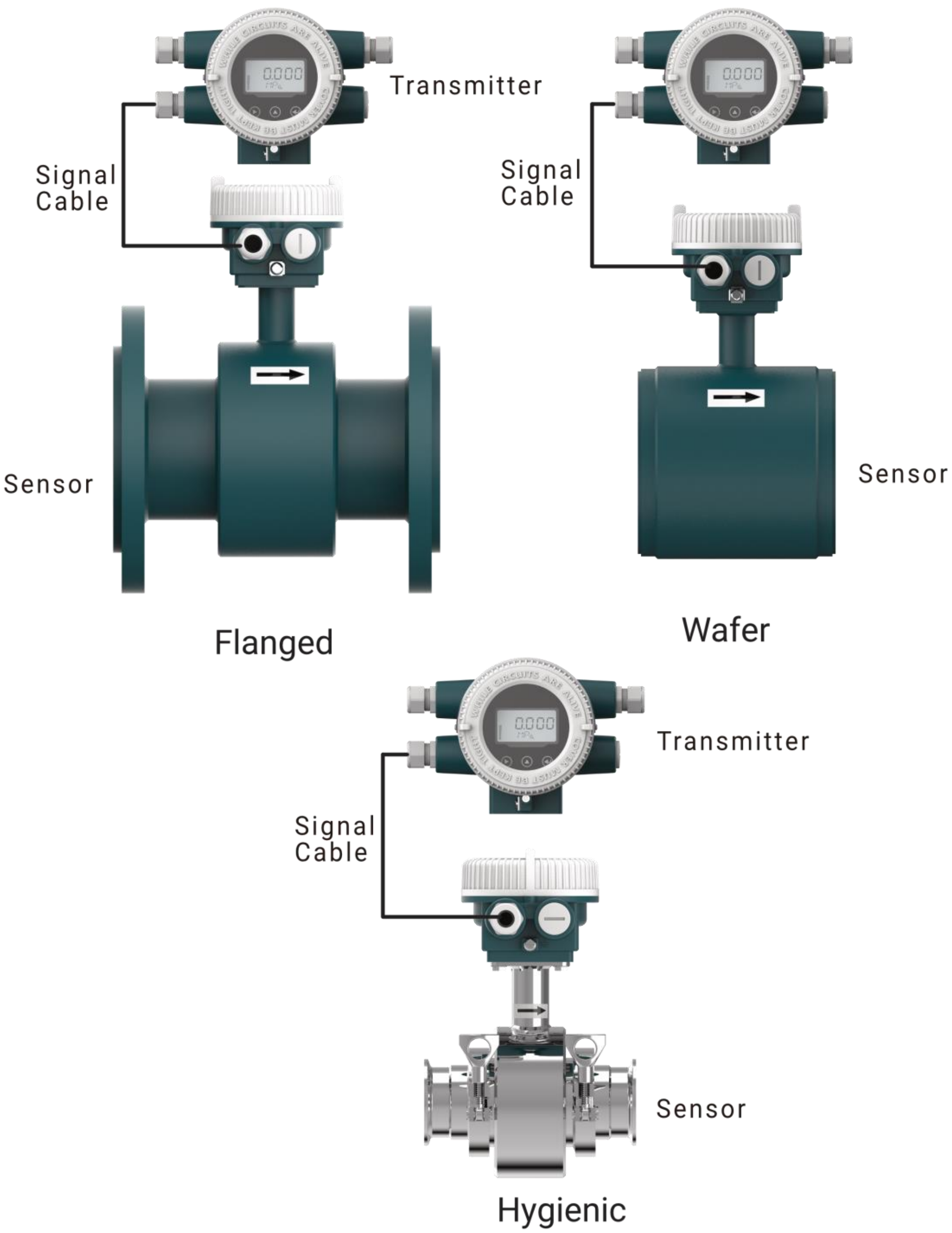


Figure 2-2 Remote Electromagnetic Flowmeter Appearance

2.2 Sensor and Transmitter Appearance

2.2.1 Sensor

The sensor consists of measuring tubes with insulated linings, coils, electrodes and enclosures.

Note

The basic components of flanged, wafer and hygienic sensors are similar. This section illustrates the appearance of a flanged sensor as an example.

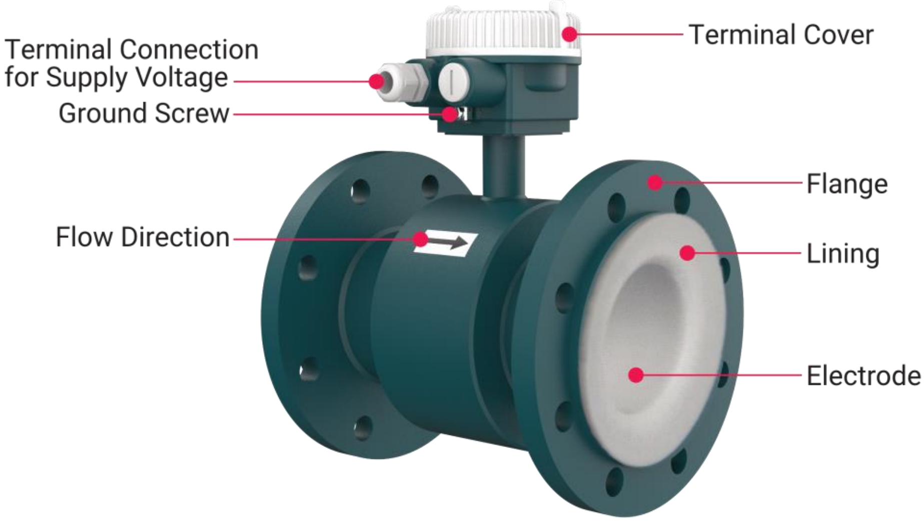


Figure 2-3 Sensor Appearance

2.2.2 Transmitter

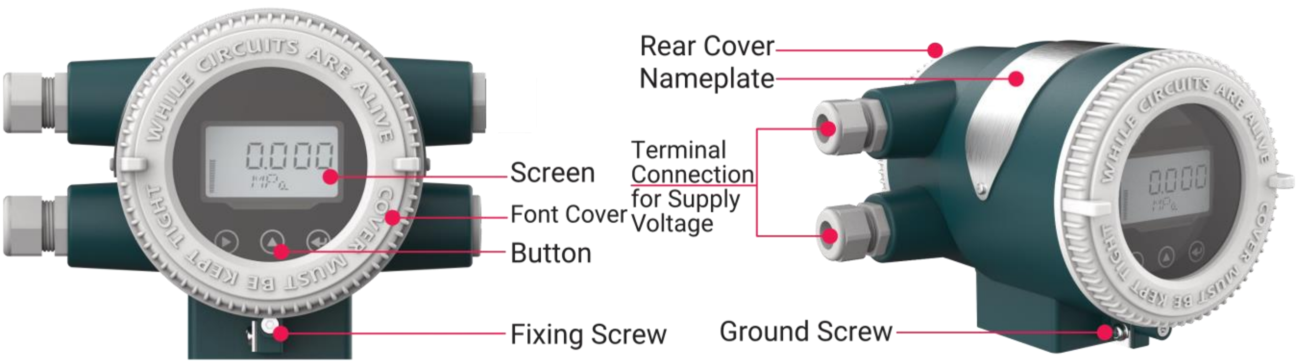


Figure 2-4 Transmitter Appearance

3. Installation

Caution

- There should be sufficient operating space around the device mounting location for easy maintenance.
- Avoid areas that are prone to lightning strikes or that may be flooded and rain-fed.
- Avoid the installation in the environment of overheating, direct sunlight and corrosion. For the integral electromagnetic flowmeter, if the pipe temperature is high, take measures to ensure that the transmitter operating environment temperature meets the requirements.
- Select a location where the pipe is not vibrating or has few vibration.

3.1 Installing Sensor

3.1.1 Installation Site Requirements

- The straight section of upstream and downstream shall be of sufficient length.
  - The minimum length allowed for the straight section of the sensor upstream is 5 D and 2 D downstream (D is the inside diameter of the pipe).

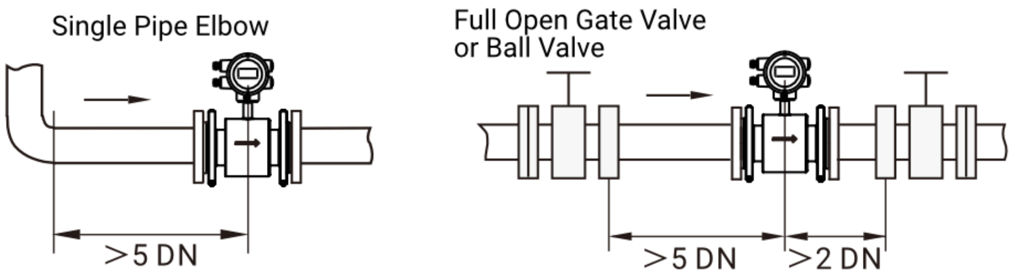


Figure 3-1 Minimum Length of Straight Pipe

  - The length of the straight pipe should be lengthened when there are flow regulators in the upstream (e.g. half-open valves, regulating valves, shut-off valves, etc.).

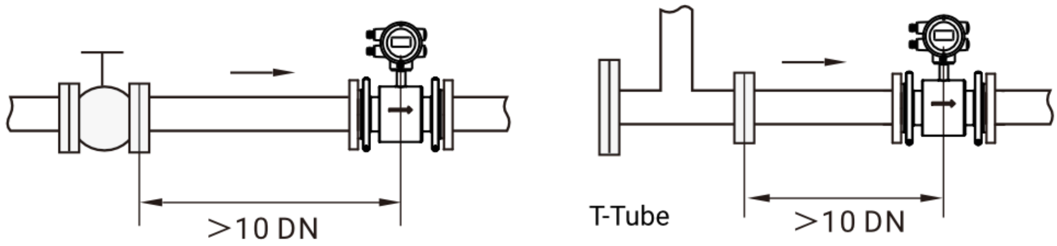


Figure 3-2 Extended Straight Pipe (DN: Average of Pipe's Inner and Outer Diameters)

– A reducing pipe with a taper less than 15° is considered a straight pipe when installed in the upstream and downstream of the measurement tube.

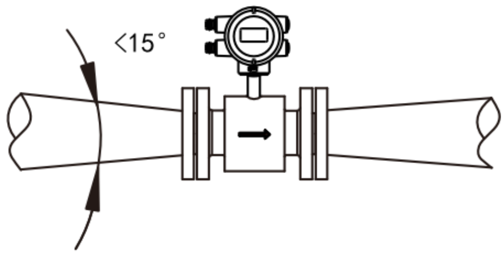


Figure 3-3 Reducing Pipe

- The sensor should be installed in a section filled with medium. Under partially filled pipe conditions, the device will exhibit large fluctuations in the displayed values and severe measurement errors.

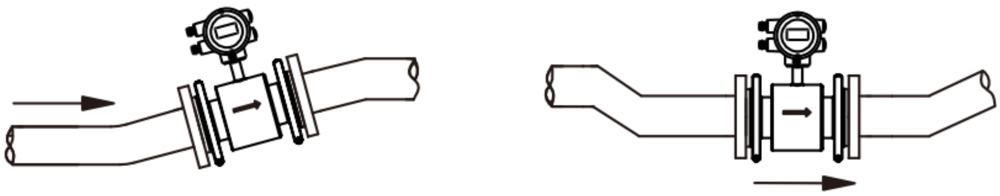


Figure 3-4 Raise the Downstream Section Outlet to Ensure Full Pipe

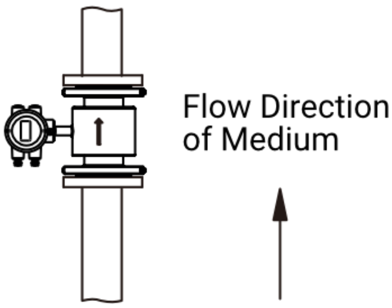


Figure 3-5 Flow From Bottom to Top Ensures Full Pipe

- Make sure that no air bubbles are created or accumulated in the location where the measuring tube is installed. If air bubbles enter the measuring tube of the sensor, they will cause a large fluctuation in the displayed values and cause severe measurement errors.

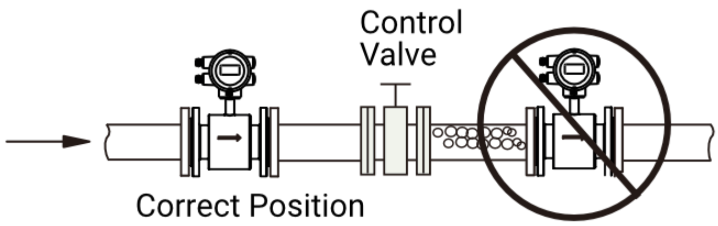


Figure 3-6 Bubbles Are Easily Created in the Downstream of the Regulating Valve

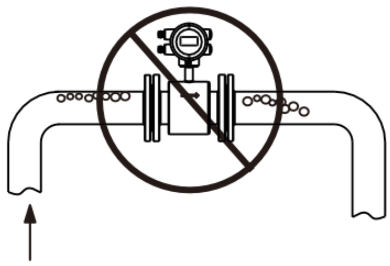


Figure 3-7 Air Bubbles Can Accumulate in the Pipe With the Outlet Facing Down

Note

In downward pipes longer than 5 m, cavitation is created due to a drop in system pressure. In such situation, install a siphon or relief valve in the downstream of the sensor.

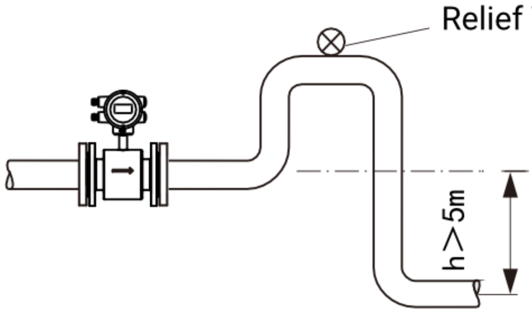


Figure 3-8 Install Relief or Siphon Valve

- The conductivity of the fluid should remain stable in the section where the measuring tube is located.

