Electromagnetic BTU Meter

Supmea

Headquarters

5th floor, Building 4, Singapore Hangzhou Science Technology Park, No. 6 street, Hangzhou Economic Development Area, Hangzhou 310018, China

Singapore

2 Venture Drive #11-30 Vision Exchange Singapore

info@ supmea. com

www.supmea.com

Supmea Automation Co.,Ltd.

Preface

- Thank you for purchasing our product.
- This manual is about the various functions of the product, wiring methods, setting methods, operating methods, troubleshooting methods, etc.
- Please read this manual carefully before operation. Use this product correctly to avoid unnecessary losses due to incorrect operation.
- After you finish reading, please keep it in an accessible place for easy reference during operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate. If you find something wrong or incorrect, please contact us.
- The content of this manual is strictly prohibited from being reprinted or copied.

Version

U-LDGR/LDGCR-SUP-L/FL-EN1

Safety Precautions

For the safe operation of this product, please strictly follow the outlined safety precautions.

About this manual

- Please ensure the instrument operators have a careful reading of this manual.
- Prior to operation, please study this manual in detail to ensure a thorough comprehension of the device's functionality.
- This manual only describes the product's functions. The responsibility for the device 's suitability for any specific purpose lies solely with the operator.

Precautions for product protection, safety, and modification

- For your safety and the normal operation of the product and its controlling systems, the guidelines and precautions specified in this manual are supposed to be fully observed. Operating the instrument in ways not specified in this manual may compromise its protective features. Our company shall not be liable for any malfunctions or accidents resulting from non-compliance with the precautions described.
- When equipping the product and its controlling systems with lightning protection or separate safety protection circuits, it needs to be implemented by other devices.
- If you need to replace components or fittings of the product, please use the model specified by the company.
- This product is not designed for use in systems directly related to personal safety, such as nuclear power facilities, radioactive equipment, railway systems, aviation equipment, marine equipment, and medical equipment. If applied, it is the user's responsibility to implement additional equipment or systems to ensure personal safety.
- Do not modify this product.
- The following safety symbols are used in this manual:

Hazard: Failure to take appropriate precautions may result in serious personal injury, product damage, or major property loss.

Warning: Pay special attention to critical information related to the product or specific sections of this user manual.

- Confirm whether the supply voltage is consistent with the rated voltage before operation.
- Do not use the instrument in a flammable and combustible or steam area.
- To prevent electric shock and operation errors, ensure proper grounding protection is in place.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at the correct electric level, shielded, with wires properly routed, and an SPD surge protector applied as needed.
- Some internal components may carry high voltage. To avoid the risk of electric shock, do not open the front square panel unless it is being handled by trained personnel or maintenance staff authorized by our company.
- To avoid electric shock, disconnect the power before performing any checks.
- Check the condition of the terminal screws regularly. If loose, please tighten them before use.
- Unauthorized disassembly, modification, or repair of the product is not allowed, as it may lead to malfunctions, electric shock, or fire hazards.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine, or other organic solvents, and avoid exposing the product to any liquids. If the product falls into the water, please cut off the power immediately to prevent leakage, electric shock, or fire hazards.

- Please check the grounding protection regularly. Do not operate the product if you think that the protection, such as grounding protection and fuses, is inadequate.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life, and fire.
- Please strictly follow the instructions in this manual; failure to do so may damage the product's protective devices.

- Do not use the instrument if it is found damaged or deformed upon opening the package.
- Prevent dust, wire ends, iron fines, or other objects from entering the instrument during installation, as this may cause abnormal operation or failure.
- During operation, to modify the configuration, signal output, startup, stop, and operation safety shall be fully considered. Improper operation may lead to failure and even destruction of the instrument and control equipment.
- Each part of the instrument has a certain service life, which must be maintained and repaired regularly for long-term use.
- If the product comes to the end of its service life, it should be disposed of as industrial waste as a way of environmental protection.
- Disconnect the instrument when it is not in use.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for terms beyond the scope of this product warranty.
- This company is not responsible for damage to the instrument, loss of parts, or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Items	Quantity
1	Electromagnetic flowmeter	1
2	User manual	1
3	Certificate	1
4	Test report	1

After opening the box, please confirm the scope of delivery before starting the operation. If you find that the model and quantity are incorrect or there is physical damage to the product's appearance, please contact us.

Contents

1 Introduction 1
1.1 Working Principle 1
1.2 Measuring Principle 1
1.3 Structure 3
1.4 Operating Environment 4
2 Installation 5
2.1 Installation Tips 5
2.2 Storage 5
2.3 Installation Requirements 5
2.4 Pipe Design 5
2.5 Installation Conditions 7
2.6 Installation Requirements 11
2.7 Mechanical Installation 13
2.8 Sensor's Size of Inline Type Electromagnetic Flowmeter 15
2.9 Converter's Size 17
3 Electrical Connection 18
3.1 Safety Tips 18
3.2 Signal Cable Connection 18
3.3 Wiring Terminals 19
3.4 Output and Power Supply Cable 21
3.5 Grounding Requirements of Converter Installation 22
3.6 Digital Output and Calculation 23
3.7 Analog Output and Calculation 26
4 Startup 28
4.1 Power on 28
4.2 Converter Start-up 28
5 Operation (Remote Type) 29
5.1 Keys and Display 29
5.2 Keys Function 29
5.3 Setting Function and Compound Keys' Operation 30

5.4 Function Selection Screen 31
5.5 Parameter Setting Menu 34
5.6 Detailed Description of Parameters 40
6 Operation (Integrated Type) 51
6.1 Display and Keys 51
6.2 Key Functions 51
7 Insertion Electromagnetic Flowmeter Series 53
7.1 Structure and Format 53
7.2 Technical Performance 53
7.3 Structure 54
7.4 Installation and Operation 56
8 Maintenance and Regular Inspection 59
8.1 PCB Protection and Alarms 59
8.2 Troubleshooting 59
9 Technical Parameters 61
9.1 Technical Parameters 61
9.2 Electrode Material 65
9.3 Flow Rate& Flow Velocity Reference Table 66
9.4 Accuracy 67
10 Communication 68
10.1 ModBus communication 68
10.2 Modbus Communication Example 69
Appendix 1 Notes on the Nonlinearity Correction Function 70
Appendix 2 Heat Measurement and Wiring 72

1 Introduction

1.1 Working Principle

The operating principle of the electromagnetic BTU meter is in the following: Hot (or cold) water supplied by a heat source flows through the heat exchange system (radiators, heat exchangers, or integrated assemblies of such components). During this circulation, the water enters at a higher (or lower) temperature and flows out at a lower (or higher) temperature. Thus, thermal energy is either released to or absorbed from the user, covering both heating and Colding energy exchange scenarios.

As the water circulates through the energy exchange system, the amount of heat released or absorbed by the system is calculated and displayed by a calculator based on the data from the flow sensor (flow rate), the paired temperature sensors (supply and return water temperatures), and the measured flow duration.

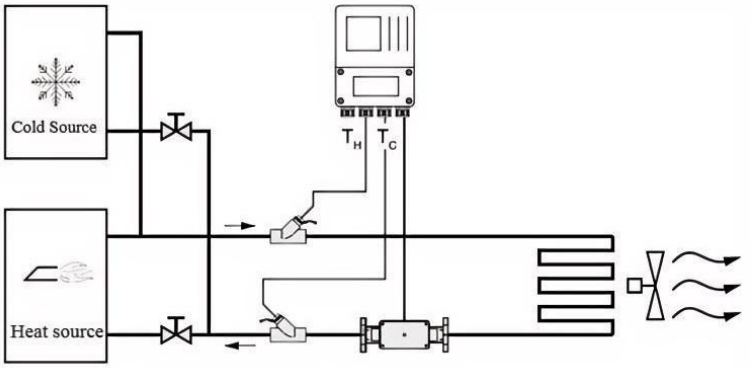


Fig.1

1.2 Measuring Principle

The operating principle of the electromagnetic flowmeter is based on Faraday's law of electromagnetic induction. The two electromagnetic coils at the upper and lower ends, as shown in Figure 1, generate a constant or alternating magnetic field. When the conductive medium flows through the electromagnetic flowmeter, the induced electromotive force can be detected between the left and right electrodes

on the wall of the flowmeter tube. The magnitude of the induced electromotive force is proportional to the electrically conductive medium flow rate, the magnetic induction density of the magnetic field, and the width of the conductor (the inner diameter of the flowmeter measuring tube), and the flow rate of the medium can be obtained by calculation. The induced electromotive force equation is as follows:

$$E=K\times B\times V\times D$$

Where: E—Induced electromotive force

K—Meter constant

B—Magnetic induction density

V—Average flow speed in the cross-section of the measuring tube

D—Inner diameter of measuring tube

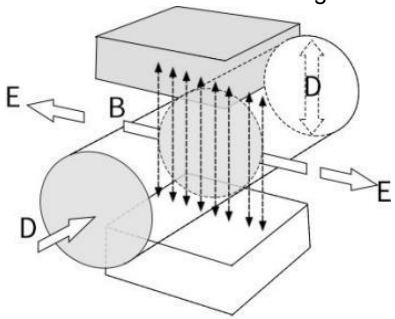


Fig.2

When measuring the flow, the fluid flows through a magnetic field that is perpendicular to the flow direction. The flow of conductive fluid induces a potential proportional to the average flow velocity, thus requiring the conductivity of the measured flowing liquid to be higher than the minimum conductivity. The induced voltage signal is detected by two electrodes and transmitted to the converter via a cable. After a series of analog and digital signal processing, the accumulated flow and real-time flow are displayed on the display of the converter.

1.3 Structure

The electromagnetic flowmeters mainly consist of two parts: the sensor and converter.

The sensor includes a flange, a lining, an electrode, a measuring tube, an excitation coil, and a sensor casing, etc; the converter includes an internal circuit board and a converter casing, see Fig.2.

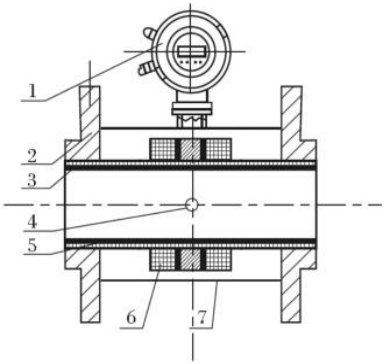


Fig.3

1-Converter; 2-Flange; 3-Insulating liner; 4-Electrode;
5-Measuring tube; 6-Excitation coils; 7-Housing

The electromagnetic flowmeter mainly consists of a sensor and a converter. The sensor includes a flange, a lining, an electrode, a measuring tube, an excitation coil, and a sensor casing etc; the converter includes an internal circuit board and a converter casing.

(1) Converter: Provide stable excitation current for the sensor, meanwhile amplify the induced electromotive force obtained by the sensor and convert it to standard electrical signals or frequency signals; at the same time, it displays real-time flow and parameters for displaying, controlling, and adjusting thereof.

(2) Flange: for connecting process piping.

(3) Lining: Refer to a complete layer of electrically insulating corrosion-resistant material located at the inner side of the measuring tube and flange sealing surface.

(4) Electrode: A pair of electrodes is installed on the wall of the measuring tube,

which is perpendicular to the magnetic line, to detect the flow signal. The material of the electrode can be selected according to the corrosion performance of the measured medium. It is also equipped with 1-2 grounding electrodes for grounding and anti-interference of flow signal measurement.

(5) Measuring tube: The measured medium flows through the measuring tube. It is made by welding non-magnetic stainless steel and a flange, and the inner side is equipped with insulation lining.

(6) Excitation coil: A group of coils is arranged on the upper and lower sides of the external side of the measuring tube, respectively, to generate a working magnetic field.

(7) Casing: Protect and seal the meter.

1.4 Operating Environment

Electromagnetic flowmeters are only suitable for measuring the instantaneous flow of conductive liquids or liquid-solid two-phase fluids and are equipped with flow accumulation functions. Typically, the flowmeter's factory parameters are preset according to the order specifications. Users do not need to configure the parameters before use, but they must check the nameplate to ensure that the parameters have been correctly preset and verify them against the actual operating conditions.

In theory, a standard electromagnetic flowmeter can be used when the conductivity of the medium is no less than 5 μS/cm. However, in practice, the measurable conductivity for standard electromagnetic flowmeters should be one to two orders of magnitude higher than the theoretical threshold, and should be at least greater than 30 μS/cm. Additionally, conductivity must be measured online to ensure accuracy. Offline measurements may result in artificially elevated conductivity values due to the dissolution of carbon dioxide and nitrogen oxides from the air into the medium.

2 Installation

2.1 Installation Tips

Note!

Please check whether the boxes are damaged or not, and whether they have been handled roughly or not. Please report the damage to the courier service and the manufacturer.

Note!

Please check the packing list to make sure the batch of goods that you have received is complete.

Note!

Please check the instrument nameplate and confirm whether the delivered contents are consistent with your order. Check whether the power supply indicated on the nameplate is correct. If not correct, please contact the manufacturer.

2.2 Storage

(1) The instrument shall be stored in a dry and clean place.

(2) Avoid exposure to direct sunlight for long periods.

(3) The instrument shall be stored in the original package.

2.3 Installation Requirements

The following measures are suggested to be taken to ensure reliable installation.

(1) Leave enough space on the side.

(2) Do not make the electromagnetic flowmeter subject to violent vibration.

2.4 Pipe Design

(1) Location

① The electromagnetic flowmeter should be installed in a dry, well-ventilated place that is not prone to water pooling.

② The flowmeter shall be protected from direct sunlight and rain. If installed outdoors, appropriate shielding or protective measures must be taken

against sun and rain exposure.

③ The flowmeter shall avoid installation in an environment containing corrosive gases. If it is unavoidable, ventilation and anti-corrosion measures shall be taken.

④ The flowmeter shall be installed to avoid as much vibration as possible, such as violent pipe vibration. In this case, brackets for fixing pipes on both sides of the flowmeter shall be provided.

⑤ Part of the sensor of flowmeters with IP68 (3m under water) protection level can be placed into the water. The flowmeter with an IP65 protection level cannot be immersed in water or installed outdoors.

(2) Avoid the interference of the magnetic field

Do not install flowmeters near motors, transformers, or other power sources that are prone to cause electromagnetic interference, near the frequency converter, or obtain power from the power distribution cabinet of the frequency converter to avoid interference.

(3) Length of inlet and outlet runs

In order to ensure the measurement accuracy of the flowmeter, it is recommended to ensure that the length of inlet runs of the sensor shall be at least 10 times of pipe diameter (10D), and the length of outlet runs shall be at least 5 times of pipe diameter (5D).

(4) Maintenance space

For the convenience of installation and maintenance, enough installation space shall be reserved around the electromagnetic flowmeter.

(5) For pipes that do not allow flow disruption in the process

When installing the electromagnetic flowmeter, bypass pipes and cleaning ports shall be added. These devices can ensure the continuous operation of the equipment system when the flowmeter is out of service.

(6) Support of the electromagnetic flowmeter

Do not install the electromagnetic flowmeter on a free-vibrating pipe without any support. Instead, a mounting base shall be used to secure the measuring tube. When the electromagnetic flowmeter is required to be installed underground, the

pipes at both inlet and outlet ends shall be provided with support items, and a metal protection plate shall be installed above the flowmeter.

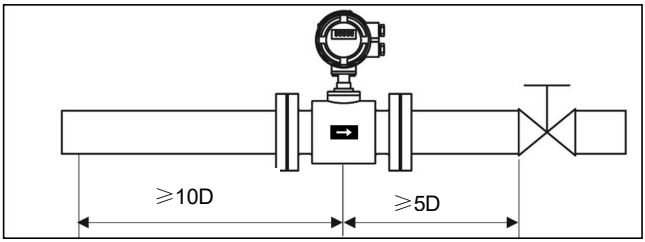


Fig.4

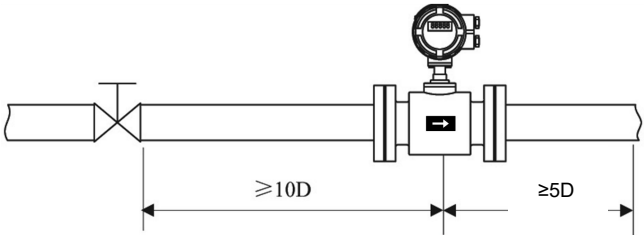


Fig.5

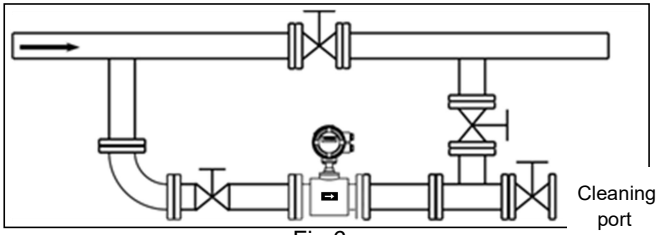


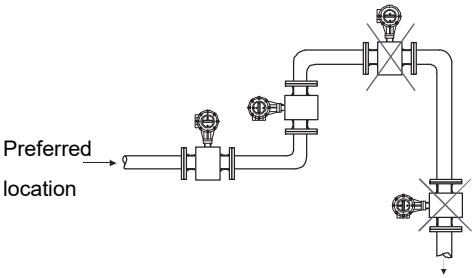
Fig.6

2.5 Installation Conditions

(1) Flow direction

The flowmeter can be set to automatically detect the positive and negative flow direction. The flow direction arrow on the sensor casing indicates the positive flow direction specified by the manufacturer. Generally, when installing the meter, the user shall make the flow arrow consistent with the on-site process flow.

Fig.7 shows the preferred location for installing the electromagnetic flowmeter.



The pipe is routed to the highest point (Bubble accumulation in the measuring tube is likely to cause measurement errors!)

Make sure the pipeline is always full.

Fig.7

(2) Installation direction of the flowmeter and sensor electrodes

The sensor allows horizontal and vertical installation. When it's installed horizontally, the electrode shall be horizontally placed such that bubbles will not be adsorbed near the electrode in case the medium is contained with bubbles or precipitates. Otherwise, this would cause converter signals to open and zero drift due to the fact that deposits are not covered by the electrode.

(3) Liquids shall always be filled with pipes.

Pipes shall be arranged to ensure that the electromagnetic flowmeter measuring tube is always filled with liquid.

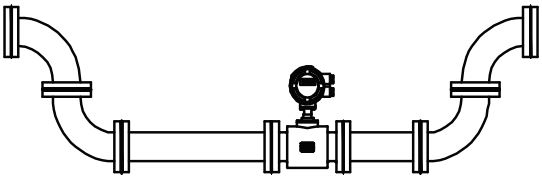


Fig.8

In case of liquids or suspensions containing solid particles, it is recommended to install electromagnetic flowmeters vertically. For one thing, the phase separation of the measured medium can be prevented; for another, the sensor lining is worn evenly. In addition, impurities will not precipitate at the bottom of the measuring tube.

It shall be guaranteed that liquids flow from bottom to top to ensure that the sensor measuring tube is always filled with medium.

(4) The electromagnetic flowmeter cannot be installed on the suction side of the pump**.**

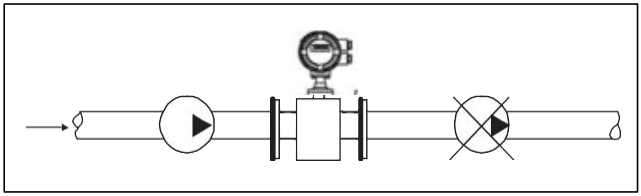


Fig.9

(5) For long pipelines, control valves are generally installed downstream of the electromagnetic flowmeter.

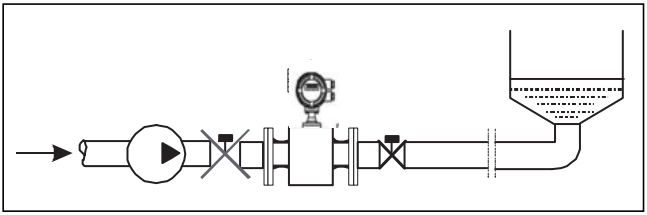


Fig.10

(6) For pipes with open discharges, the electromagnetic flowmeter shall be installed at the bottom section (lower part of the pipe).

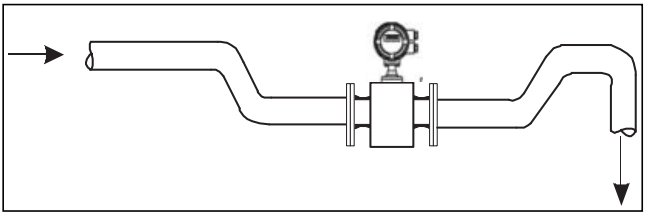


Fig.11

(7) For places where the fall head of pipes is over 5 m, the air valve shall be installed downstream of the electromagnetic flowmeter.

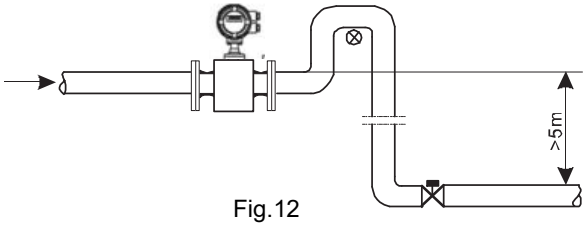


Fig.12

(8) Measurement errors caused by the ingress of foreign gas and damage to the lining caused by vacuum should be avoided.

(9) No bubbles shall be observed in the pipes.

Pipes shall be designed to prevent the air bubbles in the fluids from accumulating in the measurement pipe of a sensor. If a valve exists near the flowmeter, try to mount the flowmeter on the valve's upstream side to prevent a decrease in pressure inside the pipe, possibly consequently avoiding the possibility of air bubbles.

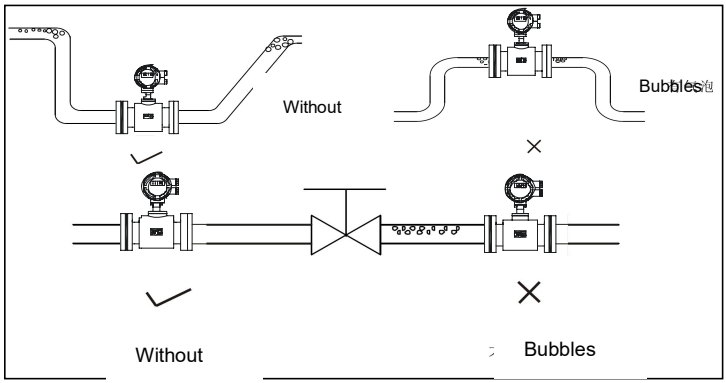


Fig.13

(10) Liquid conductivity

It's not allowed to install the electromagnetic flowmeter at a place where the liquid conductivity is extremely uneven. Injection of chemicals from the upstream of the meter can easily result in uneven liquid conductivity, which can cause serious interference to the meter flow indication. In this case, it is recommended to inject chemicals from the downstream of the meter; if chemicals must be injected from the upstream of the meter, it must be ensured that the straight pipe section on the upstream at least has 30 times of pipe diameter to ensure adequate mixing of liquids.

(11) Grounding

As the voltage of the induced signal of the electromagnetic flowmeter is small, it's more prone to being affected by noise or other electromagnetic signals. This is why the electromagnetic flowmeter needs to be grounded on many occasions. This

functions to form an internal space for shielding external interference through the grounding of the flowmeter casing, thereby improving measurement accuracy.

2.6 Installation Requirements

(1) The pipeline must be cleaned before installation of the electromagnetic BTU meter.

(2) The electromagnetic BTU meter is a precision instrument; please take great care when installing it. It is forbidden to lift the meter head or the sensor cable; Avoid squeezing the temperature sensor to protect the instrument from damage.