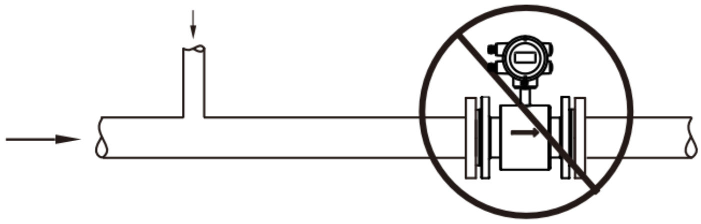


Figure 3-9 Fluid Conductivity Should Remain Stable

Caution

In the case of upstream chemical injection, the fluid conductivity may fluctuate significantly, affecting the device's normal operation. To avoid this, it is recommended to change the injection port of the chemical material to the downstream side of the device. If the injection must be carried out from the upstream side, a sufficient distance (above 50 D) should be maintained to allow the fluid to mix adequately with the injected substance.

- The pipe section near the upstream side of the sensor must not have interceptors.

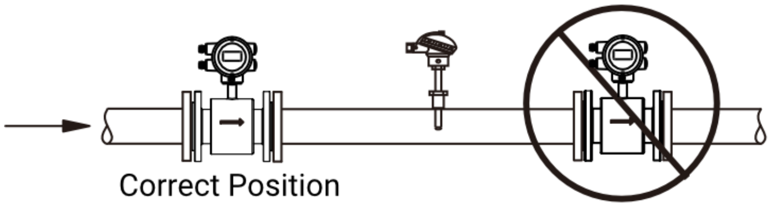


Figure 3-10 No Interceptor Allowed

- Device must not be installed in a negative pressure pipe (e.g. suction side of pump).

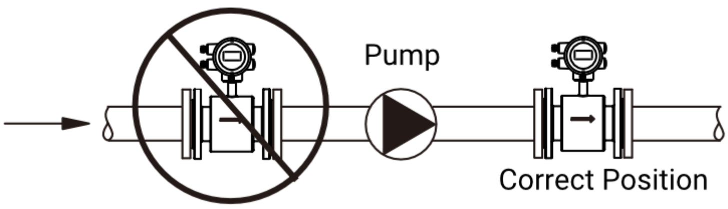


Figure 3-11 Do not Install on the Negative Pressure Side of the Pipe

3.1.2 Installation Requirements

- Pipes should be welded before the device is in position. No electrical welding is allowed after the device is in position. After the device is installed, the device power must be disconnected first if other parts of the pipe need welding construction.
- Newly installed pipes generally contain foreign matter such as weld spatter. To prevent damage to the lining, please wash away the foreign matter before the sensor is in place.

Caution

A pipe that is not centered or tilted can cause leakage or damage to the lining.

- The flow direction maker on the device should be consistent with the direction of the flow.

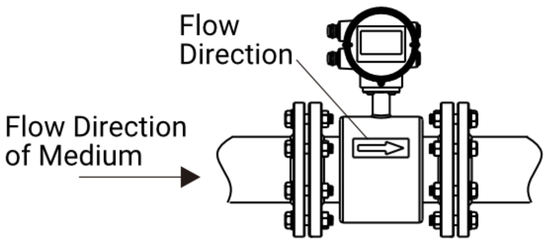


Figure 3-12 Flow Direction

Note

To facilitate device operation or data observation, the transmitter orientation can be changed as follows: Remove the four fixing screws on the bottom of the transmitter housing, rotate the transmitter by ±90° or 180°, and then reinstall the screws. Note the gasket on the bottom of the housing is properly seated during the screw tightening process.

- When the sensor is in the tube, the line XX between the two electrodes should remain horizontal.

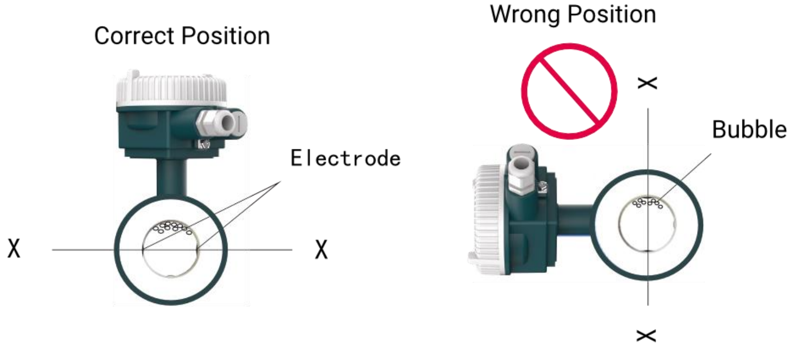


Figure 3-13 Electrode Horizontal Position

Caution

The electrode shown in the upper right image is located on the top of the measuring tube, and air bubbles escaping from the medium will cause the electrode to be isolated from the medium for a short period of time, making the measurement unstable and causing serious errors.

- Suitable gasket must be installed at the connection of the sensor to the pipe.
  - The gasket material must be compatible with the process fluid and operating conditions.
  - Do not use metal or spiral wound gasket as this will damage the lining.
  - Do not use graphite gaskets, as the inside of the measuring tube will form a conductive layer that can short-circuit the measuring signal.
  - Flange sealing gaskets are not allowed to protrude into the pipe cross section.

Caution

PFA, FEP, PTFE linings are generally equipped with PTFE gaskets. Ne, PU linings generally use rubber gaskets.

3.1.3 Installation

Install the flanged flowmeter as shown in the following figure. During installation, the flanges on both sides should be moved slowly and alternately to the sensor. Do not tighten one side and then tighten the other side to avoid crushing the lining.

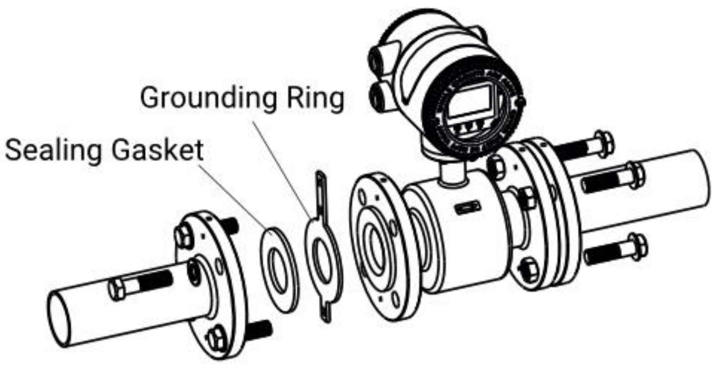


Figure 3-14 Flanged Flowmeter Installation

Mount the wafer flowmeter as shown in the following figure. During installation, make sure that the measuring tube is coaxial with the upstream and downstream pipe using a pilot pin, which is secured to the two bolts at the bottom of the sensor.

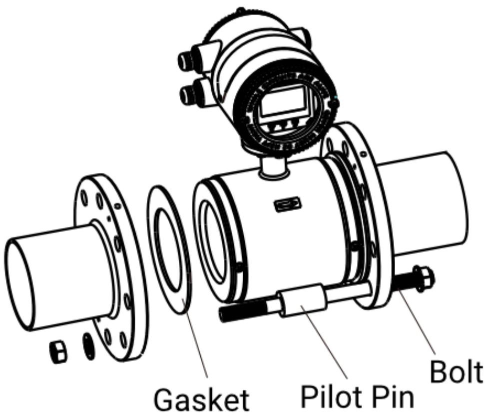


Figure 3-15 Wafer Flowmeter Installation

Caution

- The bolts should be tightened alternately and gradually, do not tighten the opposite bolt while either bolt is still loose.
- Do not over-tighten the bolt during initial installation. It is generally recommended to re-tighten after 24 hours.

3.2 Installing Remote Transmitter

The transmitter should be installed as far away as possible from the high power motor or frequency converter.

Caution

- There should be sufficient operating space in the installation area to facilitate wiring and connection of the conduit.
- For wall mounting, leave sufficient length of the cable.

Once the mounting bracket is secured as shown in the figure below, secure the transmitter to the bracket with a nut.

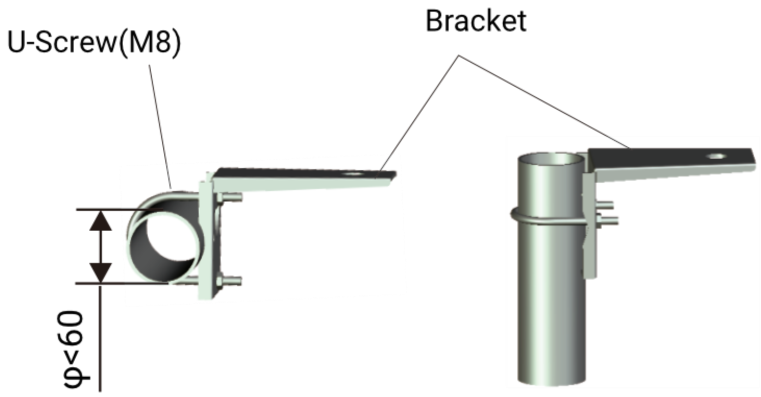


Figure 3-16 Mounting Bracket Can Be Fixed to Round Tube (Left) or Wall Mounted (Right)

Figure 3-17 The Transmitter Is Secured to the Bracket With a Nut

4. Grounding

The medium grounding connection is one of the necessary conditions for the correct operation of the device, as shown in the following figure. Make sure that the earth terminal (ground resistance ≤ 10 Ω) is connected with a cable with a sectional area of ≥ 2 mm.

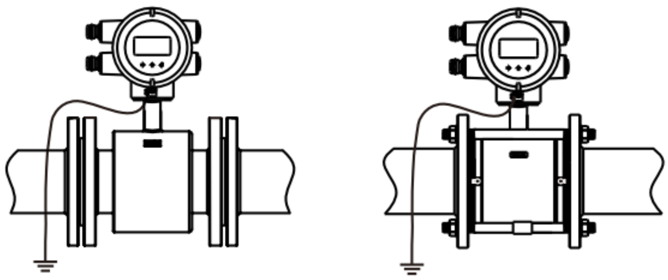


Figure 4-1 The Device Housing and Medium Should Be Grounded at the Same Time

However, when the device is installed on a metal pipe, the medium can be directly grounded through the pipe itself. When installed in an insulated pipe, it needs to be grounded through the grounding ring or the grounding electrode.

The grounding ring material include stainless steel 304, 316L, Hastelloy C; the earth electrode material include 316L, Hastelloy B, Hastelloy C, tantalum, platinum, etc. When the grounding electrode is installed in the measuring tube, it is referred to as the "three-electrode sensor".

The following describes how to ground the device when it is installed on different pipes.

4.1 Metal Pipes

Wire the ground end of the device housing to the pipe flange.

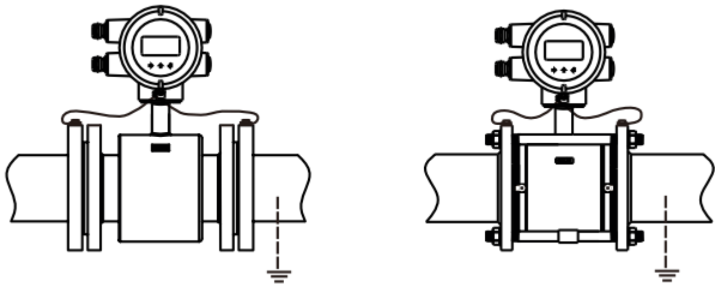


Figure 4-2 Metal Pipe Grounding

4.2 Metal Pipe Lined With Insulating Material (Grounding Ring or Grounding Electrode Required)

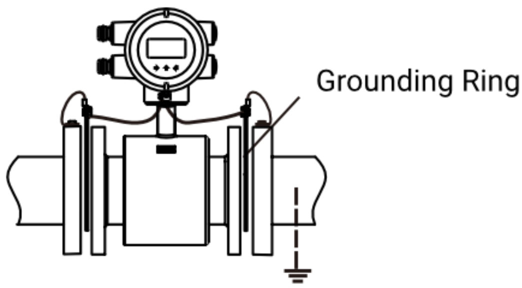


Figure 4-3 Grounding for Metal Pipe With Insulating Lining

Note

- When using a grounding ring, the grounding of wafer sensor is shown in the figure to the right in Figure 4-1 or the figure to the right in Figure 4-2.
- When using a three-electrode sensor, the grounding is shown in Figure 4-1.

4.3 Cathode Protection Pipe (Grounding Ring or Grounding Electrode Required)

The pipe flanges shall be electrically isolated from the device housing and the pipe flanges on both sides shall be electrically connected with copper wire.

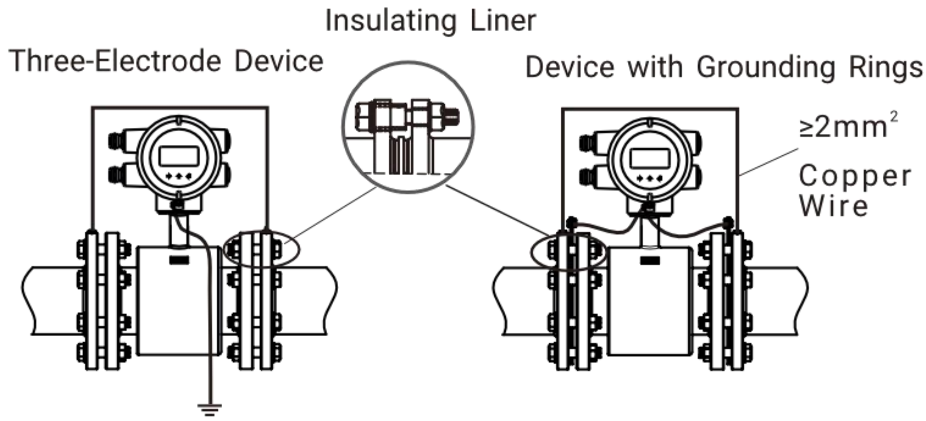


Figure 4-4 Grounding of Cathode Protection Pipe

Note

The grounding of the wafer sensor is shown in Figure 4-1 on the right.

4.4 Non-Metallic Pipe (Grounding Ring or Three-Electrode Flowmeter Required)

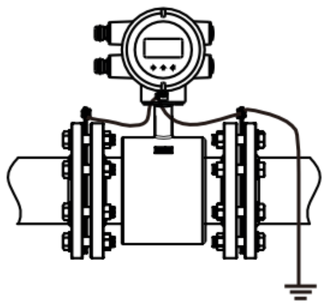


Figure 4-5 Grounding for Non-Metallic Pipe (With Grounding Rings)

Note

The grounding of wafer flowmeter is shown in Figure 4-2 on the right; and the grounding of three-electrode flowmeter is shown in Figure 4-1 on the left.

5. Wiring

5.1 Cable Selection

Caution

Hard-drawn copper wire is not allowed for flowmeter power and output signals.

5.1.1 Power Cable

- In order to ensure the sealing of the device conduit port, choose a round three-core multi-strand sheath cable with an outer diameter of 6 to 10 mm, with each core sectional area being 1.0 to 1.5 mm.
- For ambient temperature above 60 °C, use cables with a rated temperature of 80 °C. If the ambient temperature exceeds 80 °C, use cables rated at 110 °C.

Caution

- The operation ambient temperature of transmitter is -25 ℃~+55 ℃.
- When using a DC 24 V supply, the voltage delivered to the transmitter drops due to the cable resistance. The relation of the supply voltage and the allowable cable length is shown in the figure below.

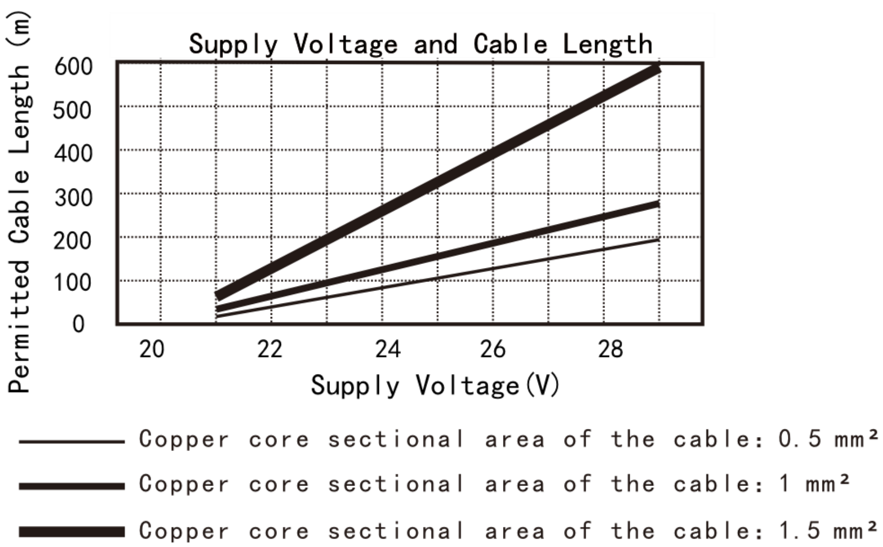


Figure 5-1 Relation Between Supply Voltage and Cable Length

5.1.2 Output Signal Cable

- To ensure the sealing performance of the conduit ports, choose a round multi-strand sheath cable with an outer diameter of 6~10 m and copper core sectional area of 0.5~1.5 mm.
- If ambient noise and crosstalk can adversely affect the signal, use RVVP shielded cable.
- If the environment is exposed to lightning, use a multicore cable or RVVP shielded cable and securely ground excess cores or shielding in the multicore cable.

5.1.3 Dedicated Signal Cable for Remote Electromagnetic Flowmeter

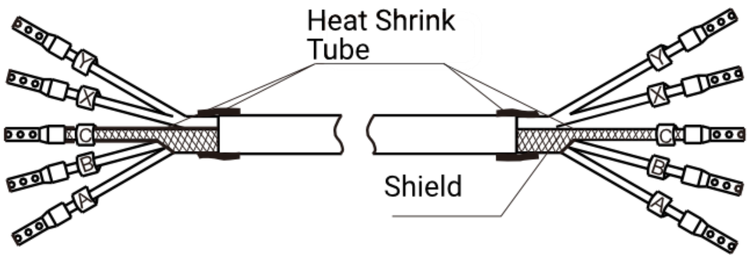


Figure 5-2 Signal Cable Terminal Processing

Caution

- If the signal cable supplied with the product is too short, contact us to replace it. Do not lengthen the cable by yourself.
- Do not wrap the signal cable if it is too long; if you need to shorten the cable, handle the terminal as shown above.
- If used in an environment susceptible to lightning, the shield of the signal cable at the transmitter side for the remote flowmeter should be securely grounded through the housing.

5.2 Cable Laying

5.2.1 Seal Cable Port

Insert the parts of the sealing plug into the cable as shown in the figure below and screw them into the conduit port of the device in turn.

Note

When connecting the conduit to the sealing plug, make sure not to compromise the sealing properties of the cable and avoid tightening the cable.

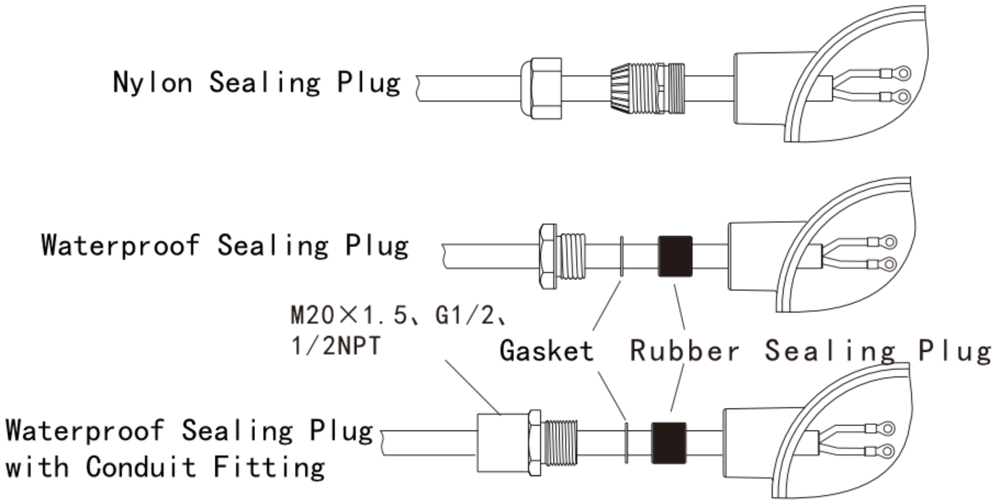


Figure 5-3 Install the Sealing Plug

5.2.2 Lay the Conduit

To protect cables and avoid electrical noise, it is recommended that cables should be routed using conduit and constructed according to the following requirements:

- Power cables, and output signal cables are not allowed to share conduit, nor are they allowed to share conduit with dedicated signal cables. If the power cables are routed in the same cable bridge as the other cables mentioned above, keep the cables isolated.
- The dedicated signal cables for different devices are not allowed to share conduit or tied together.
- When connecting the device to a conduit, a watertight sealing plug with conduit fitting should be used. Conduit connector A (see the figure below) should be

located below the device conduit port. Install a drain valve at the end of the vertical pipe for regular draining of water from the conduit.

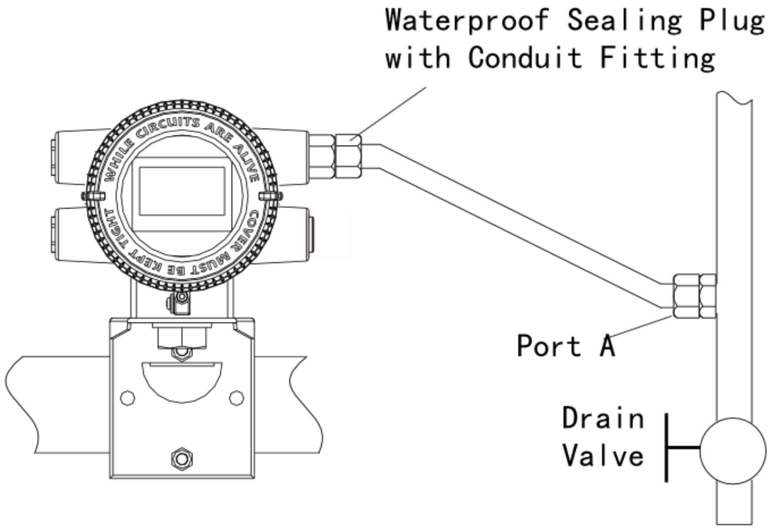


Figure 5-4 Lay the Conduit

Caution

The power supply to the device and each signal cable are allowed to be exposed to bare wiring, but injury from external factors should be avoided; the dedicated signal cable for the remote flowmeter should be kept away from the high power motor and frequency converter.

5.3 Wiring

Caution

- To prevent damage to the device from condensation, do not connect cables outdoors in rainy days.
- Removal for the sealing cap of unused conduit port is not allowed.
- The cable sheath should enter the device housing completely and properly (see Figure 5-3).

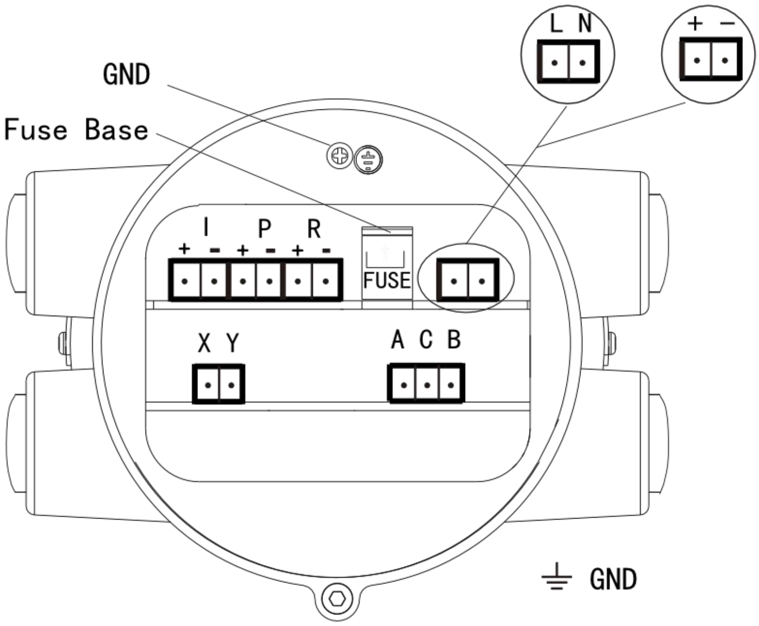


Figure 5-5 Transmitter Terminal

Table 5-1 Terminal Description

Terminal Symbol	Description	Terminal Symbol	Description
I+/I-	4 to 20 mA output	A.	Sensor electrode input signal
P+/P-	Pulse output	B.	Sensor electrode input signal
R+/R-	RS-485 interface	C.	Signal common terminal
L/N.	Power input: AC powered	X.	Excitation current input
+/-	Power input: DC powered	Y.	Excitation current output

5.3.1 Connection Between Transmitter and Sensor

Caution

The transmitter terminals are all plug-in type. Please tighten the lead into the plug first, and check the connection before inserting the plug into the appropriate terminal block.

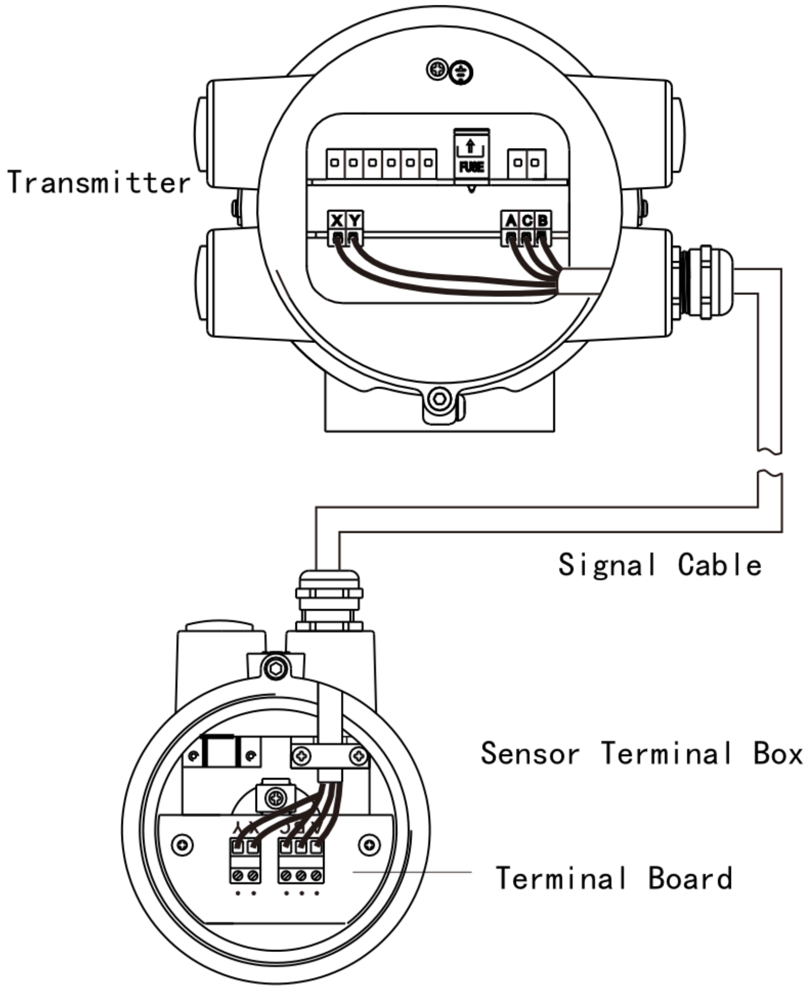


Figure 5-6 Connection Between the Transmitter and the Sensor

5.3.2 Connection of Transmitter to External Device

The device establishes signal connection with external devices via terminals 1+, I-, P+, P-, R+, R-. The cable should be crimped on the insulated straight pipe end before it is fed into the terminal.