(3) The direction pointed by the arrow of the electromagnetic heat and cold meter sensor body indicates the direction of water flow, and theoretically, it is not allowed to be installed backwards.

(4) The front end of the BTU meter's cold pipe must be equipped with a filter of the corresponding caliber.

(5) When installing the flow sensor of the electromagnetic heat and cold meter, it should be ensured that there is at least a straight pipe section with 10 times the diameter upstream of the water flow direction of the electromagnetic heat and cold meter pipe, and at least a straight pipe section with 5 times the diameter downstream.

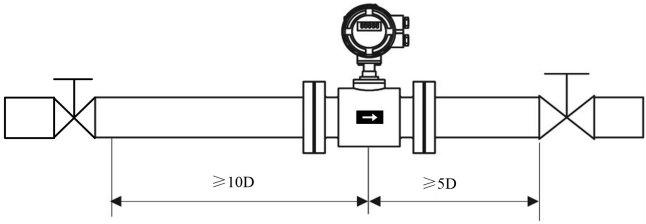


Fig.14

(6) Valves with corresponding diameters must be installed at both ends of the electromagnetic heat and cold meter, and they can be separated from the electromagnetic heat and cold meter for cleaning and maintenance of the electromagnetic heat and cold meter during use;

(7) An electromagnetic heat and Colding meter has a pair of temperature sensors

used at the water inlet and the water outlet, respectively. When installing, install the temperature sensor with a red label on the water inlet pipe, and install the temperature sensor with a blue label on the water outlet pipe. The temperature sensor probe should be inserted into the pipe at the center of the pipe section (there are three ways to insert the temperature sensor, as shown in the figure below: 1 represents the temperature sensor sheath, 2 represents the pipe opening, 3 represents the pipe section, and 4 represents the temperature sensor probe).

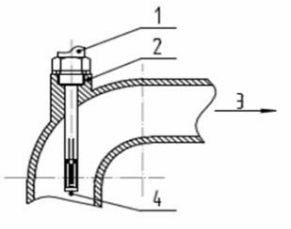


Fig.15 Insertion way in bent pipe

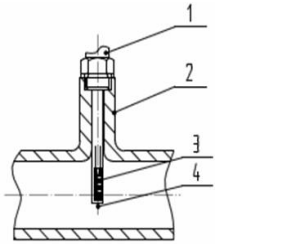


Fig.16 Insertion way in straight pipe

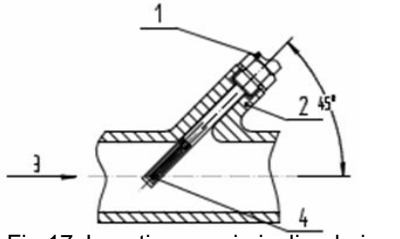


Fig.17 Insertion way in inclined pipe

(8) The standard wire length of the temperature sensor is 3 meters. In case of special circumstances during installation, it can be lengthened according to the actual requirement. When making the order, please report the situation to the manufacturer. The lead length of the temperature sensor should not be

increased or decreased arbitrarily.

(9) After the meter installation, seal all connections, especially where the temperature sensor is inserted into the pipe.

2.7 Mechanical Installation

2.7.1. Installation of the Flowmeter Pipeline

(1) Prior to installation, the pipeline shall be calibrated to ensure that the diameter of the meter has good coaxiality with the user's pipeline. For sensors with a nominal diameter of no more than 50mm, the protrusion of their axis shall not exceed 1.5 mm; for sensors with a nominal diameter of 65~300 mm, it shall not exceed 2mm, and for sensors with a nominal diameter of no less than 350 mm, it shall not exceed 4 mm.

(2) In general, foreign particles (such as welding slag) may exist in newly installed pipelines. Before the flowmeter is installed, wash away the debris. It not only prevents the lining from being damaged but also measurement error caused by foreign particles that pass through the measuring tube during measurement.

2.7.2. Precautions

Operating introduction:

(1) Avoid Damage upon Unpacking

Take care to avoid damage to the meter when you are unpacking. It is suggested not to unpack the box before transporting it to the installation site to avoid damage of the meter. It's prohibited to use a stick or rope to lead through the measuring tube of the sensor. Instead, follow the correct lifting as shown in the figure below.

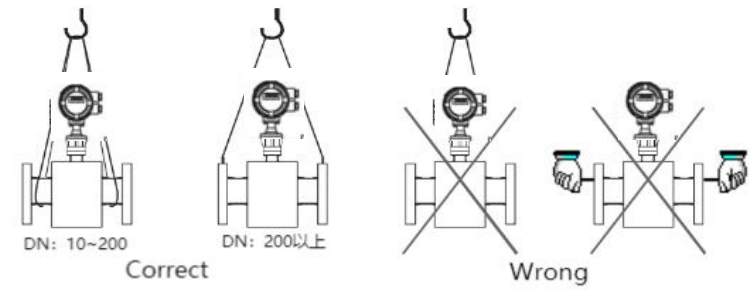


Fig.18

(2) Avoid vibration

Avoid heavy falling or pressing, especially on the flange surface, which cannot be stressed (otherwise, the lining may be damaged to disable the operation of the meter).

(3) Protection of the flange surface

After unpacking, pay attention to protect the flange. Do not place it on the unpadded floor or other uneven boards.

(4) Terminal box

It's not allowed to seal the terminal box cover before electrical wiring. After the wiring is completed, please apply the special sealant provided by our company to the terminal box as soon as possible. Then cover the terminal box and tighten the screws to ensure the tightness.

If the protection level of the electromagnetic flowmeter is IP68 at type selection, it has been subject to waterproof sealing.

(5) No operation for a long duration

After the instrument is installed, it shall be ensured that the meter is regularly checked. The following aspects should be the checking items:

A. Check the tightness of the covers and the wiring terminals to ensure that no moisture or water enters the meter.

B. Conduct regular inspections. Check against the measures mentioned above and the terminal box at least once a year. In the event of water entry into the meter (eg, after heavy rain, etc.), the meter shall be inspected immediately.Installation of flowmeter

2.7.3. Installation of Flowmeter

(1) Installation direction

The flow direction of the measured fluid shall be consistent with the flow direction mark indicated on the flowmeter.

(2) Seal gaskets installed between flanges shall have good corrosion resistance and shall not protrude into the interior of the pipe.

(3) When welding or flame cutting is performed adjacent to the sensor pipe, isolation measures shall be taken to prevent the lining from being deformed due to heat.

(4) If it is installed in a well or immersed in water, apply sealant on the terminal box of the sensor after the system is installed and debugged. (If the protection level of the electromagnetic flowmeter is IP68, it has been subject to waterproof sealing.)

(5) During on-site installation, the sensor flange should be connected to the pipeline flange using bolts. Ensure that all bolts and nuts are properly tightened. The threads must be intact, undamaged, and well-lubricated. Flat washers and spring washers should be used together. A torque wrench should be used to tighten the bolts according to the flange size and required torque. In routine operation, bolts should be regularly re-tightened to prevent loosening.

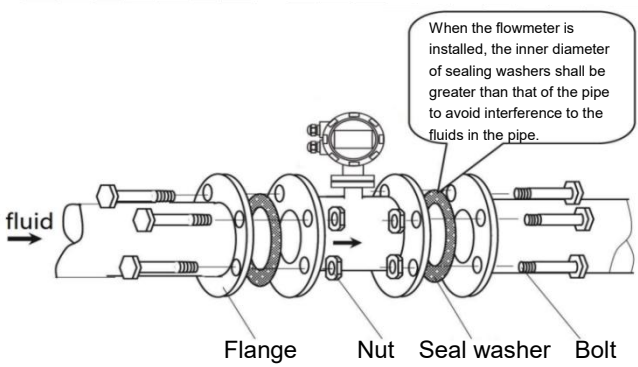


Fig.19

2.8 Sensor's Size of Inline Type Electromagnetic BTU Meter

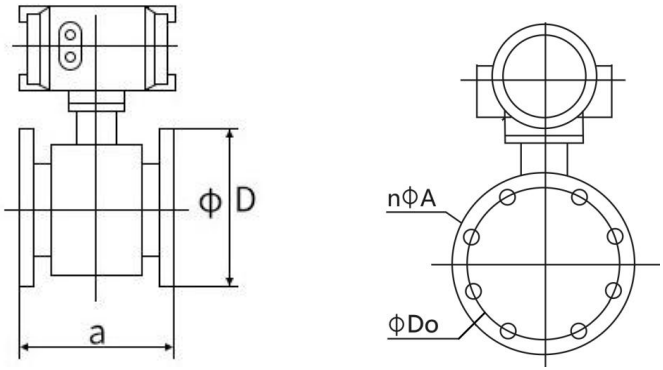


Fig.20

Table 1 Sensor size

Unit: mm

DN	a	D	Do	n * A	Pressure resistance
10	200	90	60	4*14	
15	200	95	65	4*14	
20	200	105	75	4*14	
25	200	115	85	4*14	
32	200	135	100	4*18	
40	200	145	110	4*18	
50	200	160	125	4*18	1.6MPa
65	200	180	145	4*18	
80	200	195	160	8*18	
100	250	215	180	8*18	
125	250	245	210	8*18	
150	300	280	240	8*23	
200	350	335	295	12*23	
250	450	405	355	12*25	
300	500	440	400	12*23	
350	550	500	460	16*23	
400	600	565	515	16*25	
450	600	615	565	20*25	
500	600	670	620	20*25	1.0MPa
600	600	780	725	20*30	
700	700	895	840	24*30	
800	800	1015	950	24*33	
900	900	1115	1050	28*33	
1000	1000	1230	1160	28*36	
1200	1200	1405	1340	32*33	
1400	1400	1630	1560	36*36	
1600	1600	1830	1760	40*36	0.6 Mpa
1800	1800	2045	1970	44*39	
2000	2000	2265	2180	48*42	

2.9 Converter's Size

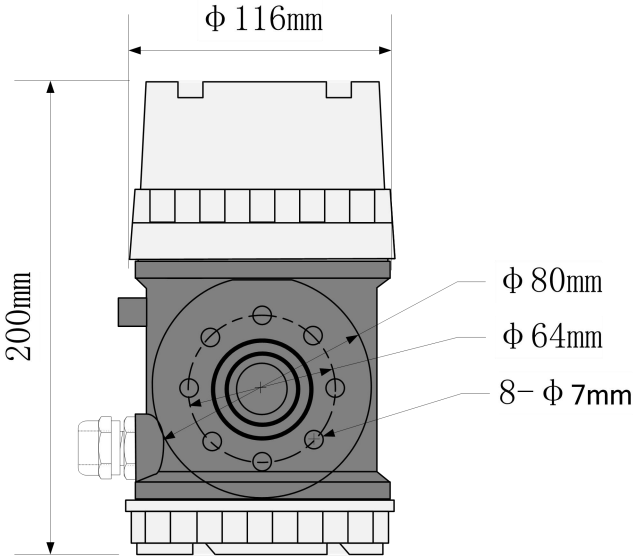


Fig.21 Integrated Type

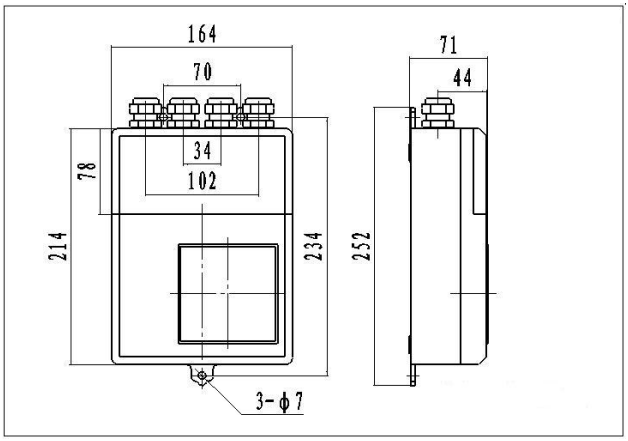


Fig.22 Remote Type

3 Electrical Connection

3.1 Safety Tips

Danger!