IO Output

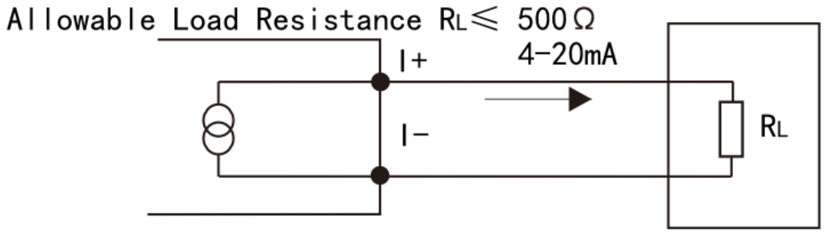


Figure 5-7 4 to 20 mA Output

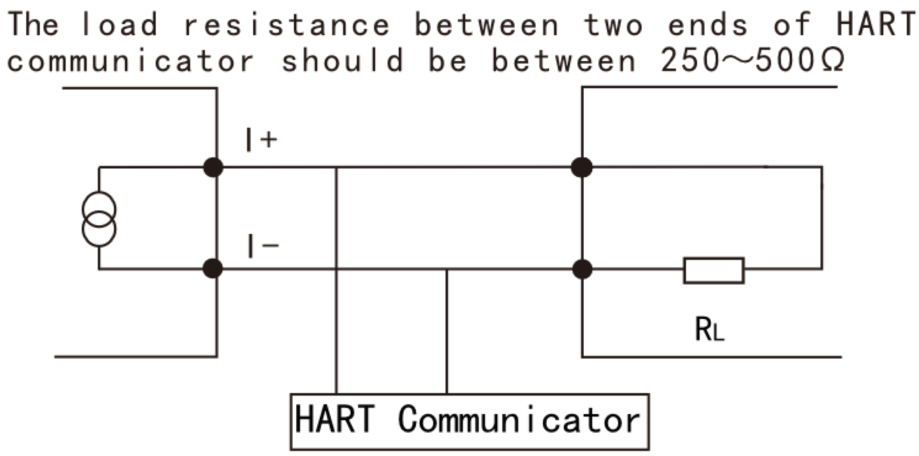


Figure 5-8 4 to 20 mA Output With HART Protocol

PIO Output

The PIO parameters of the device are configured according to the order requirements before leaving the factory. In actual scene, the functions and parameters of the PIO can be modified, as described in section 7.1.

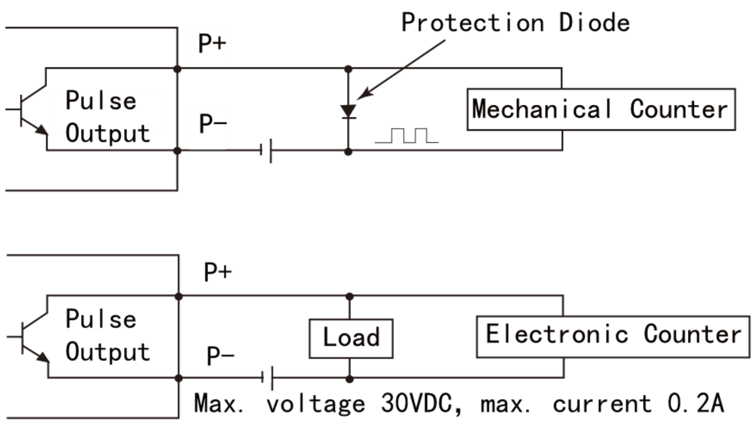


Figure 5-9 Passive Pulse Output

Caution

- As PIO is a transistor junction output (isolated), be aware of the voltage and power polarity when wiring.
- The voltage of the circuit supply must not be more than 30 V, and the current in the circuit must not be greater than 0.2 A after the load is inserted. This is to prevent damage to the device.
- When the input filter time constant of the electronic counter is larger than the pulse width, it may cause inaccurate counts. Therefore, set the pulse width to higher values (see Table 7-2, Note 4).
- Induced noise from the power supply can cause incorrect counting if the input impedance of the electronic counter is large. A shielded cable or lower input impedance of the electronic counter can fit within the specifications of the device pulse output.

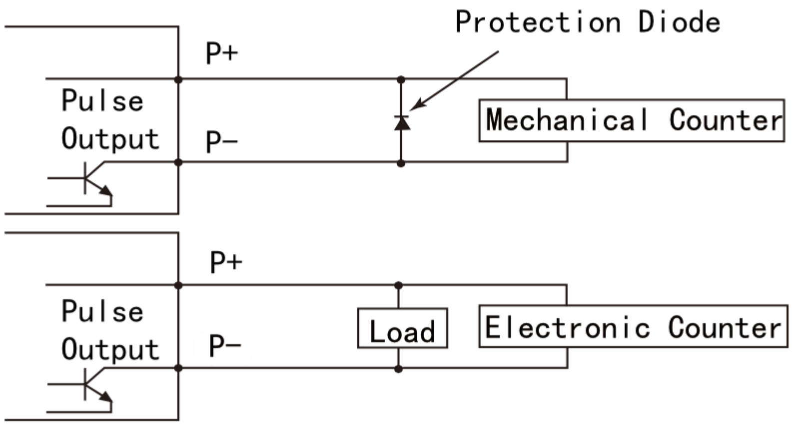


Figure 5-10 Active Pulse Output

Caution

Short circuit between P+ and P- is not allowed when the PIO interface is set to active pulse output.

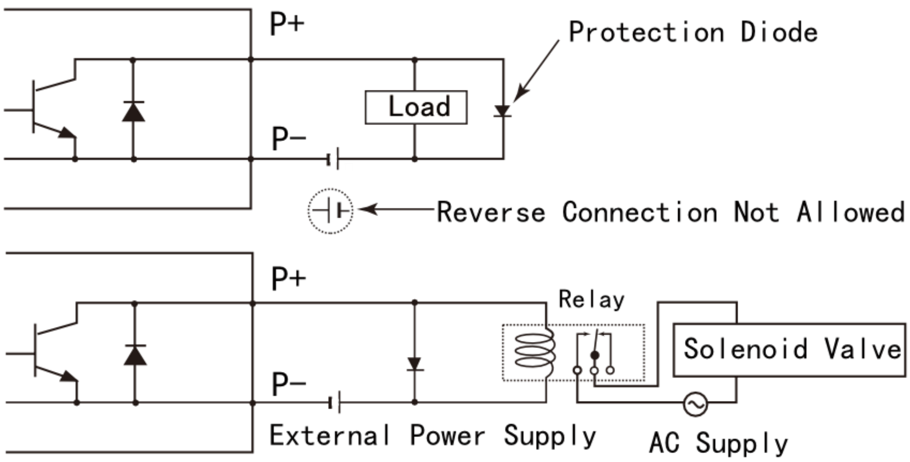


Figure 5-11 Alarm Output

Caution

- Be aware of voltage and polarity when wiring. The external supply voltage must not be greater than 30 V and the current must not be greater than 0.2 A to prevent damage to the device.
- The PIO interface should work with an intermediate relay to drive the load with AC power supply, as shown above.

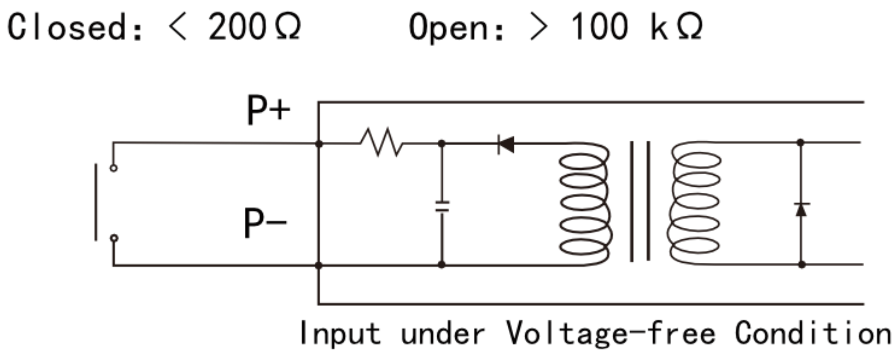


Figure 5-12 Contact Signal Input

Caution

The contacts must be dry (voltage free) and no other power supply in the circuit, or damage to the device may occur.

RS-485 Output

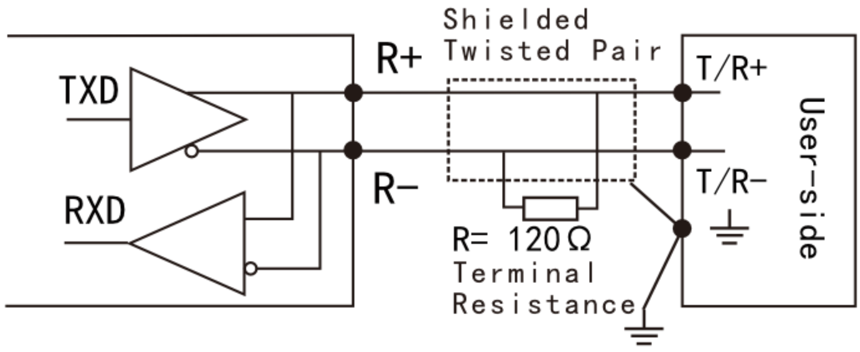


Figure 5-13 RS-485 Signal Output

5.3.3 Power Cable Wiring

Grounding

Before connecting the power cable, the device housing shall be grounded for the safety of the operators. The grounding wire should use 600 V insulated wire with a conductor cross-sectional area greater than 2 mm², and the grounding resistance should be less than 10 Ω.

Wiring

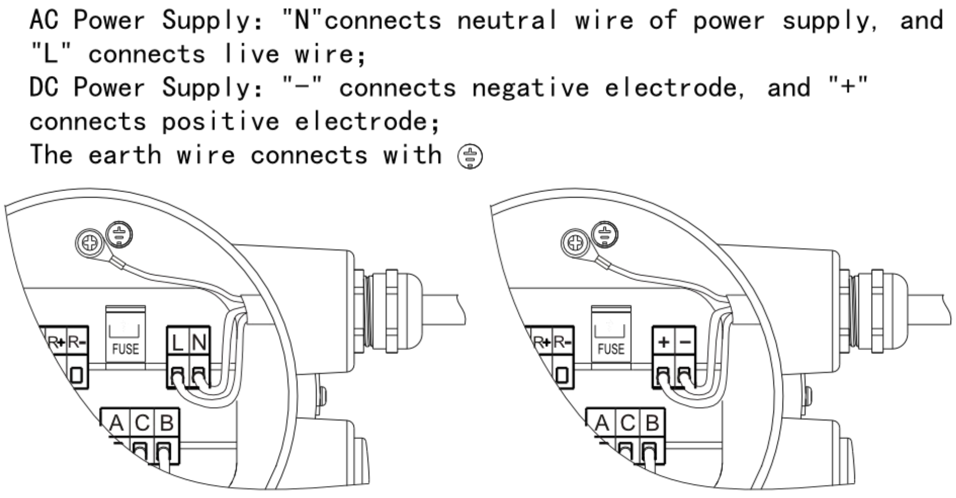


Figure 5-14 Power Cable Wiring

Caution

- Check the following when connecting the power cable:
- Check if the power supply meets the device requirements.

- Make sure the power supply is disconnected before wiring.
- The power supply should be connected to the device via an external fuse or circuit breaker (2 A).

6. Basic Operation

You can view measurement data, device parameters, alarm messages and clear the totalizer by pressing the key while the device is in the measurement state.

6.1 View Home Screen

After the device is powered up, it enters the initializing state.

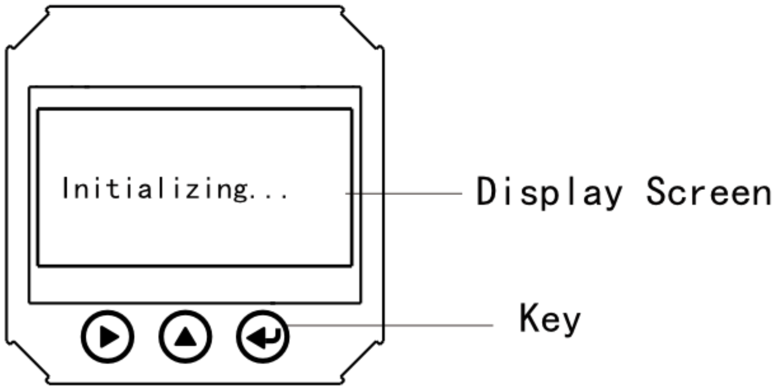


Figure 6-1 Initializing

After a few seconds, the device automatically enters the measurement state, and the display screen is shown as follows:

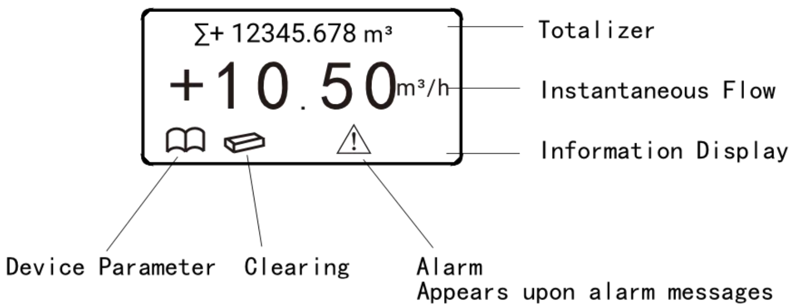
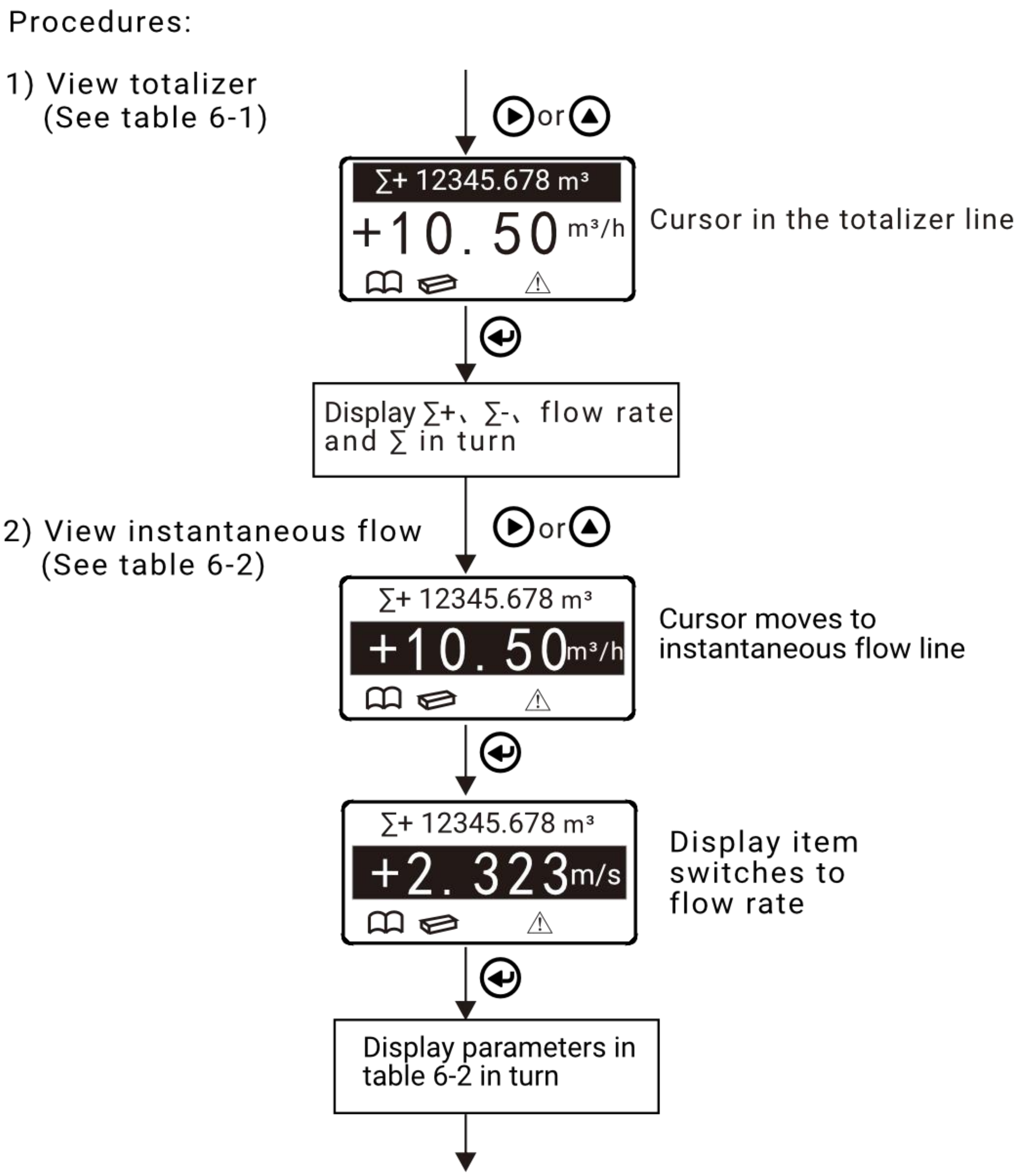
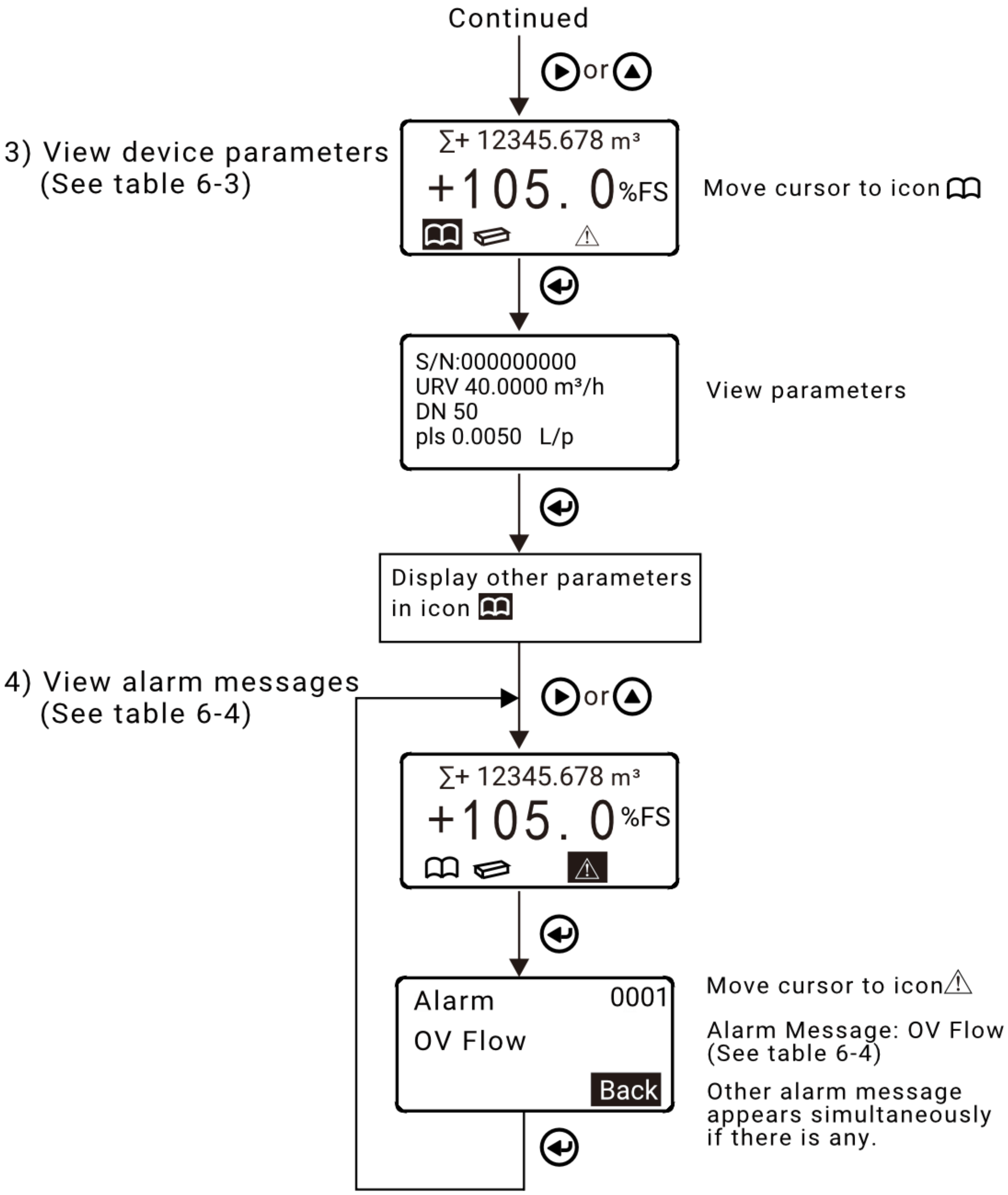


Figure 6-2 General Setting Interface

6.2 View Measurement Data and Device Information

Press any key on the panel and the cursor (black block) appears on the display. Press the key or the key to move the cursor to each line or icon. Press the key to display the parameters and information where the cursor is located.





Note

During the above procedure, the cursor will disappear automatically if no keys are pressed for 5 minutes.

Table 6-1 Parameters in the Totalizer Line

Parameter	Description
Σ+	Accumulated value of forward flow
Σ-	Accumulated value of reverse flow
Σ	Net totalizer, $\Sigma=\Sigma_{+}-\Sigma_{-}$
Flow rate	Displays the flow rate

Table 6-2 Instantaneous Flow Line Parameter

Parameter	Units	Description
Instantaneous flow	See Table 7-1	Consists of flow units and instantaneous units
Flow rate	m / s	The units change to mm/s when flow rate is less than 0.1 m/s.
Percentage flow	%FS	The percentage of the current instantaneous flow to FS
Current	mA	Current output signal current value
Frequency	Hz	Current output signal frequency value

Table 6-3 Parameters in Icon

Parameter	Meaning	Description
S/N	Serial number	Same as the "Serial Number" on the sensor and transmitter nameplates
URV	Upper range value	See Appendix D for instructions, or order requirements, or default (see Appendix C) settings
DN	Specifications	See appendix D
pls	Pulse factor	See appendix D
Ks	Sensor factor	See appendix D
Kc	Transmitter factor	/
Comm	Communications	For the name of the communication protocol used by this device, see Table 7-1
/	The firmware version	The software version identification number of the device

Table 6-4 Parameter in Icon (Alarm Message)

Parameter	Description
Upper limit	Appears when the measurement result is greater than the alarm upper threshold (see Table 7-4). This item is displayed only if it is selected in the Alarm Output.
Lower limit	Appears when the measurement result is less than the alarm lower threshold (see Table 7-4). This item is displayed only if it is selected in the Alarm Output.
Direction of flow	Appears when the measured flow value is '-' (see Table 7-4). This item is displayed only if it is selected in the Alarm Output.
Empty tube status	Indicates that the pipe is empty when the empty detect function is on (see Table 7-1, Note 4).
OV. Flow	Appears when measured flow value is greater than the upper range value (see Table 7-1, Note 1).
Pulse Factor	Appears when current output frequency is larger than 5 kHz (see Table 7-2, Note 5).
Pulse Width	Appears when the pulse width of actual pulse output signal is less than the set value (see Table 7-2, Note 6).

6.3 Clearing Totalizer

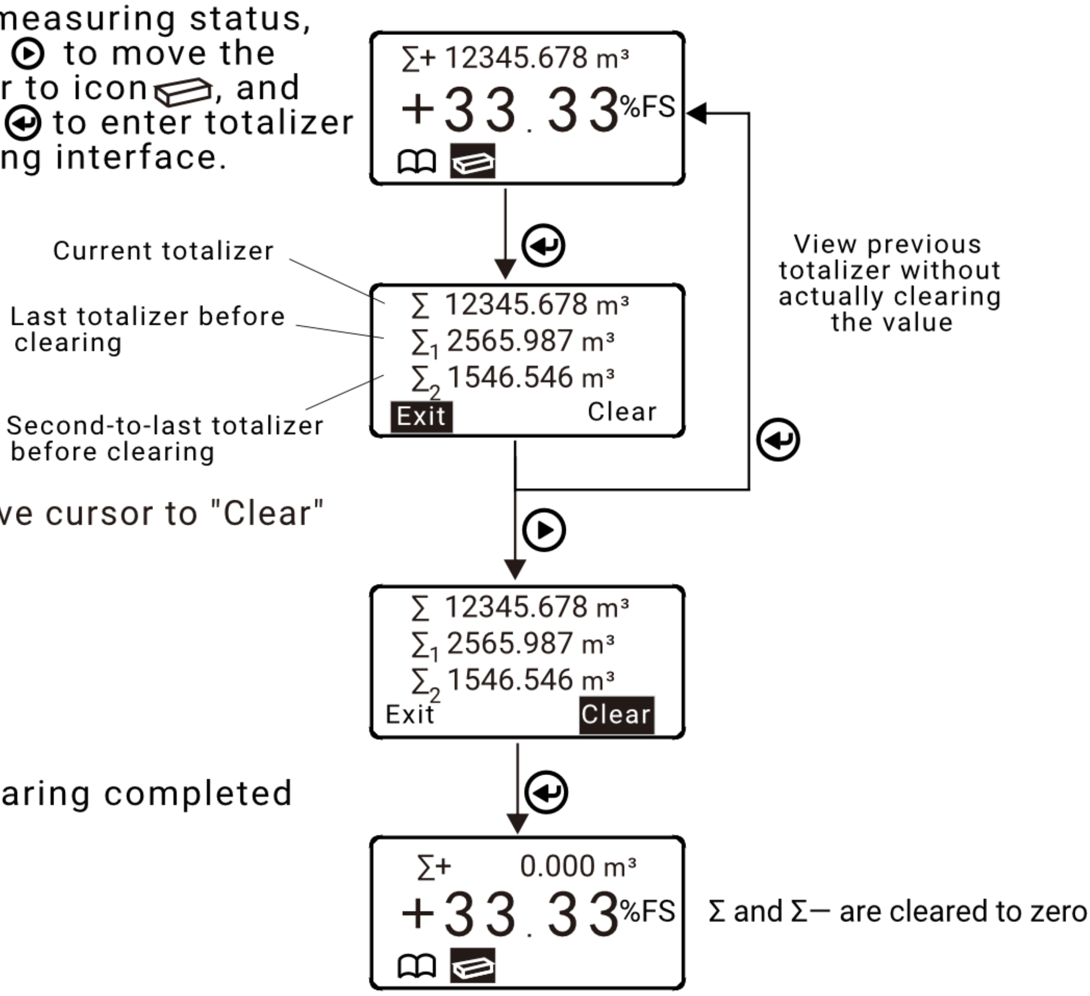
Clear the current cumulative flow display values Σ—, Σ+, and Σ.

Procedures

1) In measuring status, press ▶ to move the cursor to icon, and press ↵ to enter totalizer clearing interface.

2) Move cursor to "Clear"

3) Clearing completed



7. Parameters Setting

Before using the device, set the operating parameters of the device according to the actual application (see Table 7-1 and Table 7-2 below).