All electrical connection work must be carried out with the power supply disconnected. Please heed the nameplate for power supply specifications.

Danger!

Please observe national installation regulations.

Warning!

Please strictly observe local occupational health and safety regulations. Only properly trained personnel are allowed to work on electrical equipment.

Tips!

Please check the nameplate of the equipment, and confirm that the delivered product matches your order. Ensure that the power supply voltage on the nameplate is correct. If incorrect, contact the manufacturer or instrument supplier.

3.2 Signal Cable Connection

Danger!

Signal cables and excitation current cables may only be connected with the power supply disconnected.

Danger!

The instrument must be properly grounded to ensure operational safety.

Danger!

For instruments applied in hazardous explosive areas, refer to the specialized explosion-proof manual for safety instructions.

Warning!

Please strictly observe occupational health and safety regulations. Only personnel with proper training are permitted to work on electrical equipment.

3.3 Wiring Terminals

(1) Remote type

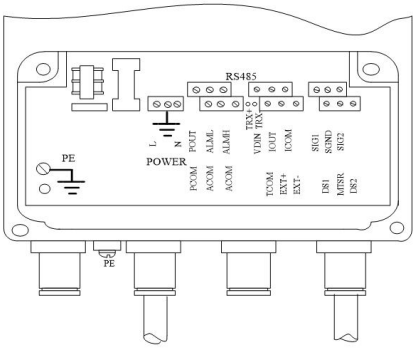


Fig.23

Table 2

TRA1	Inlet temperature input	TRA2	Inlet temperature input
TRA3	Inlet temperature input	TRB1	Outlet temperature input
TRB2	Outlet temperature input	TRB3	Outlet temperature input
TRA4	Reserve	TRB4	Reserve
SIG +	Signal 1	SGND	Signal
SIG-	Signal 2	DRS +	Excitation Shield 1
DRS-	Excitation Shield 2	MTDR	Reserve
EXT +	Excitation current +	EXT-	Excitation current (-)
POUT	Frequency output (-)	PCOM	Frequency output
IOUT	Current output (+)	ICOM	Current output
TRX-	Communication interface (RS485-B)	TRX +	Communication interface (RS485-A)
LN-	220V power input	LN +	220V power input
Switch A	RTD selection	DIOP	Reserve

Note: Switch A in Figure 23 is the Pt1000 thermal resistor and Pt100 thermal resistor selector switch. The factory default setting is Pt1000 RTD, with Switch 1 and Switch 2 set to OFF. If a Pt100 RTD is adopted, set both Switch 1 and Switch 2 to ON.

(2) Integrated version

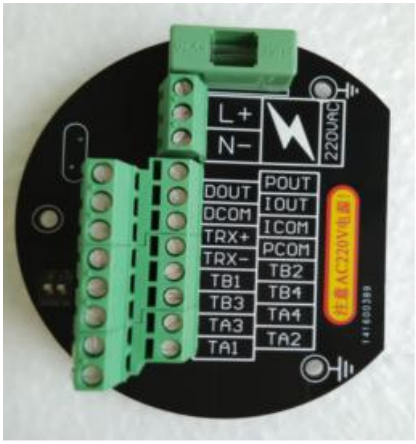


Fig.24

Definition of Switch K:

When set to ON, the RS485 communication terminal resistor is connected (standard resistor: 120Ω).

When set to OFF, the resistor is disconnected.

Note: The terminal resistor is used for long-distance communication and should be disconnected for short-distance communication.

The meanings of each wiring terminal are as follows:

Table 3

Symbol	Meaning
TA1	Inlet temperature input
TA2	Inlet temperature input
TA3	Inlet temperature input
TA4	Inlet temperature input
TB1	Outlet temperature input
TB2	Outlet temperature input
TB3	Outlet temperature input
TB4	Outlet temperature input

POUT	Frequency/pulse output
PCOM	Frequency/pulse output ground
ICOM	Current output ground
IOUT	Current output
DOUT	Reserve
DCOM	Reserve
TRX-	Communication input (RS485-B)
TRX +	Communication input (RS485-A)
N	220V power input
L	220V power input

Note: Switch A in Figure 24 is used to select between the Pt1000 and Pt100 RTD sensors. The factory default setting is Pt1000, with both Switch 1 and Switch 2 set to OFF. If a Pt100 RTD is used, set both Switch 1 and Switch 2 to ON.

3.4 Output and Power Supply Cable

All output and power cables should be prepared by the user according to actual wiring requirements. However, please ensure that the cables meet the load current specifications.

The external power supply and load connections for the current output, pulse output, and alarm output are shown in Figures 25 to 28. When using an inductive load, a freewheeling diode should be connected as illustrated.

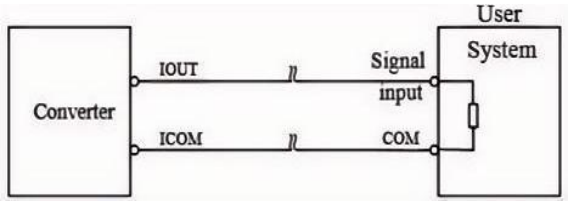


Fig.25 Wiring diagram

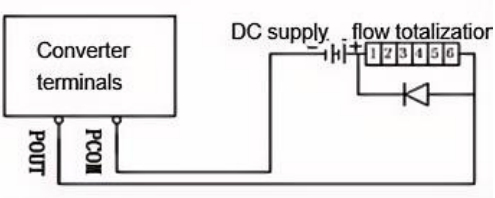


Fig.26 Wiring diagram of external power supply connected to electronic counter

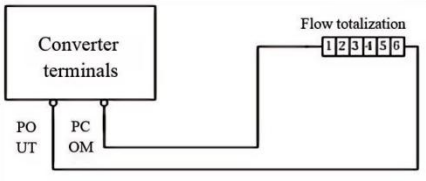


Fig.27 Wiring diagram of internal power supply connected to electronic counter

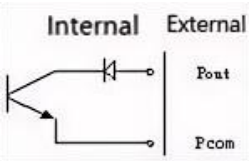


Fig.28 The connection way of OC gate inside the meter

3.5 Grounding Requirements of Converter Installation

The converter housing grounding terminal PE should be connected to the ground with a grounding copper wire no less than 1.6 mm^2. The grounding resistance from the converter housing to the ground should be less than 10Ω.

First, cut the Φ20 copper tube into a 1700mm length (can be extended as needed) and make ground nails buried 1500mm in the ground (Note: when burying the ground nails, sprinkle a layer of charcoal on the tip of the ground nails, and then pour salt water).

Secondly, weld the 4 mm^2 copper wire to the ground nail, and finally connect the ground wire to the sensor flange, grounding ring, and pipe flange, as shown in Figure 29.

Note: The ground wire screws, spring washers, and flat washers must be made of stainless steel.

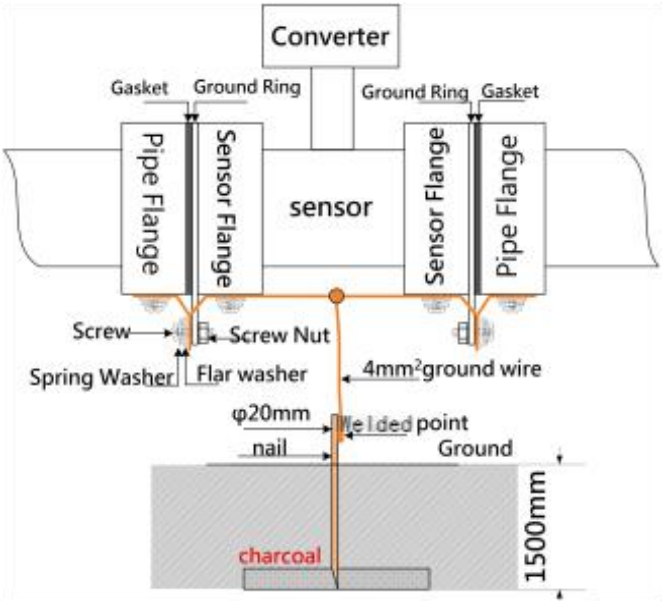


Fig.29 Converter grounding diagram

3.6 Digital Output and Calculation

Digital output refers to frequency output and pulse output. Frequency output and pulse output use the same output point in wiring, so users cannot select both frequency output and pulse output at the same time, but can only select one of them.

3.6.1. Frequency Output

The frequency output range is 0~5000Hz, and the frequency output corresponds to the flow percentage.

$$F = \frac{\text{Measured value}}{\text{Full scale value}} * \text{Frequency range}$$

The upper limit of the frequency output is adjustable. Users can choose 0~5000HZ, or a lower frequency, such as 0~1000HZ or 0~5000HZ.

Frequency output is generally used for control applications because it reflects the percentage flow rate. If the user uses it for metering applications, the pulse output should be selected.

3.6.2. Pulse Output Mode

The pulse output mode is mainly used for metering. One pulse output represents an equivalent flow rate, such as 1L or 1m3, 1T.

The pulse output equivalent is divided into: 0.001L～59.999 m3. When selecting the pulse equivalent, the user should pay attention to the matching of the flow meter flow range and the pulse equivalent. For the volume flow, the calculation formula is as follows:

$Q_L = 0.0007854 \times D^2 \times V$ (L/S)

Or $Q_M = 0.0007854 \times D^2 \times V \times 10^{-3}$ (M^3/S)

Where: D—pipe diameter (mm)

V—Flow rate (m/s)

If the pipeline flow is too large and the pulse equivalent is too small, the pulse output will exceed the upper limit. Therefore, the pulse output frequency should be kept below 3000Hz. Conversely, if the flow rate is low but the pulse equivalent value is set too large, the instrument will take a long time to generate a single pulse. It should also be noted that pulse output differs from frequency output. A pulse is generated only after the accumulated flow reaches one pulse equivalent, so the pulse output is not uniform. Generally, a counter instrument should be used to measure pulse output, rather than a frequency meter.

3.6.3. Wiring of Digital Outputs

Digital output has two contacts: the digital output contact, the digital ground contact, and the flow direction contact. The symbols are as follows:

POUT————Digital output contact

PCOM————Digital ground connection point

POUT is an open collector output. When wiring, users can refer to the following circuit:

(1) Digital level output connection

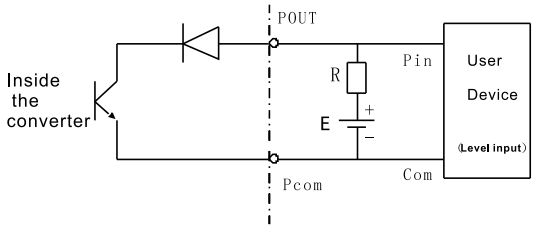


Fig.30 Digital level output connection

(2) Digital output connected to photocoupler (such as PLC, etc.)

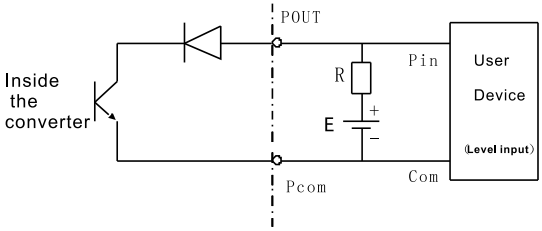


Fig.31 Digital output connected to photocoupler

Generally, the user's optocoupler requires about 10mA current, so E/R = about 10mA. E = 5 ~ 24V.

(3) Digital output connected to a relay

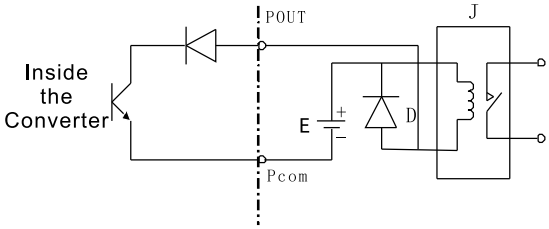


Fig.32 Digital output connected to a relay

Generally, the E required by the intermediate relay is 12V or 24V. D is a freewheeling diode, which is built into most intermediate relays. If the intermediate relay itself does not contain this diode, the user should connect one externally.