In the measurement state, hold the key for 3 seconds, and the device display prompts to remind you to enter the password:

Figure 7-1 Password Input Interface

In the parameter setting state, the functions of keys are as follows:

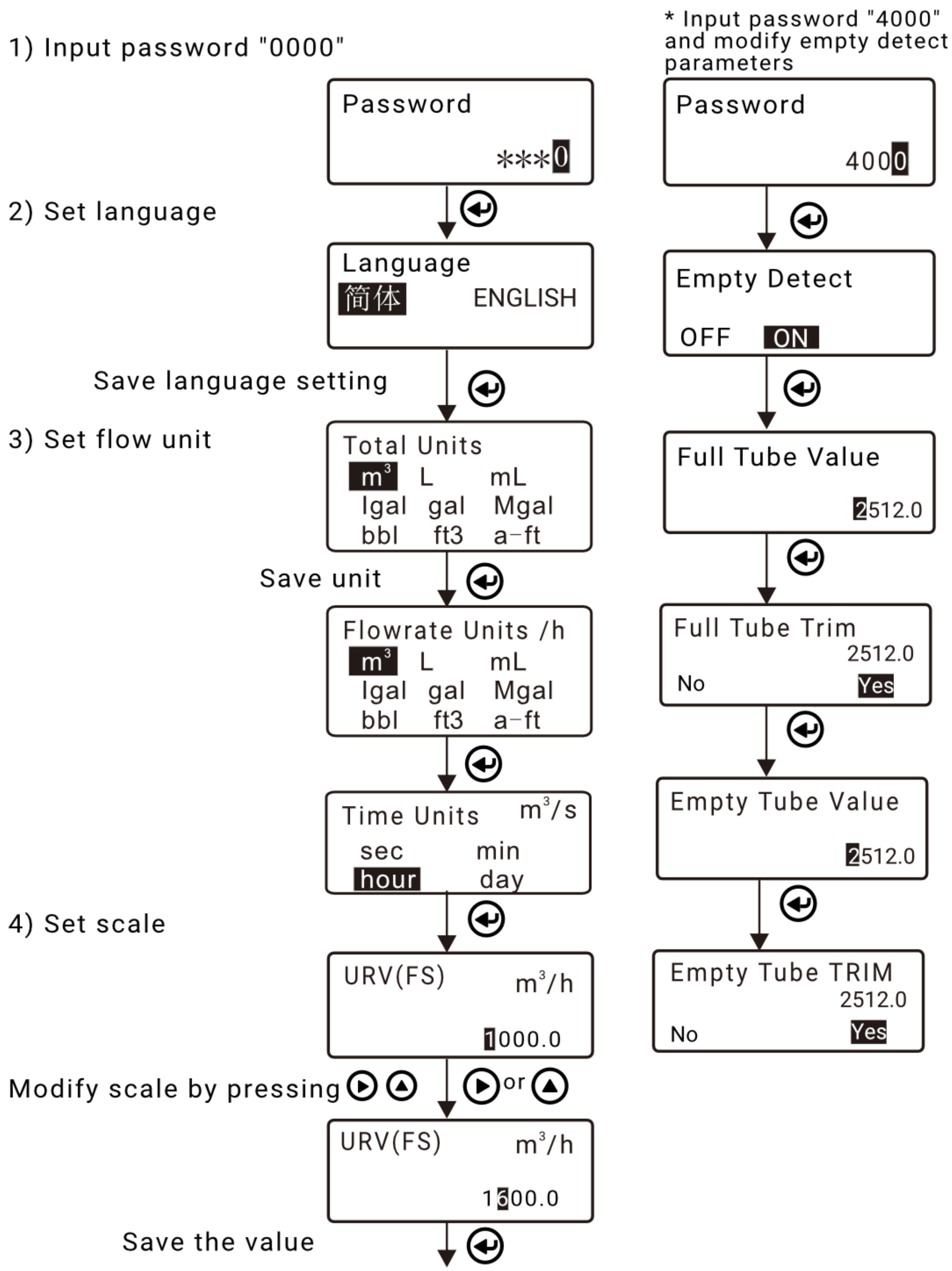
	Moves the cursor.
	Modifies the value at the cursor position.
	Saves the data or options and go to the setup interface for the next parameter.

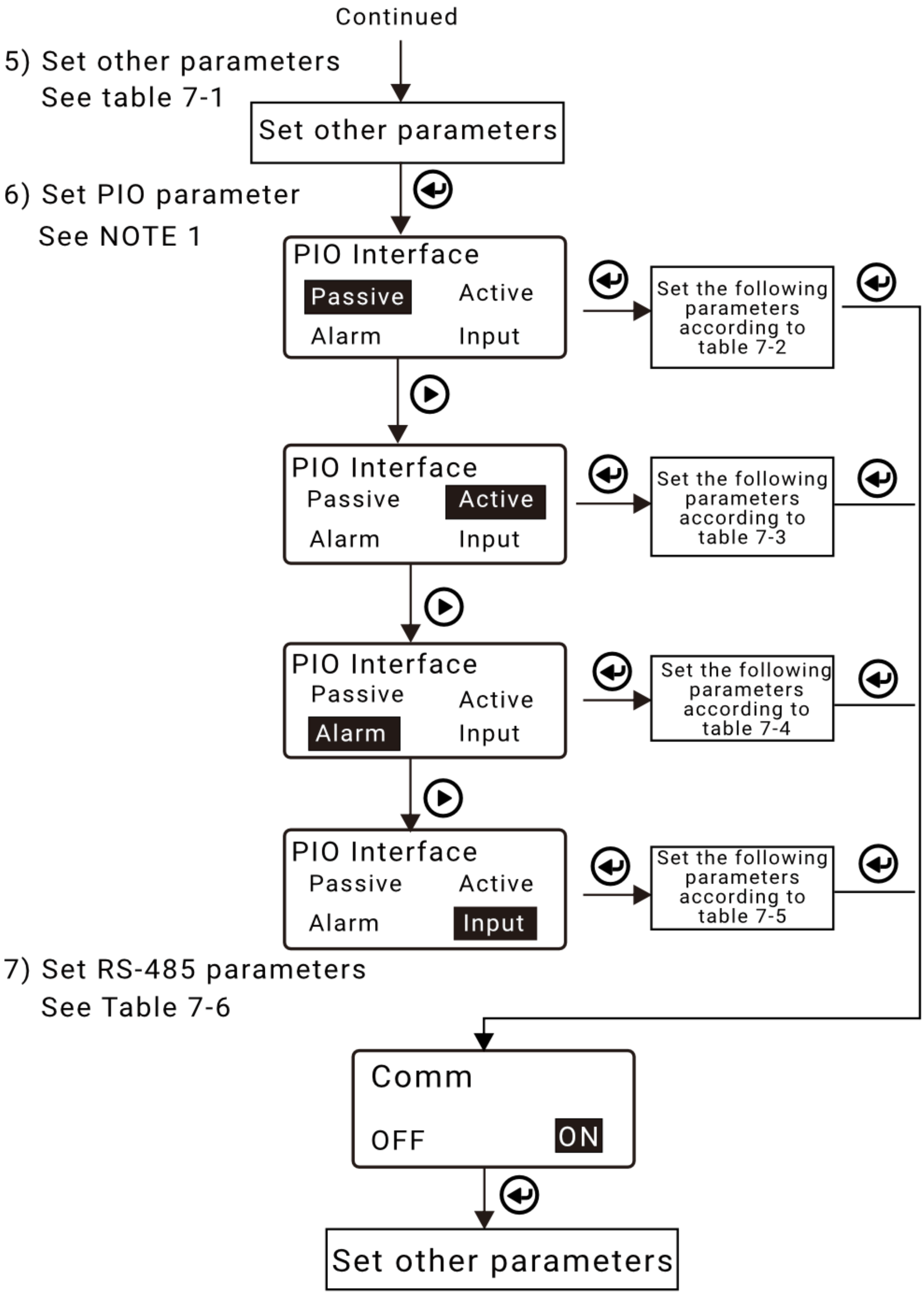
Press and hold the key, and after 3 seconds the device exits the parameter setting interface and returns to the measurement status.

Note

In the parameter setting interface, if no key is pressed within 5 minutes, the device will automatically exit the parameter setting interface and return to the measurement state.

7.1 Basic Parameters





Note

NOTE 1: After setting the PIO interface parameters, complete the wiring according to section 5.3.2.

Table 7-1 Basic Parameter Description

Parameter	Option/Range	Description
Language	Simplified Chinese, English	When set to ENGLISH, device interface language is English.
Total Units	m^3, L, mL, Igal, gal, Mgal, bbl, ft^3, a-ft, t, kg, g, lb, STon, LTon	
Flowrate Units		
Time Units	sec, min, hour, day	
URV(FS)	0.00001-999999	See Appendix D and Appendix C for default values
Low Cutoff (%FS)	00~9.9	See Appendix D and Appendix C for default values
Damping (s)	0.0~99.0	NOTE 1, default value: 05
Hydro-State	Normal Wave	/
Direction	Forward Bi-directional	NOTE 2, default option: Bi-directional
Indication	Fwd. Rev.	Direction indicated by the direction of the flow marker, default option: Forward
Empty Detect	Off/On	NOTE 3, see Appendix D, default option: On
Loop Mode	4~20mA 4~12~20mA	4~20mA: Corresponding range is 0 to full scale; 4~12~20mA: Corresponds to negative range to 0 to full scale
PIO Interface	Passive/Active/Alarm/Input	The subsequent parameter setting interface (see Table 7-2~7-5) is displayed. Default option: Passive
Comm	OFF/ ON	When ON is selected, follow Table 7-6 to set the subsequent parameters; default option: ON
Modbus Address	1-247	/

Table 7-2 Passive Pulse Output Parameter

Parameter	Option/Range	Description
Pls Factor Unit	L/p, mL/p, Hz	
Pls Factor	0.00001-999999	See Appendix D for instructions and Appendix C for default values
Pulse Width (ms)	200, 100, 50, 20, 10, 50%	NOTE 4, default: 50
Pulse Type	Normally Open/Normally Closed	Status of contacts with no signal output, default: normally open

Table 7-3 Active Pulse Output Parameter

Parameter	Option/Range	Description
Pls Factor Units	L/p, mL/p, Hz	
Pulse Factor	0.00001-999999	See Appendix D for instructions and Appendix C for default values
Pulse Width (ms)	200, 100, 50, 20, 10, 20%	Note 4, default: 20

Note: The contact mode is Normally Open.

Note

- NOTE 1: This parameter is used to suppress the fluctuations of measurement value and output signal. The larger the damping value, the smaller the fluctuation will be, and also longer response time. Usually, the damping value is set to 1 to 3 s.
- NOTE 2: Select "Forward", and the meter can only measure and display forward flow (in the direction of the flow direction marker); select "Bi-directional" to measure and display both forward and reverse flow.
- NOTE 3: After selecting "On", the device prompts to set the "Empty Limit", which is usually set to 40~50%, if the detection sensitivity needs to be improved, Thresholds can be increased appropriately.
- Note 4: Pulse width refers to the time the contact closes (transistor on) within a pulse signal cycle when the pulse type is normally open, or the time the contact opens within a pulse cycle when pulse type is normally closed:

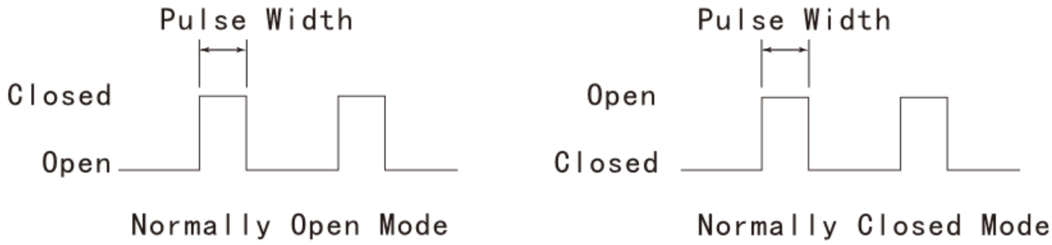


Figure 7-2 Pulse Widths for Different Pulse Types

The pulse width is set according to the requirements of the signal receiving device and the corresponding signal frequency upper limit is as follows:

Pulse width setting (ms)	200	100	50	20	10
Signal Frequency Upper Limit (Hz)	2.5	5	10	25	50

The meter outputs a pulse signal according to the pulse width value when the signal frequency is less than the upper frequency limit in the list. The device automatically outputs 50% duty cycle when the signal frequency is greater than the frequency upper limit corresponding to the pulse width setting, and an icon ⚠ is displayed on the screen to prompt you to reset the pulse width or pulse factor . Default pulse width: 100 ms.

Table 7-4 Status/Alarm Output Parameter

Parameter	Range	Description
Upper (%FS)	0~130	The PIO contact is closed when the actual flow (percentage flow) value is greater than the upper alarm value.
Lower (%FS)	0~130	The PIO contact is closed when the actual flow (percentage flow) value is less than the lower alarm value.
DIR	Normally open, normally closed	When set to normally open, the flow direction is reversed, and the PIO contact is closed.

Note

The wiring for different PIO interface status/alarm output is described in section 5.3.2.

Table 7-5 Contact Input Signal Parameter

Parameter	Option	Description
State In	Clear	The totalizer is cleared when the input contact is closed for more than 1 second.
	Other	Feature designed per user specification

Note

The wiring for the PIO interface defined as "contact input" is shown in 5.3.2.

Table 7-6 Modbus Protocol Parameter

Parameter	Option/Range	Description
Comm Type	Modbus-RTU BACNET	/
Baudrate	1200, 2400, 4800, 9600, 19200, 38400	/
DataBits	8	/
Parity	None/ODD/EVEN	Parity checking is not performed when data bit is 8.
StopBit	1, 2	Select 1 or 2 for none parity checking, and select 1 for odd/even parity checking.
Modbus Address	1-247	Decimal number

Note

See Appendix F for Modbus address and examples.

7.2 Set Sensor

When the device is shipped from the factory, the sensor parameters within the transmitter are set and should be reset after replacing the transmitter or sensor.

In the measurement state, press and hold the key for 3 seconds. Then the display prompts you to enter the password. After entering the password "1111", you are directed to the parameter setting interface. Set the sensor number, size, and sensor factor in turn by pressing the keys (see table below).

Table 7-7 Sensor Parameter

Set the item	Option/value range	Description
Sensor No.	00000000~99999999	Matches with the number on the sensor nameplate and the corresponding number on the transmitter nameplate.
Size (mm)	0000 ~ 9999	Conforms with the data on the sensor nameplate.
Sen Factor (Ks)	0.001 to 99.9999	/
Load setting	No, yes	/

Note

The parameters in Tables 7-1 and 7-7 are set at the factory according to the order requirements, and are set to default when not specified. In the event of an error in the parameter setting during the actual application and the need to restore the factory parameter options or settings, follow the instructions below:

(1) Select "Yes" on the " Load setting" interface. Press key to restore the device parameters to the factory settings.

(2) After the setup is complete, hold the key to exit the parameter setup interface and return to the measurement state.

7.3 Check Zero Point and Perform Zero Calibration

The value of the electrode output signal when the tube in which the measuring tube is located is filled with medium and stationary is known as the device "zero point” under the condition that the grounding connection is working properly. The zero calibration is to set the value that is opposite to the current zero point value, so that the measurement result of the device at the flow rate of "0 m/s" is "0".

If the measurement values appear unstable or error is large during device operation, you can determine the causes and solve the problem by checking zero point and perform zero calibration in most cases.

7.3.1 Check Zero Point

Check the "zero point" of the device to determine if zero calibration is required.

Close the pipe, verify that the medium is full and stationary, and check the flow rate according to instructions in section 6.1:

- If the displayed value fluctuates more than ±20 mm/s, the possible causes are shown as follows:
  - (1) The tube contains air or air bubbles passing through the measuring tube.
  - (2) Dielectric conductivity less than 10 μS/cm.
  - (3) The device is not properly grounded (see Chapter 4).
  - (4) Improper cable routing (see section 5.2 and section 5.1.3).
  - (5) The medium corrodes the electrode material.
  - (6) Sensor malfunction (see Chapter 8, Notes 5 and 8).

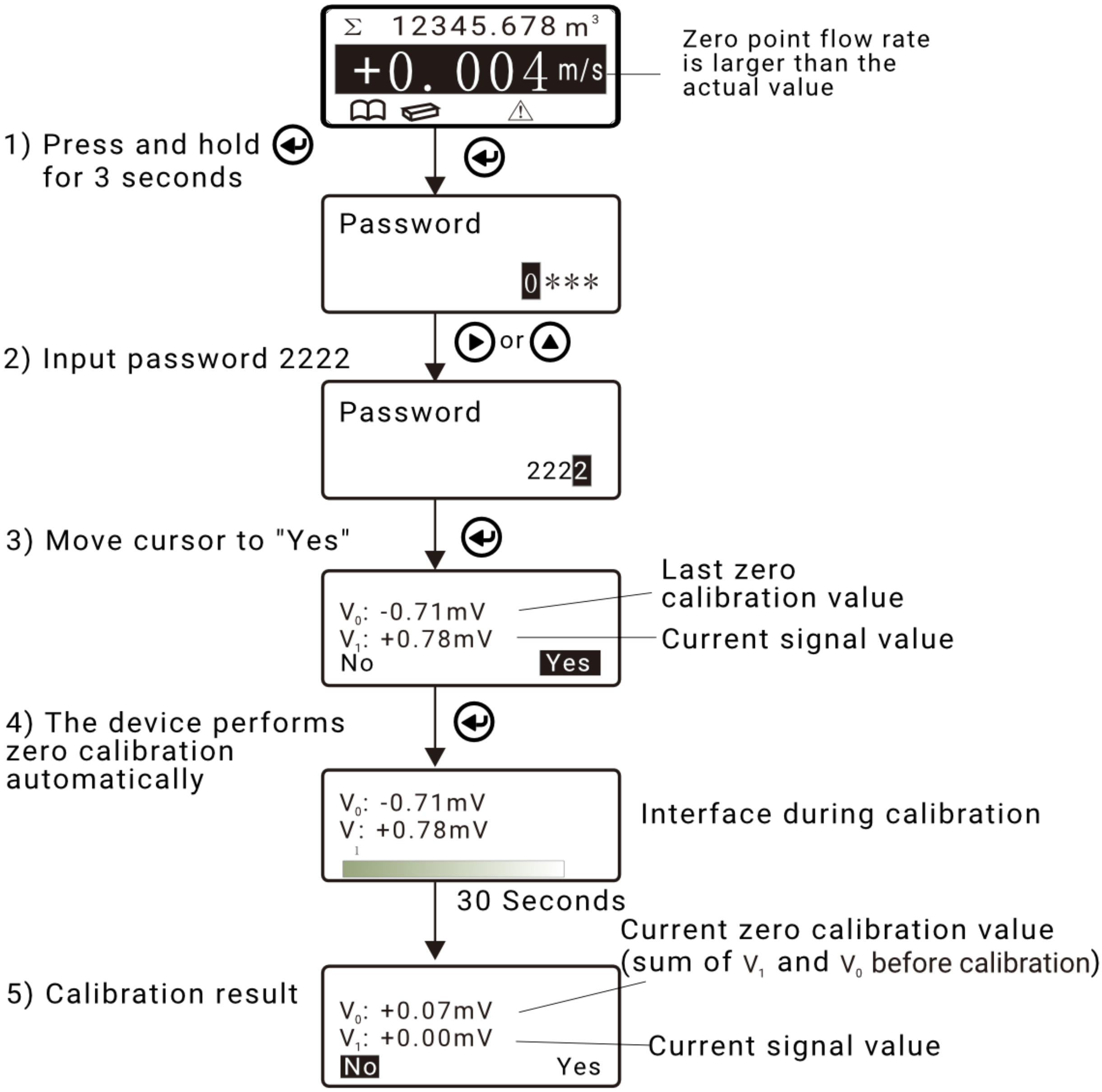
Please rule out the above reasons. If the causes are (2), (5) and (6), please contact us.

- Under the condition that the "zero point" value is stable, if the average zero point value displayed value is ≥ +2.5 mm/s or <-2.5 mm/s, check whether the following condition exist:
  - (1) The pipe has not been completely shut down or there is a leak.
  - (2) Insufficient conditions during last zero calibration.

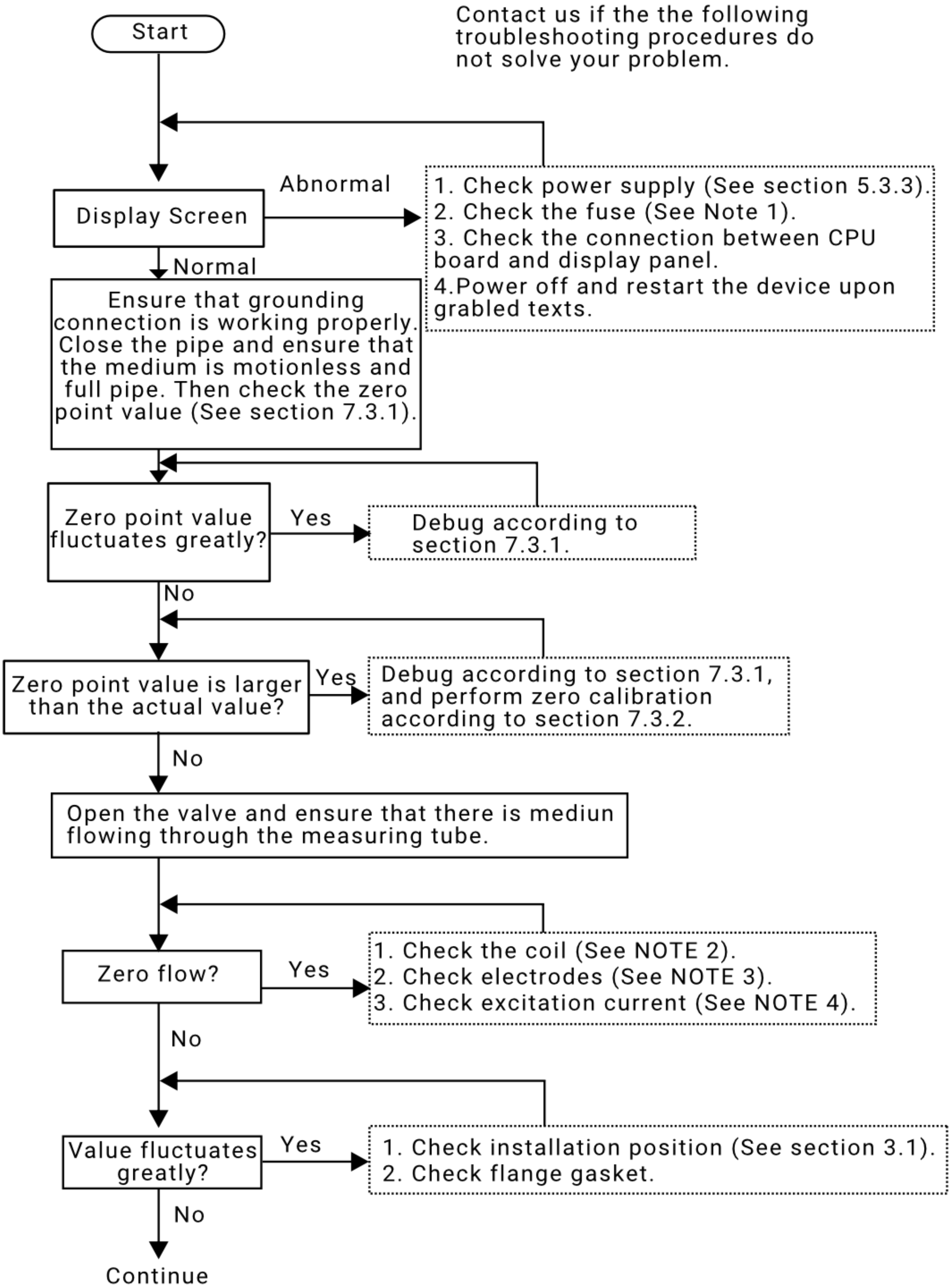
If the condition (1) does not apply, the device needs to be zeroed.

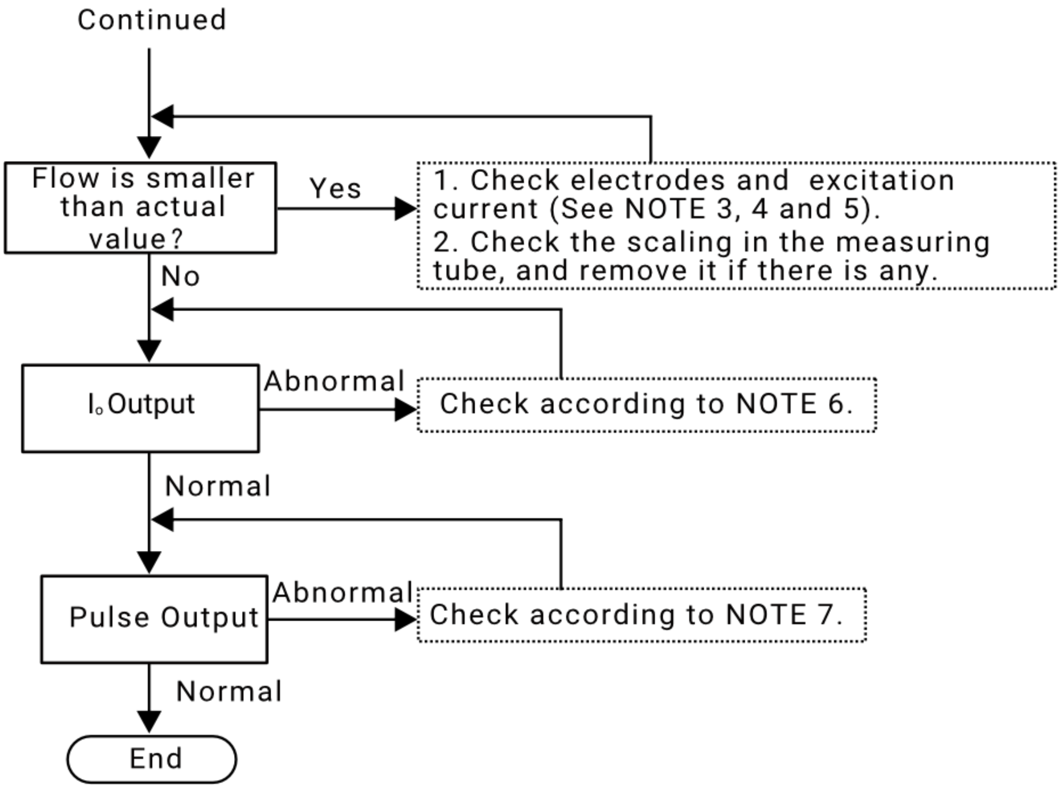
7.3.2 **Zero Calibration**

After confirming that the device needs to be zeroed (current zero point value is greater than +2.5 mm/s or less than -2.5 mm/s) and the zero calibration conditions are met (medium is full and the indication fluctuates less than ±20 mm/s), follow the following steps to perform zero calibration:


Σ 12345.678 m³
+0.004 m/s
Zero point flow rate is larger than the actual value
1) Press and hold for 3 seconds
Password
0***
2) Input password 2222
or
Password
2222
3) Move cursor to "Yes"
V0: -0.71mV
V1: +0.78mV
No
Yes
Last zero calibration value
Current signal value
4) The device performs zero calibration automatically
V0: -0.71mV
V1: +0.78mV
Interface during calibration
30 Seconds
Current zero calibration value (sum of V1 and V0 before calibration)
5) Calibration result
V0: +0.07mV
V1: +0.00mV
No
Yes
Current signal value

8. Troubleshooting





Note

- NOTE 1: Switch off the voltage, open the transmitter cover, remove the fuse, check the fuse, and replace if blown.
- NOTE 2: After the device is powered off, measure the resistance between the sensors X and Y. Resistance value of 10 ~ 100 Ω is normal.
- NOTE 3: After the device is powered off, measure the resistance between terminals A, B and C. Short circuit should not occur.
- Note 4: When the device is powered on, use the DC current range of a multimeter to measure the X, Y. Positive and negative jumps of the value indicates that the transmitter is working properly.
- Note 5: Drain the medium or remove the device to keep the inside wall of the measuring tube dry. Unplug the transmitter signal terminal and measure the insulation resistance between terminals A, B and C with a megohmmeter. The insulation resistance should be greater than 100 MΩ, otherwise measurement results will be smaller than the actual value.
- Note 6: Unplug the transmitter terminals, measure the current value I_0 between terminal block I+, I- directly with a milliammeter. I_0 should be equal to the mA value displayed on the device (see Table 6-2). Switch on the circuit, and measure

I_0. If I_0 = 0 mA, the external circuit is open; if I_0 is small, there may exist poor external circuit contact or excessive loop load (R_L should be less than 500Ω).

- Note 7: The pulse output signal f_0 should be equal to the frequency value displayed by the device (see Table 6-2). If f_0 = 0, check if the external wiring method is correct (see section 5.3.2 and note 4 to Table 7-2).
- Note 8: Remove the excitation and signal terminals of the transmitter and measure the insulation resistance of the terminals X, Y and C with a megohmmeter. The measurement results should be greater than 100 MΩ, or the measurement results may be larger than the actual value and fluctuating results may occur.