The digital output parameter table is as follows:

Table 4 POUT

Parameter	Test conditions	Min.	Typical Value	Max.	Unit
Operating voltage	IC=100mA	3	24	36	V
Working current	Vol≤1.4V	0	300	350	mA
Operating frequency	IC=100mA Vcc=24V	0	5000	7500	HZ
High level	IC=100mA	Vcc	Vcc	Vcc	V
Low level	IC=100mA	0.9	1.0	1.4	V

3.7 Analog Output and Calculation

3.7.1. Analog Output

The analog current output is internally powered by 24V and can drive a load resistor of 750Ω under a 4-20mA signal system.

The analog current output corresponds to the percentage flow rate, that is:

$$I_0 = \frac{\text{Measured value}}{\text{Full scale value}} * \text{Current range} + \text{Current zero-point}$$

For the 4-20mA signal system, the current zero point is 4mA.

Therefore, in order to improve the resolution of the output analog current, the user should appropriately select the flow meter range.

Before shipping, the manufacturer has calibrated the parameters of the analog output. Usually, users does not need to make any adjustments. If an abnormal situation occurs and the user needs to calibrate the analog output, the following operating procedures can be followed.

3.7.2. Analog Output Adjustment

(1) Calibration Preparation

Turn on the meter and run it for 15 minutes to allow the internal part of the meter to reach thermal stability. Prepare a 0.1% level ammeter, or a 250Ω resistor, and a 0.1% voltmeter, and connect them as shown below.

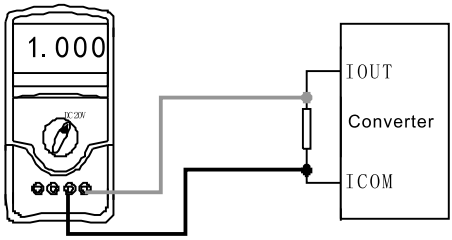


Fig.33

(2) Current “0” Point Correction:

Set the converter to parameter setting state, select the "current zero correction" item, enter, turn the standard signal source to the "0" position, and adjust the correction coefficient value so that the ammeter indicates exactly 4mA (±0.004mA).

(3) Current Full Scale Correction

Select the "Current Full Scale Correction" parameter, enter, set the standard signal source to the full scale position, and adjust the converter correction factor so that the ammeter indicates exactly 20mA (±0.004mA).

After adjusting the current "0" point and full-scale value, the current function of the converter can guarantee accuracy. The linearity of the current output of the converter is within 0.1%.

(4) Current Linearity Check:

Set the standard signal source to 75%, 50%, and 25% to check the linearity of the output current.

4 Startup

4.1 Power on

Please check whether the installation is correct before powering on the device, including:

① The meter installation is in line with safety and compliance requirements.

② Power supply connection must be performed in accordance with the regulations.

③ Please check the correction of the electrical connection.

④ Tighten the rear cover of the converter housing.

4.2 Converter Start-up

The flowmeter consists of a measuring sensor and a signal converter. It is delivered in a ready-to-use state. All operating parameters and hardware settings have been configured according to the users' order specifications.

Once powered on, it will perform a self-check. After that, it will immediately start the measurement and display the current value.

5 Operation (Remote Type)

5.1 Keys and Display

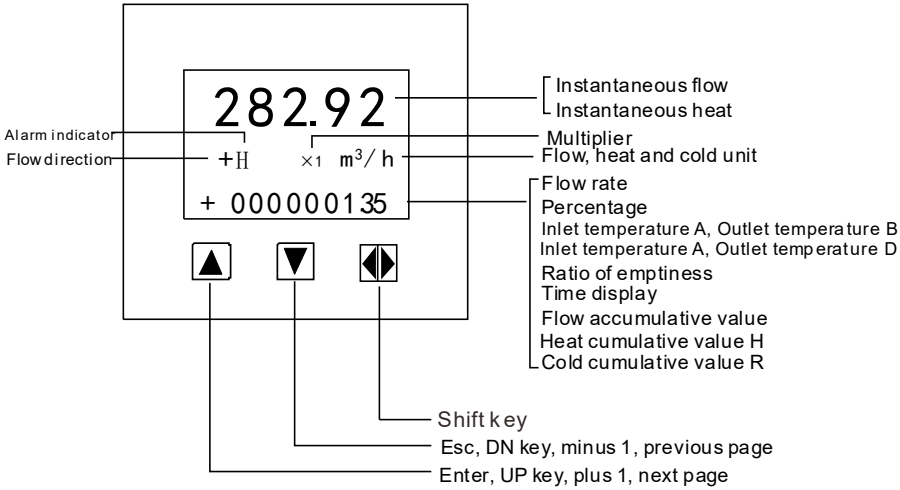


Fig.34 Keys for the remote version

After powering it on, the meter will automatically enter the measurement state. In the automatic measurement state, it will finish each measurement function and display the corresponding measurement date. In the parameter setting state, the three keys on the front panel will enable users to finish the parameter setting.

5.2 Keys Function

5.2.1. Keys Function in Automatic Measurement State

UP: the conversion between instantaneous heat (cold) amount and instantaneous flow; Heat display: H; Cold display: R.

DN: Scroll down to access the off-screen options.

LCD Contrast Adjustment: UP+DN key (Long press)—the contrast darkens; UP+Shift keys(Long press)—the contrast brightens.

5.2.2. Key Functions in Parameter Setting Mode

DN: Decreases the digit at the cursor position by 1; return to the previous page;

UP: Increases the digit at the cursor position by 1; comes to the next page;

Press the Shift key to move the cursor under the UP key and press the UP key to

enter the submenu.

Press the “Shift” key to move the cursor under the “Down” key, and press the “Down” key to return to the previous menu.

5.3 Setting Function and Compound Keys’ Operation

To configure or modify the meter parameters, the meter must be switched from measurement mode to parameter setting mode. In measurement mode, press the “Shift” keys once to enter the function selection screen and select “parameter setting”. Then press the “Shift” key to move the cursor under the “UP” key, and press the “UP” key to enter the password “00000” state. After entering the password, press the “shift” key to move the cursor under the “UP” key, and press the “UP” key to access the main menu, as shown in the figure below:

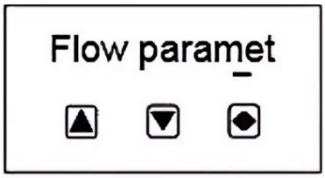


Fig.35

To change the main menu, press the “UP” key.

To enter the main menu and reset the sub-menu parameters, move the cursor under the “UP” key and press the “UP” key again to access the sub-menu of the current main menu, as shown in the following figure:

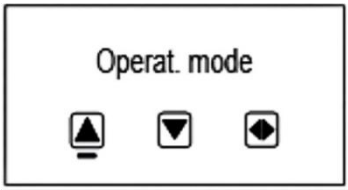


Fig.36

To enter its submenu, move the cursor below the “UP” key and click this key to configure this parameter.

According to the authority permission levels, users can modify it with the provided

password. After pressing the “Shift” key, the desired function selection interface will appear.

The meter is designed with two-level passwords, in which the first-level users can set password of themselve, and the second-level password is a fixed value. The two levels of passwords are reserved for operators with different authority permissions.

5.4 Function Selection Screen

Press the "Shift" key to enter the function selection screen. Then re-press the “Enter” key to select from five available functions on this screen:

Table 5

Parameters	Functions	Description
1	Parameter setting	Select to enter the parameter setting screen
2	Total clearing	Select to reset the totalized value of the instrument
3	Heat monthly log	Select this feature to view 18-month positive and heat accumulations
4	Cold monthly log	Select this feature to view 18-month forward and cold accumulations
5	Error log	Select this function to view 24 error records (error records are generated during excitation or temperature alarm)

5.4.1. Parameter Setting

Press the “shift” key to bring out the “parameter setting” interface. After entering the password, move the cursor below the “Enter” key, and press the “Enter” key again to access the parameter setting.

5.4.2. Total Clearing

Press the “shift” key to bring out the “parameter setting” interface. Then, press the UP key to scroll to Total Reset. Enter the total reset password (this password

should be pre-set in the parameter menu), then press the “shift” key to move the cursor under the enter key, and press the enter key. When the reset password automatically changes to “00000, the reset is completed, and the totalized value stored in the instrument will be cleared to zero.

Note:

"Total Clearing Password" +0 can clear the cumulative value of the total flow;

"Total Clearing Password" +1 reservation;

"Total Clearing Password" +2 can clear the accumulated value of total heat;

"Total Clearing Password" +3 can clear the cumulative value of total Colding capacity;

"Total Clearing Password" +4 reservation;

"Total Clearing Password" +5 can clear monthly records and power-down records;

"Total Clearing Password" +6 can clear all accumulated parameters;

5.4.3. Monthly Cumulative Display

The meter is designed with a non-volatile real-time clock (powered by an internal battery), which can work continuously for more than 5 years To enable the monthly totalizer and power-off timing functions, ensure the internal clock is functioning properly.

Set the corrent year, month, day, hour, minute, and second values of the clock;

Ensure that the internal battery power is sufficient (replace the battery every 5 years)

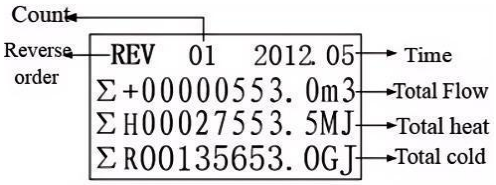


Fig.37 Monthly total value

The total monthly accumulation can record data up to 32 times. When it exceeds 32 times, the new records will automatically overwrite the original data in turn.

5.4.4. Power-off Time Display

The operation method is the same as that of the monthly cumulative display. A maximum of 32 power-off records can be stored, and up to 9999 power-off events can be recorded.

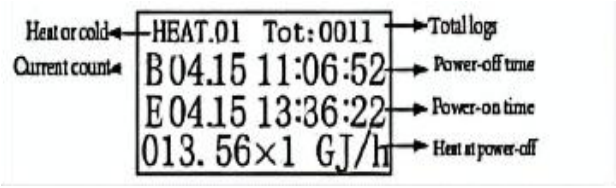


Fig.38

5.4.5. Calibration Mode

According to the verification regulation JJG225-2010 for heat meters, electromagnetic BTU meters must be equipped with a calibration mode in addition to the normal measurement mode.

Mode switching:

Press the “shift” key once to display “parameter settings”, then press the UP key to scroll to “calibration mode”.

Press the “UP” key again to select the desired mode, and press the “shift” key to return to the main screen after selection.

Calibration mode: the unit for BTU meter is fixed at kWh/h;

The cumulative Colding unit and the cumulative heat unit are fixedly displayed at 0.001 kWh;

The temperature shows 0.01℃;

Cumulative flow unit of different diameters: DN10 ~ DN25: 0.00001 m^3;

DN32 to DN100: 0.0001 m^3;

DN > 100: 0.001 m^3;

Note: The meter will automatically switch to normal measurement mode after working in calibration mode for 6 hours.