Appendix A. Corrosion Resistance of Electrode Material

Material	Symbol	Corrosion resistance	
		Features and uses	Prohibited
Stainless steel	316L	Water, sewage, neutral and alkaline solutions, weak acids such as acetic acid and carbonic acid.	Electroplating wastewater, strong acid, chlorine-containing solution
Hastelloin C.	Hc	Phosphoric acid, nitric acid, seawater, caustic alkali and various common chemical medium	Electroplating wastewater, hydrochloric acid, hydrofluoric acid, aqua regia and sulfuric acid containing oxidizing impurities
Hastelloin B.	Hb	Non-oxidative acids, alkali and salt such as hydrofluoric acid, organic sulfur, sulfuric acid, phosphoric acid	Electroplating wastewater, nitric acid and aqua regia
Tantalum	Ta	Hydrochloric acid, aqua regia, sulfuric acid	Not resistant to hydrofluoric acid, fluorinated salt, alkali solution, fluorinated solution
Titanium	Ti	Sea water, various chlorides, alkalis, etc.	Electroplating wastewater, hydrochloric acid, sulfuric acid, phosphoric acid, hydrofluoric acid and aqua regia
Platinum Iridium alloy	Pt	Electroplating wastewater, hydrochloric acid, sulfuric acid	Aqua regia, Halogen

Tungsten Carbide	W.	Abrasive medium such as slurry, pulp, etc.	Electroplating wastewater, strong acid, chlorine-containing solution

Caution

Most medium are not single component solutions and contain small amounts of impurities that can be fatal to some electrode materials. For example, tantalum has good corrosion resistance performance in a pure phosphate solution. However, when phosphoric acid contains more than 4 ppm of fluorine, tantalum will be corroded rapidly. Unless you are experienced in this area, it is best to consult us when selecting electrode materials.

Appendix B. Lining Material Performance

Material	Designation	Scope of application	Operating temperature
Teflon	PTFE	Suitable for the majority of strong acids, strong alkalis and other chemical fluids and high temperature fluids, food and beverage, etc.	-40 ~ +120°C.
Polyurethane	PU	Excellent wear resistance. Suitable for water, cement slurry, mineral slurry, etc. Do not use on acidic medium.	-30 ~ +80°C.
Neoprene	Ne	Water, sewage, low concentrations of non-oxidizing acids, alkalis, Salt. It is prohibited for use in various oxidative acids.	-30 ~ +70°C.
Polyperfluoroethylene	FEP	Wear resistance is far better than PTFE; good adhesion resistance; corrosion resistance is comparable to PTFE.	-40 ~ +140°C.
Meltable polytetrafluoroethylene	PFA	Corrosion resistance is the same as PTFE; adhesion resistance; the rest of application is the same as FEP.	-40 ~ +180°C.

Note

Operating temperature: Varies depending on the size of the aperture, see Appendix E for details.

Appendix C. Default Parameters

Specification DN	Flow range m^3/h.	Default Upper Range Value m^3/h.	Pulse Factor L/P.
10	0.16 to 1.6	1.6	0.0002
15	0.36 to 3.6	3.6	0.0002
20	0.64 to 6.4	6.4	0.001
25	1 to 10	10	0.001
32	1.64 to 16.4	16.4	0.002
40	2.56~25.6	25.6	0.002
50	3.99~39.9	39.9	0.005
65	6.75~67.5	67.5	0.01
80	10.22~102.2	102.2	0.01
100	15.97 to 159.7	159.7	0.02
125	24.96~249.6	249.6	0.02
150	35.94 ~ 359.4	359.4	0.02
200	63.9~639	639	0.05
250	99.84~998.4	998.4	0.1
300	143.77 ~ 1437.7	1437.7	0.1
350	150~1500	1500	0.1
400	250 ~ 2500	2500	0.2
450	300 ~ 3000	3000	0.2
500	350 ~ 3500	3500	0.2
600	400 ~ 4000	4000	0.3
700	500 ~ 5000	5000	0.5
800	700~7000	7000	1

900	800~8000	8000	1
1000	1000 ~ 10000	10000	1
1200	1600~16000	16000	1

Note

Other default parameter / default value: (1) Language: Simplified Chinese; (2) Low cutoff (%): "0.2"; (3) Damping: "2s"; (4) Empty detect: OFF upon low conductivity medium without field calibration, other 40; (5) Pulse width: "100ms"; (6) PIO function: passive pulse output; (7) Pulse type: "normally open"; (8) Communication parameters: "RTU, 9600, N, 8, 1"; Modbus address: "1".

Appendix D. Terminology

Device

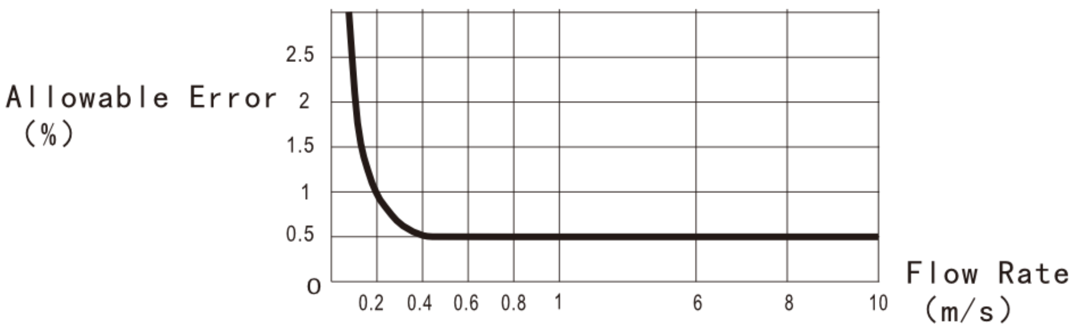
General term for electromagnetic flowmeters and their components (sensors, transmitters) in this manual.

Medium

Refers to the liquid or slurry in the target pipe.

Accuracy

The relative indication error between the measured result and the measured truth value. The allowable error of a flowmeter with an accuracy of 0.5 at different flow rates is shown in the following figure:



Measuring range

The range between the minimum and maximum flow required to achieve the specified accuracy.

Specification

Refers to the diameter of the measuring tube, usually expressed in nominal diameter (DN); in mm.

Sen Factor

The reciprocal of the device coefficient, obtained by the real-current calibration.

Pressure rating

The maximum pressure that the measuring tube can withstand at a medium temperature of 20 °C, displayed in nominal pressure PN.

IP ratings

Degree of protection of device housing from ingress of solid foreign objects or water. IP65: dust and water protection; IP67: water immersion protection, i.e. the device can be immersed in water for a short period of time; IP68: continuous water. The device can be used in water up to a depth of 5 meters for a long time.

Protective grounding

The electrical metal housing is reliably connected to the ground by a conductor, protecting the safety of the operator.

URV (Upper range value)

The flow value for 20 mA. Configured at the factory according to the order information. If this value is not specified when ordering, the device is set automatically by default (see Appendix C).

Active output

The output signal is supplied by the device itself.

Passive output

The output signal of the device is powered by an external DC power supply.

Pulse Factor

The flow represented by one pulse. The lower the pulse factor setting, the higher the output frequency. The relationship between pulse factor P and output frequency f is as follows:

$$f = \frac{F}{P \times 3.6}$$

F: measured flow (unit: m^3/h)
P: pulse factor (unit: L/P)

The device's frequency output is limited to 5 kHz. When the f value for F is greater than 5 kHz (the icon ⚠ will appear on the display to remind you to modify the pulse factor value), the output signal frequency is cut off at 5 kHz, which may cause serious errors to the system. The default pulse factor of the device is shown in Appendix C.

Low cutoff

Set a "Low cut off" value for the device, which displays or outputs a value of "0" when the measurement is less than this value. The low cutoff value for this device is expressed as a percentage of the upper range value. For example: When the low cutoff value is set to 1, which means that when the measured flow is ⩽ 1% FS, the instantaneous flow and percentage flow display is displayed as "0" and the output current signal is 4 mA.

Empty detection

The device automatically detects whether the medium in the measuring tube is of full pipe. When empty or unfilled, the device issues a warning message and treats the current flow as “0”. The empty detect function is set to On by default, and the threshold is 40% by default. The empty detect feature is OFF by default when measuring low conductive medium without field calibration.

Appendix E. Flanged Sensor Lining, Length and Heat Resistance

<table>
<tr><th rowspan="2">DN
mm</th><th rowspan="2">Nominal pressure
MPa</th><th colspan="5">Lining material</th><th colspan="3">Overall dimensions mm</th><th colspan="3">Connection size mm</th><th rowspan="2">Weight
Kg</th></tr>
<tr><th>Ne</th><th>FEP</th><th>PTFE</th><th>PU</th><th>PFA</th><th>L.</th><th>D.</th><th>H.</th><th>K.</th><th>N.
Number of holes</th><th>Φ
Diameter</th></tr>
<tr><td>10</td><td rowspan="8">4.0</td><td>×</td><td>O</td><td>×</td><td>×</td><td>O</td><td rowspan="6">150</td><td>90</td><td>84</td><td>60</td><td rowspan="4">4</td><td rowspan="4">14</td><td rowspan="2">3.5</td></tr>
<tr><td>15</td><td>×</td><td>O</td><td>×</td><td>×</td><td>O</td><td>95</td><td>84</td><td>65</td></tr>
<tr><td>20</td><td>×</td><td>O</td><td>O</td><td>×</td><td>O</td><td>105</td><td>84</td><td>75</td><td rowspan="2">4.5</td></tr>
<tr><td>25</td><td>×</td><td>O</td><td>O</td><td>O</td><td>O</td><td>115</td><td>90</td><td>85</td></tr>
<tr><td>32</td><td>×</td><td>O</td><td>O</td><td>O</td><td>O</td><td>140</td><td>93</td><td>100</td><td rowspan="3">4</td><td rowspan="3">18</td><td>6.5</td></tr>
<tr><td>40</td><td>×</td><td>O</td><td>O</td><td>O</td><td>O</td><td>150</td><td>93</td><td>110</td><td>7.0</td></tr>
<tr><td>50</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td rowspan="3">200</td><td>165</td><td>100</td><td>125</td><td>9.5</td></tr>
<tr><td>65</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>185</td><td>113</td><td>145</td><td rowspan="4">8</td><td rowspan="4">18</td><td>12</td></tr>
<tr><td>80</td><td rowspan="4">1.6</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>200</td><td>113</td><td>160</td><td>15</td></tr>
<tr><td>100</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td rowspan="2">250</td><td>220</td><td>126</td><td>180</td><td>17</td></tr>
<tr><td>125</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>250</td><td>138</td><td>210</td><td>21</td></tr>
<tr><td>150</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>300</td><td>285</td><td>151</td><td>240</td><td rowspan="2">8</td><td rowspan="2">22</td><td>28</td></tr>
<tr><td>200</td><td rowspan="8">1.0</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>350</td><td>340</td><td>190</td><td>295</td><td>36</td></tr>
<tr><td>250</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>400</td><td>395</td><td>222</td><td>350</td><td rowspan="2">12</td><td rowspan="2">22</td><td>49</td></tr>
<tr><td>300</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td rowspan="2">450</td><td>445</td><td>248</td><td>400</td><td>61</td></tr>
<tr><td>350</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>505</td><td>264</td><td>460</td><td>16</td><td>22</td><td>79</td></tr>
<tr><td>400</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>500</td><td>565</td><td>299</td><td>515</td><td>16</td><td>26</td><td>99</td></tr>
<tr><td>450</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td rowspan="2">600</td><td>615</td><td>325</td><td>565</td><td rowspan="2">20</td><td rowspan="2">26</td><td>121</td></tr>
<tr><td>500</td><td>O</td><td>×</td><td>O</td><td>O</td><td>×</td><td>670</td><td>360</td><td>620</td><td>143</td></tr>
</table>

600		O	×	O	×	×		780	412	725	20	30	187
700		O	×	O	×	×	700	895	445	840	24	30	260
800		O	×	O	×	×	800	1015	492	950	24	33	342
900		O	×	O	×	×	900	1115	555	1050	28	33	420
1000		O	×	O	×	×	1000	1230	605	1160	28	36	503
1200	0.6	O	×	×	×	×	1200	1405	705	1340	32	33	666

Note

If there is need for operation under high pressure and other scenarios, please contact us.

Appendix F. Modbus Parameter

Number	Type	Register length	Description	Register address		Read-write (R/W)	Option
				Hexadecimal	Decimal		
1	Int	0x0001	Flow direction	0x0017	23	R/W.	0x00: Forward 0x02: Bidirectional
2	Int	0x0001	Totalizer unit	0x003F	63	R/W.	0x2B:m^3 0x29:L. 0xE7: ML 0x2A: Igal 0x28: gal 0xE8: Mgal 0x2E:bbl 0x70:ft^3 0xE9:a-ft 0x3E:t. 0x3D: Kg 0x3C: g 0x3F:lb 0x40: Ston 0x41: Iton
3	Int	0x0001	Instantaneous flow unit	0x0046	70	R/W.	
4	Int	0x0001	Time unit	0x0043	67	R/W.	0x00:sec 0x01:min. 0x02:hour 0x03:day
5	Long	0x0002	Sensor	0x0127	295	R/W.	0~999999

			number				9
6	Long	0x0002	Forward accumulated flow high	0x0309	777	R.	Factor 10^7 Note
7	Long	0x0002	Forward cumulative flow low	0x030B	779	R.	0~9999999
8	Long	0x0002	Reverse Accumulated flow high	0x030D	781	R.	Factor 10^7 Note
9	Long	0x0002	Reverse cumulative flow low	0x030F	783	R.	0~9999999
10	Float	0x0002	Damping	0x0189	393	R/W.	0~9.9
11	Float	0x0002	Low Cutoff (%FS)	0x0197	407	R/W.	0~9.9
12	Float	0x0002	Output current	0x0149	329	R.	4~20
13	Float	0x0002	Upper range value	0x014B	331	R/W.	0.0001 to 999999
14	Float	0x0002	Instantaneous flow	0x0253	595	R.	0~999999

Note: Accumulated flow = high × 10^7+ low

Caution

The Modbus address is decimal in the parameter setting interface and hexadecimal when actually sent.

Note

Take Modbus communication and instantaneous flow value as an example:

Set the Modbus address to 1, check the communication parameters address table, and the register address for the instantaneous flow value is 0253; the register length is 0002; and data type is float.

The sending format is as follows:

Format Meaning	RTU (HEX)
Modbus address	01
Function code	03
(Register Address-1) (High)	02
(Register Address-1) (Low)	52
Register Length (High)	00
Register Length (Low)	02
Check code	64 62
/	/

The receiving format is as follows:

Format Meaning	RTU (HEX)
Modbus address	01
Function code	03
Data length	04
Data (High)	C1
Data	48
Data	00
Data (Low)	00
Check code	47 D9

The instantaneous flow received is four-byte single precision: C1 48 00 00, converted to fixed-point number in IEEE754 format: -12.5.

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