5.5 Parameter Setting Menu

Table 6

Code	Parameter	Setting Way	Password level	Description
Flow Paramet				
1	Operat. mode	Select	2	Heat meter mode Cold meter mode Cold——Heat mode
2	Snsr Size	Select	2	10～2000
3	Flow Unit	Select	2	L/s, L/m, L/h, m^3/s, m^3/m, m^3/h
4	Heat Unit	Select	2	GJ/h, MJ/h, KWh/h, MWh/h
5	Cold Unit	Select	2	GJ/h, MJ/h, KWh/h, MWh/h
6	Flow Rspns	Select	2	1～60S
7	Flow Direct	Number	2	FORWARD, REVERSE
8	Flow Zero	Number	2	0~±9999
9	Flow Cutoff	Number	2	Based on flow setting
10	Tempe. Cutoff	Select	2	0～199.9
11	Total Unit	Select	2	0.00001L, 0.0001L, 0.001L, 0.010L, 0.100L, 1.000L, $0.00001m^3$, $0.0001m^3$, $0.001m^3$, $0.010m^3$, $0.100m^3$, $1.000m^3$
12	HeatTotUnit	Select	2	0.0001MJ, 0.001M, 0.010MJ, 0.100MJ, 1.000MJ, 0.000 1GJ, 0.001GJ, 0.010GJ, 0.100GJ,

Code	Parameter	Setting Way	Password level	Description
				1.000GJ, 0.0001 KWh, 0.001 KWh, 0.010 KWh, 0.100 KWh, 1.000 KWh, 0.0001 MWh, 0.001 MWh, 0.010 MWh, 0.100 MWh, 1.000 MWh
13	ColdTotUnit	Select	2	0.0001MJ, 0.001M, 0.010MJ, 0.100MJ, 1.000MJ, 0.000 1GJ, 0.001GJ, 0.010GJ, 0.100GJ, 1.000GJ, 0.0001 KWh, 0.001 KWh, 0.010 KWh, 0.100 KWh, 1.000 KWh, 0.0001 MWh, 0.001 MWh, 0.010 MWh, 0.100 MWh, 1.000 MWh
14	REV Flow Ena	Select	2	Enable/Disable
Output Param				
15	Current Mode	Select	2	Flow output Heat output Cold output Heat&Cold status output Flow direction
16	Flow range	Number	2	0～59999
17	Heat range	Number	2	0～59999
18	Cold Range	Number	2	0～59999

Code	Parameter	Setting Way	Password level	Description
19	Data Output	Select	2	Flow frequency, flow pulse Lt Flow pulse m^3, heat pulse MJ Heat pulse GJ, heat pulse KWh Heat pulse MWh, cold pulse MJ, cold pulse GJ, cold pulse KWh, cold pulse MWh, cold heat P MJ, cold heat P GJ, cold heat P KWh, cold heat P MWh, work status mark, flow direction
20	FrequencyMax	Number	2	0～59999
21	Pulse Factor	Number	2	0.001～59.999
22	Pulse Width	Number	2	0.5ms～499.9ms
Sensor Param				
23	Sensor Fact	Number	2	0.0000～5.9999
24	Field Type	Select	2	Type1/Type2
25	Snsr Code1	User set	3	0～99999
26	Snsr Code2	User set	4	0～99999
27	Sensor Post.	Select	4	Flow inlet/outlet
Temperature				

Code	Parameter	Setting Way	Password level	Description
28	Heat Start T	Number	2	0～199.9
29	Cold Start T	Number	2	0～199.9
30	Pres. Range	Select	2	0.6MP/1.6MP
31	TempA Zero	Number	2	0～59999
32	TempA Range	Number	2	0～5.999
33	TempB Zero	Number	2	0～59999
34	TempB Range	Number	2	0～5.999
35	Rt Type	Select	2	Pt1000/pt100
Alarm Param				
35	Mtsnsr Ena	Select	2	ENABLE/DISABLE
36	MtsnsrTrip	Number	2	0～59999
37	Sys Alm Ena	Select	2	ENABLE/DISABLE
38	MtsnsrZero	Number	2	0～9999
39	MtsnsrRange	Number	2	0～5.9999
Linearizati				
38	Line Crc Ena	Select	2	ENABLE/DISABLE
39	Lineary CRC1	User set	2	Based on flow setting
40	Lineary Fact 1	User set	2	0.0000～1.9999
41	Lineary CRC2	User set	2	Based on flow setting
42	Lineary Fact 2	User set	2	0.0000～1.9999
43	Lineary CRC 3	User set	2	Based on flow setting

Code	Parameter	Setting Way	Password level	Description
44	Lineary Fact 3	User set	2	0.0000～1.9999
45	Lineary CRC 4	User set	2	Based on flow setting
46	Lineary Fact 4	User set	2	0.0000～1.9999
Communication				
47	Comm Addres	Number	2	0～250
48	Baud Rate	Select	2	300～38400
49	Comm Mode	Select	2	8-digit none parity 8-digit odd parity 8-digit even parity
Data Paramet				
50	YEAR	Number	2	0～99
51	MONTH	Number	2	0～99
52	DAY	Number	2	0～99
53	HOUR	Number	2	0～99
54	MINUTE	Number	2	0～99
55	SECOND	Number	2	0～99
Factory Adj				
56	Meter Fact	Number	2	0.0000～5.9999
57	AnalogZero	Number	2	0.0000～1.9999
58	Anlg Range	Number	2	0.0000～3.9999
59	Clr Sum Key	User change	2	0～99999

Code	Parameter	Setting Way	Password level	Description
60	MeterCode 1	Factory set	2	0～99999
61	MeterCode 2	Factory set	2	0～99999
62	Password 1	User change	2	0～59999
63	Language	Select	2	Chinese/English
Test Paramet				
64	Heat Test	Select	2	ENABLE/DISABLE
65	TempA Value	Number	2	0～199.9
66	TempB Value	Number	2	0～199.9
67	Speed Value	Number	2	0～19.999
Total Parame				
68	Total Parme	User change	2	0～99999
69	TotalWordLo		2	0～9999
70	TotalWordHi		2	0～99999
71	HeatTotalLo		2	0～9999
72	HeatTotalHi		2	0～99999
73	ColdTotalLo		2	0～9999
74	ColdTotalHi		2	0～99999

The instrument parameters define its operating status, calculation method, output type, and overall performance. Proper selection and configuration of these parameters ensure the optimal performance and improve the accuracy of measurement display and output.

The parameter setting function includes **two password levels**. **Level 1** is the **user**

password, and **level 2** is the **manufacturer password**. The manufacturer (Level 2) password can be used to reset the Level 1 password.

With either password, users can view the meter's parameters. Modifying the parameters requires the corresponding access level.

- Level 1 password (factory value: 00521) view only access.
- Level 2 password (fixed value): modification of the parameters listed above.

5.6 Detailed Description of Parameters

5.6.1. Flow Parameters

(1) Operat. Mode

There are three operation modes: Heat work mode, cold work mode, and heat and cold work mode.

- **Heat Mode**

It is the default mode and only calculates the heat energy, represented by H.

- **Cold Mode**

It only calculates the cold energy, represented by R.

- **Heat and Cold Mode**

Calculates and displays both heat and cold energy separately.

(2) Snsr Size

The matching sensor diameter range: 10 ~ 2000mm.

10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000

(3) Flow Unit

Select the flow display unit in the parameters. The meter flow display units are: L/s, L/m, L/h, m^3/s, m^3/m, m^3/h. Users can select a suitable flow display unit according to process requirements and usage habits.

(4) Heat and Cold Unit

There are four types: MJ/h, GJ/h, kWh/h/h, and MWh/h.

(5) Damping Time

Also filter time. A long measurement damping time can improve the stability of the meter flow display and output signal. A shorter damping time enables faster

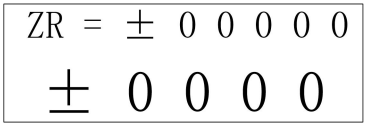
response, which is ideal for process control applications. The measurement damping times is set by selecting from provided options.

(6) Flow Direct (Direction)

If the actual fluid direction differs from the design direction, users can directly adjusting the flow direction parameter instead of changing the wiring of the excitation or signal lines.

(7) Flow Zeroing

When this function is enabled, the pipe should be filled with full and still water. The flow zeroing is represented by the flow rate, unit in mm/s. The flow zeroing of the heat meter is displayed as below:



* Upper row display: "ZR" represents the actual zero-point measurement value.
* Lower row display: Displays the flow velocity zero-point correction value.
* When the ZR value is not “0”, adjust the correction value to make FS=0.

Note: If the ZR value increases with the adjustment of the correction value on the lower row, you need to reverse the sign of the correction value (positive or negative) to bring the FS reading back to zero.

The flow zero correction value is a constant specific to the sensor and must be recorded on the sensor's record sheet and nameplate.

When recording, the sensor zero value is expressed as the flow velocity in mm/s, and its sign is opposite to that of the correction value.

(8) Flow Cutoff

It is set in terms of flow rate. When the small signal cutoff function is active, only the flow velocity is displayed, while the flow rate, percentage display, and signal output are disabled.

(9) Temp. Cutoff

When the temperature difference between the inlet and outlet is lower than the set value, the instrument will not calculate heat or cold energy.

(10) Total (Flow) Unit

The converter display features a 9-digit counter, with a maximum count value of 999999999.

The accumulation flow unit can be set to L, m^3 (liter, cubic meter), etc.

Flow accumulation equivalent: 0.001L, 0.010L, 0.100L, 1.000L

0.001m^3, 0.010m^3, 0.100m^3, 1.000m^3

0.001T, 0.010T, 0.100T, 1.000T

(11) Total Energy Unit (Heat/Cold)

The heat meter display uses a 9-digit counter, with a maximum count value of 999,999,999.

Available total energy units: MJ, GJ, kWh, and MWh.

Available total energy equivalents:

- 0.0001 MJ, 0.001 MJ, 0.010 MJ, 0.100 MJ, 1.000 MJ
- 0.0001 GJ, 0.001 GJ, 0.010 GJ, 0.100 GJ, 1.000 GJ
- 0.0001 kWh, 0.001 kWh, 0.010 kWh, 0.100 kWh, 1.000 kWh
- 0.0001 MWh, 0.001 MWh, 0.010 MWh, 0.100 MWh, 1.000 MWh

Note: The maximum cumulative count is 99,999,999.

(12) REV Flow Ena (Reverse Flow Measurement Disable)

The electromagnetic BTU meter includes the reverse flow disable function (SegmaN in the meter display).

When set to “disable”, the instrument does not calculate heat or cold energy, provides no output, and only displays flow velocity.

When set to “enable”, the instrument operates normally.

As heat or cold energy should not be automatically calculated for reverse flow in principle, the default setting is “disable”.

5.6.2. Output Parameter

(1) Current Mode

The electromagnetic heat/Cold meter supports six types of current output modes:

Flow output, Heat output, Cold output, Heat/Cold combined output, Heat/Cold status output, Flow direction output

- **Flow output:** Current output is proportional to the instantaneous flow rate

percentage. The percentage display shows the flow rate percentage.

- **Heat output**: Current output is proportional to the instantaneous heat rate percentage. The percentage display shows the heat percentage.
- **Cold output**: Current output is proportional to the instantaneous Colding rate percentage. The percentage display shows the Colding percentage.
- **Heat/Cold combined output**: Current output is proportional to the instantaneous heat or Cold rate percentage. The percentage display shows the respective percentage.
- **Heat/Cold status output:** The current output indicates whether the instrument is measuring heating or Colding. When measuring Colding, output = 20 mA; when measuring heating, output = 4 mA.
- **Flow direction output:** The current output indicates the flow direction. When the flow is reverse, output = 20 mA; when forward, output = 4 mA.

(2) Flow/ Heat/ Cold Rnage

The meter range setting refers to determining the upper limit value, and the lower limit flow value will automatically be set to “0”.

As such, if this range setting defines the meter measuring range, it means the corresponding relation among percentage display, frequency output, current output, and flow is also decided.

- Displayed percentage value=(measured flow value/meter range)×100%
- Frequency output value=(measured flow value/meter range)×20 ma + 4ma
- Current output value=(measured flow value/meter range)×full-scale current

(3) Pulse type

There are 16 types of the pulse output. Flow frequency output; Flow pulse (L); Flow pulse (m^3); Heat pulse (MJ); Heat pulse (GJ); Heat pulse (kWh); Heat pulse (MWh); Cold pulse (MWh); Cold pulse (MJ); Cold pulse (GJ); Cold pulse (kWh); Heat/Cold pulse (MJ); Heat/Cold pulse (GJ); Heat/Cold pulse (kWh); Heat/Cold pulse (MWh); Heat/Cold status output; Flow direction output.

- Frequency output mode:

The frequency output is a continuous square wave, with the output frequency corresponding to the flow rate percentage.

- Pulse output mode:

The pulse output is a rectangular pulse train, where each pulse represents a defined flow quantity. The pulse equivalent is determined by the combination of pulse output type and output pulse coefficient. This mode is mainly used for total flow accumulation and is typically connected to a totalizer.

- Heat/Cold status output:

When the pulse output is configured to indicate the heat/cold status,

Low level represents heating; High level represents Colding

- Flow direction output:

When the pulse output is configured to indicate the flow direction,

Low level represents forward flow; High level represents reverse flow

(4) FrequencyMax (Upper Limit of Frequency Output)

The electromagnetic heat/cold meter's frequency output corresponds to the flow rate percentage (not to heat or cold rate). The selectable range is 1–5000.

The calculation formula is as follows:

Frequency output=(measured flow value/flow range)×Full-scale frequency value

(5) Pulse Fact (Output Pulse Coefficient)

The pulse coefficient, also referred to as the pulse equivalent, ranges from 0.001 to 59.999. Its unit is the same as that of the selected pulse output type.

It is used for quantifying the pulse output for measurement purposes.

(6) Pulse Width (Output Pulse Width)

The pulse output is active at a low level.

The pulse width can be set within 0.5–999.9 ms.

A table is provided below showing the relationship between pulse width and the maximum number of output pulses.

Table 7

No.	Pulse width (ms)	Max. number of output pulses per hour (p/h)
1	1	1800000
2	5	360000
3	10	180000
4	50	36000
5	100	18000
6	200	9000
7	500	3600

5.6.3. Sensor Parameters

(1) Sensor Fact

This refers to the calibration coefficient of the complete electromagnetic BTU meter. The coefficient is obtained through actual calibration and is stamped on the sensor

(2) Field Type

The electromagnetic converter provides two excitation frequency options: 1/10 power frequency (mode 1), and 1/12 power frequency (mode 2). For small-diameter sensors, the excitation inductance is low, so mode 1 should be selected. For large-diamter sensors, the excitation inductance is higher, so mode2 is recommended. During operation, start with Mode 1. If the zero flow rate reading is too high, switch to mode 2.

Note: the excitation mode used during calibration must be the same as the one used during operation.

(3) Snsr Code 1/2

These are factory-assigned codes used for identifying and recording individual sensors.

(4) Sensor Post.

If the heat meter flow sensor is installed at the inlet of the heating pipe, please select "Flow Inlet"; If it is installed at the outlet, select “flow outlet”.

Caution: Incorrect parameter selection incosistent with the actual installation position will result in calculation errors.

5.6.4. Temperature Parameters

(1) Heat/Cold Start T

This parameter defines the temperature threshold for calculating heat and cold energy.

When the measured temperature is lower than the set value, the instrument will not perform heat or Colding energy calculations.

(2) Pres.Range

In compliance with CJ128-2007, the electromagnetic heat meter offers two pressure options—0.6 MPa and 1.6 MPa—for user convenience.

(3) TempA/ TempB Zero, and Temperature Calibration

The electromagnetic heat meter uses a three-wire bridge connection for both Pt1oo0 and Pt100 resistance temperature detectors (RTDs).

For detailed calibration procedures, refer to Appendix 4.

(4) Rt Type

The electromagnetic heat meter supports both Pt1oo0 and Pt1o0 RTD options.

Select Pt1000 if the temperature measurement section uses a Pt1000 RTD; select Pt100 if it uses a Pt100 RTD.

5.6.5. Alarm Parameters

(1) Mtsnsr En:

The flowmeter features an empty pipe detection function without the need for additional electrodes. If the user enables the empty pipe alarm, the instrument can detect an empty pipe condition when the fluid level in the pipe falls below the measuring electrodes. Upon detecting an empty pipe condition, the analog and digital outputs are set to a zero signal, and the flow rate display on the instrument shows zero.

(2) Mtsnsr Trip:

When the pipe is full of fluid (regardless of whether there is flow), the empty pipe alarm setting can be modified, making it more convenient for the user. The upper row displays the measured conductivity value, while the lower row is used to set the empty pipe alarm threshold. When configuring the empty pipe alarm threshold, it is recommended to set the value to 3 to 5 times the measured conductivity. There will be “MT” readings on the alarmed meter screen.

(3) Sys Alm Ena:

Selecting “Enable” turns on the excitation alarm function, while selecting “Disable” turns it off. When an alarm occurs, the meter displays “**SY**” on the measurement screen.

(4) Zero Correct

When the full pipe value on-site is relatively high, the user can perform the empty pipe zero-point adjustment. During the adjustment, ensure the sensor tube is completely filled with fluid. The display for empty-pipe zero-point adjustment is

shown below:

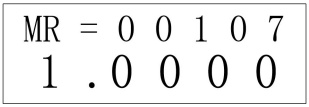
* Upper row display: "MZ" represents the actual zero-point measurement value.

* Lower row display: Displays the flow velocity zero-point correction value.

First, according to the measured conductivity MT value, the correction value is adjusted so that MZ = about 5-10 (note: when the downward correction value is increased, the MZ value decreases).

(5) Range Correct

When the MT value of the empty pipe conductivity measured by the meter is too small, the user can correct the empty pipe range. Ensure that there is no fluid in the sensor tube when correcting the empty pipe range. The empty pipe range correction display is as follows:



* Upper row display: "MR" represents the actual zero-point measurement value.

* Lower row display: Displays the flow velocity zero-point correction value.

When the MT value of the empty-pipe conductivity measured by the instrument is low, the user can perform an empty-pipe range correction.

Before performing the correction, make sure that there is no fluid inside the sensor tube. The display during empty-pipe range correction is as follows:

Upper line display: “MR” represents the measured empty-pipe range value of the meter.

Lower line display: Empty-pipe range correction value.

Increasing the lower adjustment value will increase MR, while decreasing it will reduce MR. Users can adjust MR to a suitable value according to actual requirements (recommended around MR = 500). After adjustment, the measured empty-pipe conductivity will approximately match the corrected MR value.

5.6.6. Linearization

(1) Line Crc Ena

This parameter is used to select whether the instrument performs nonlinear correction.

When set to **Enable**, the correction is applied; when set to **Disable**, the correction is not applied.

(2) Lineary CRC1-4

For detailed setting methods, refer to Appendix 1.

(3) Lineary Fact 1-4

For detailed setting methods, refer to Appendix 1.

5.6.7. Communication

(1) Comm Address

Indicates the communication address of the instrument during data communication. The address range is 01-250, with 00 reserved.

(2) Baud Rate

Selectable baud rates:300, 600,1200, 2400, 4800, 9600,19200,38400.

(3) Communication Mode

The instrument is equipped with the standard MODBUS communication mode using 8-bit, no parity by default. Users may also select 8-bit odd parity or 8-bit even parity modes as needed.

(4) Communication Terminal Resistance

Fig.39 Resistance Switch

Switch 1 or 2 defines:

ON is connected to the RS485 communication terminal resistor (standard configuration resistor: 120Ω);

OFF means no answer.

Note: The terminal resistor is used for long-distance communication, and is not connected for short-distance communication.

5.6.8. Data Parameter

Year, month, day, hour, minute, and second time settings, used for power failure timing and clock setting of the monthly total amount.

5.6.9. Factory Adj

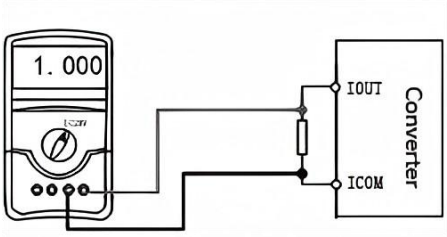
(1) Meter Fact

This coefficient is a special parameter used by the heat meter manufacturer. It is applied to normalize the measurement circuit system of the electromagnetic heat meter, ensuring that the interchangeability between all electromagnetic heat meters reaches 0.1%.

(2) AnalogZero/Anlg Range

- **Preparation for Instrument Calibration:**

After powering it on, let it run for about 15 minutes to ensure thermal stability. Prepare a 0.1% accuracy ammeter, or a 250 Ω precision resistor used together with a 0.1% accuracy voltmeter, and connect them as shown in the diagram below.



- **AnalogZero (Current Zero Adjustment)**

Set the converter to the parameter setting mode and select "AnalogZero."

Set the standard signal source to the "0" position, then adjust the correction coefficient until the ammeter reads exactly 4 mA (±0.004 mA).

- **Anlg Range (Current Full-Scale Adjustment)**

Select "Anlg Range."

Set the standard signal source to the full-scale position, then adjust the converter's correction coefficient until the ammeter reads exactly 20 mA (±0.004 mA).

Once both the zero and full-scale adjustments are completed, the converter's current output accuracy can be ensured.

The linearity of the converter's current output is within 0.1%.

(3) Clr Sum Key

Users with Level-2 password access can set this password and use it within the Totalizer Reset menu.

(4) MeterCode 1/2

The converter codes record the manufacturer's date and serial number of the converter.

(5) Language

The electromagnetic heat meter supports Chinese and English interfaces, and users can switch between them as needed.

5.6.10. Total Parameters

(1) TotalWordLo/Hi

These parameters allow modification of the accumulated flow value, mainly for instrument maintenance or replacement purposes.

Users with Level-2 password access may adjust the accumulated total, which must not exceed the counter’s maximum value of 999 999 999.

(2) ColdTotalLo/Hi

The setting method is the same as for the flow totalizer.

The maximum cumulative value is 999 999 999. If the set value exceeds this limit, the display will show 999 999 999.

6 Operation (Integrated Type)

6.1 Display and Keys

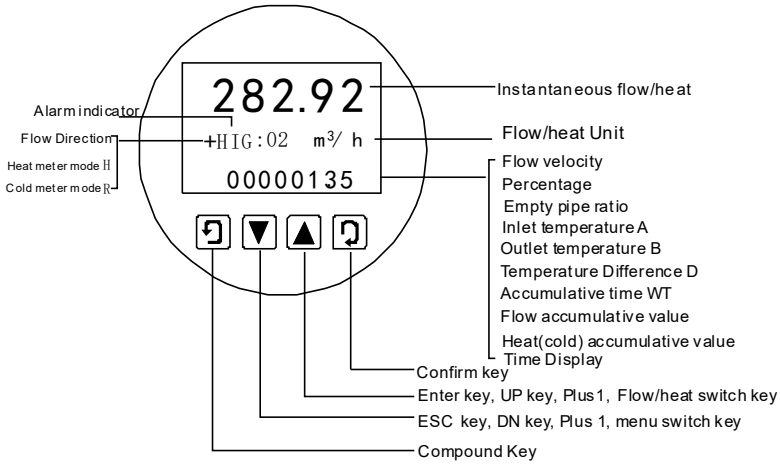


Fig.40 Keys definition and LCD

When the meter is powered on, it automatically enters the measurement mode. In this mode, the instrument performs all measurement functions and displays the corresponding data automatically.

In the parameter setting mode, users can configure the instrument parameters with the three keys on the front panel.

6.2 Key Functions

6.2.1. Key Functions in Automatic Measurement Mode

Up Key: Switches the display between instantaneous heat and instantaneous flow.

Down Key: Cycles through the options for the lower line display on the screen.

Enter Key: Enters the password input mode. After entering the correct password, users can access the converter menu.

6.2.2. Key Functions in Parameter Setting Mode

Down Key: Decreases the number at the cursor position by 1 or turns to the previous page.

Up Key: Increases the number at the cursor position by 1 or turns to the next page.

Enter Key: Moves the cursor clockwise; **composite key:** Moves the cursor counterclockwise.

When the cursor moves below the Up Key, pressing it enters a submenu.

When the cursor moves below the Down Key, pressing it returns to the previous menu.

Note: For details on parameter setting functions, parameter setting menus, and instrument parameter descriptions, refer to the remote (separate) version of the manual.

7 Insertion Electromagnetic Flowmeter Series

7.1 Structure and Format

The product is insertion electromagnetic flowmeter. It is connected to the pipeline via a mounting base, ball valve, compression nut and positioning screw.

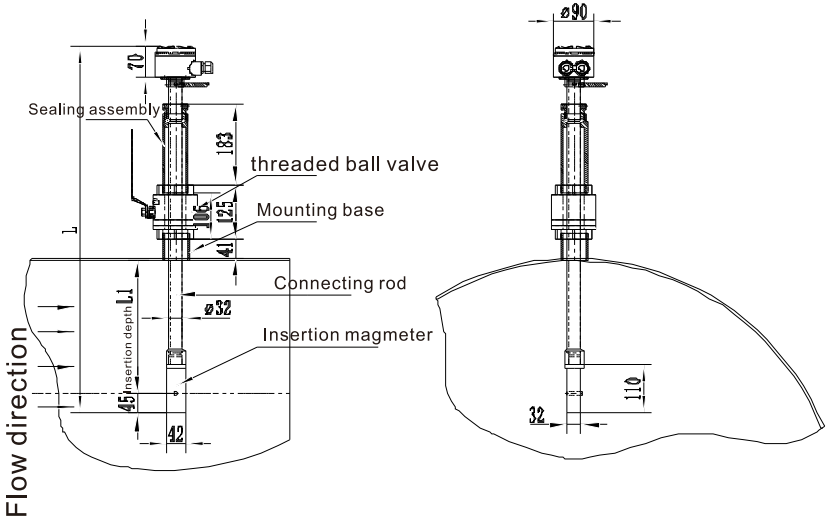
The sensor is available in two structural types: measuring tube type and flat-electrode type.

- The measuring tube type is suitable for measuring clean media.
- The flat-electrode type is suitable for measuring liquids containing impurities.

7.2 Technical Performance

Applicable pipe diameter	DN100 to DN3000	
Flow velocity measuring range	0–1 to 0–10 m/s; full-scale range adjustable continuously within 1–10 m/s	
Accuracy	Flow: ±1.5% F.S when flow velocity>1 m/s Heat: 2.0 class	
Conductivity of the measured medium	Greater than 30 μS/cm	
Maximum operating pressure	1.6 MPa	
Electrode materials	316L, HC (Hastelloy C), etc.	
Measuring tube (measuring head) material	ABS	
Maximum temperature of measured medium	60°C (for ABS material)	
Protection level	Sensor: IP68; Converter:IP65	
Flowmeter output signals - DC current	DC current	(0–10) mA, load resistance 0–1 kΩ;
		(4–20) mA, load resistance 0–500 Ω;
	Frequency: 1–5 kHz	
Connection method	Flanged ball valve or threaded (screw) ball valve	
Pipe specification	15D upstream of straight pipe, 10D downstream	

7.3 Structure



Note: If integrated converter is used, the meter height shall be increased by 81mm.

Fig.41 Product dimensions of remote magmeter (unit: mm)

Table 8 Insertion Type Total Length

Insertion length	
Specification	length
DN≤200	630 mm
400≥DN≥250	730 mm
1200≥DN＞400	830 mm
2000≥DN＞1400	1030 mm

Insertion depth L1: pipe diameter ≤ DN400, insertion depth is ½ DN ;

For pipe diameters > DN400, the insertion depth is ¼ DN

■ **Sensor**

The sensor, as illustrated, is primarily composed of a measuring head (or measuring tube), excitation system, insertion rod, terminal box (or integrated

display unit), mounting base, and sealing and positioning mechanism.

- **Measuring Head (or Measuring Tube):**

The measuring head (or measuring tube) is positioned at the velocity point of the fluid within the pipeline and is used to detect the flow velocity at that point. It consists of an insulating end cap or conduit equipped with a pair of electrodes. Apart from the electrode ends or the inner wall of the measuring tube, all other parts are insulated from the measured fluid.

- **Excitation System:**

The excitation system generates the working magnetic field and consists of an excitation coil and an iron core. It is encapsulated in an insulated and sealed manner within the insertion rod.

- **Insertion Rod:**

Made of stainless steel, the insertion rod houses the measuring head. Excitation and electrode leads are routed through the insertion rod, sealed against the measured medium, and connected to the junction box. A direction indicator is welded onto the insertion rod to ensure that the magnetic field, flow direction, and electrode axis remain mutually perpendicular during installation—fulfilling the requirements of Faraday's law of electromagnetic induction.

- **Terminal Box:**

Located at the top of the sensor, the junction box contains terminals for connecting the sensor to the converter. (Note: For the integrated display unit version, it is also located at the top of the sensor and functions in conjunction with the sensor.)

- **Mounting Base:**

The mounting base is welded to the measured pipeline and serves as the interface for the ball valve and the insertion-type electromagnetic flow sensor.

- **Sealing and Positioning Mechanism:**

Comprising a stainless-steel threaded compression seat, a compression nut, a rubber gasket, and a positioning screw, this mechanism seals the insertion-type sensor and enables it to withstand a certain level of operating pressure.

7.4 Installation and Operation

7.4.1. Installation

(1) Installation environment

- Be away from devices with the strong magnetic field, such as a motor, or VFDS.
- Be free from strong vibration while pipes are securely fixed, and environmental changes are slight.
- Places where are easy for installation and maintenance.

(2) Installation site

- The installation location must ensure that the pipeline is always completely filled with the measured fluid.
- Select a location with minimal flow pulsation — i.e., away from pumps, valves, elbows, and other components that create local resistance.
- When measuring multi-phase fluids (solid-liquid or gas-liquid), choose a position where phase separation is less likely to occur.
- Avoid locations where negative pressure may occur.
- The diameter or circumference of the pipeline at the measurement point should be easy to determine, and the pipe should have minimal ovality.

7.4.2. Straight Pipe Length

A straight pipe section of at least 15D should be provided upstream of the sensor, and at least 10D downstream, where D is the inner diameter of the pipe.

7.4.3. Flow Control and Regulating Valves

The flow control valve should be installed upstream of the sensor in the measured pipeline. The flow regulating valve should be installed at least 3D downstream of the sensor. During measurement, the flow control valve is typically kept fully open.

7.4.4. Welding of the Mounting Base

Before installation, a 50 mm diameter hole should be drilled in the measured pipeline. The hole size should match the outer diameter of the connecting pipe on the mounting base. The welding of the mounting base to the pipeline is shown in Figure 41.

The technical requirements for welding are as follows:

(1) The axis of the mounting base must be perpendicular to the axis of the pipeline.

(2) Flat welding using stainless steel welding rods should be employed. After welding, the flange end face must remain parallel to the pipeline axis. The weld should be firm and capable of withstanding a pressure of 1.6 MPa without leakage.

7.4.5. Sensor Installation

① Remove welding slag and burrs from the mounting base on the measured pipe.

② Shut off the upstream flow control valve or use low-pressure water supply.

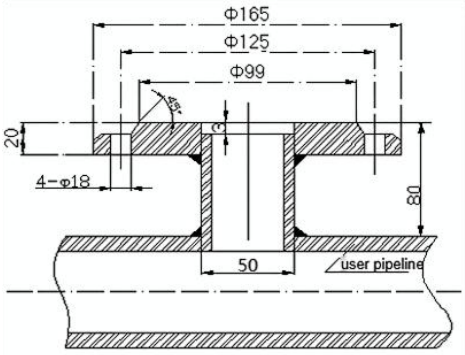


Fig.42

③ Determine the insertion depth of the insertion-type electromagnetic flowmeter (i.e., the position of the two electrodes on the sensor within the pipeline).

④ Install a DN50 ball valve onto the mounting base as shown in Figure 40. Make sure the longer cavity of the ball valve faces upward. Check that the valve can open and close fully. Tighten the compression nut and positioning screw. Ensure the sensor's direction indicator aligns with the fluid flow direction.

⑤ Determining the insertion depth of the insertion-type electromagnetic flow sensor:

- For pipelines with diameter D ≤ 400 mm, the insertion depth should be half the pipe diameter (D/2).
- For D > 400 mm, the insertion depth should be one-quarter of the pipe

diameter (D/4).

(Note: The instrument coefficients for these two depths are different.)

7.4.6. Grounding

The flow signal generated by the sensor is extremely weak, typically in the microvolt or millivolt range. Therefore, preventing external electrical interference is critical for reliable flowmeter operation. Grounding is an effective measure to mitigate electrical interference.

The key grounding requirement is to ensure the measured medium is grounded. The grounding terminals of both the sensor and the converter should be connected to the metal shielding of the flow signal cable, and, through the insertion rod, connected to the measured medium.

If the measured pipeline is non-metallic, the sensor's grounding terminal should be directly connected to earth with a grounding wire. The grounding resistance must be less than 10 Ω.

7.4.7. Adjustment and Operation

(1) If the flow rate of the measured pipeline is known, the flow range can be set based on the flow rate and the range setting method described in the converter's installation and operation manual.

(2) Once all preparations are complete, first open the upstream flow control valve of the sensor, then slowly open the downstream flow regulating valve. Observe the converter: the flow reading should increase gradually. If the reading is negative, turn off the power and swap the signal wires "SIG1" and "SIG2."

(3) Based on the actual measured flow, reset the flow range and meter coefficient as needed by referring to the converter's manual.

(4) If the sensor is installed outdoors or buried underground, after connecting the terminal wires, it should be sealed using the sealant provided by the manufacturer.

(5) First, open the upstream flow control valve; then open the downstream flow regulating valve to let the fluid discharge for a few minutes so that any entrained gas can be expelled. Next, close both valves, ensuring the pipeline is fully filled with fluid but without flow. Finally, follow the instructions in the converter's manual to perform zero calibration.

8 Maintenance and Regular Inspection

8.1 PCB Protection and Alarms

The printed circuit board of the electromagnetic heat meter adopts surface soldering technology, which is not repairable for users. Therefore, users are prohibited from opening the converter housing.

Intelligent converters have self-diagnose function. Without the trouble of power and hardware circuit, the normal trouble can be detected correctly. This information displays on the left of LCD. The trouble is like this:

SY---- System excitation alarm; MT ---- Fluid empty pipe alarm;

CU ---- Signal cutoff alarm.

8.2 Troubleshooting

8.2.1. No Display

a. Check the power supply connection;

b. Check the power fuse;

c. Check the compliance of power voltage with requirements;

d. Check the contrast of LCD and regulate it to the working state;

e. If the above items a, b, and c are all normal, but item d — the contrast adjustment of the display — is not functioning, please return the converter to the manufacturer for repair.

8.2.2. Excitation Alarm

a. Check whether the excitation wiring EXI and EX2 are open.

b. Is the total resistance of the sensor excitation coil less than 150Ω?

c. If both a and b are normal, the converter is faulty.

8.2.3. Empty Pipe Alarm

a. Whether the measured medium is full of the measuring pipe.

b. Short-circuit the three points of the converter's signal input terminals SIG1, SIG2, and the grounding terminal SGND with a wire. In this case, if the "empty pipe alarm" prompt is not displayed, it indicates that the converter is working normally, and it is possible that the conductivity of the measured fluid is low or there are errors in the settings of the empty pipe threshold and the empty pipe

range.

c. Check whether the signal connection is correct;

d. Check whether sensor is normal

① Set the flow rate to zero and observe — the displayed conductivity ratio should be less than 100%.

② Under flow conditions, measure the resistance between terminals SIG1 and SGND, and SIG2 and SGND, respectively. The resistance should be less than 50 kΩ (for water-based media). (It is recommended to use an analog multimeter for this measurement, where the charging and discharging behavior during the test can be observed).

e. Measure the DC voltage between DS1 and DS2 with a multimeter. It should be less than 1V. If the voltage exceeds this value, it indicates the sensor electrodes may be contaminated and should be cleaned.

8.2.4. Inaccuracy of Measured Flow

A. Check whether the measuring tube of the sensor is completely filled with fluid.

B. Check whether the signal wiring is properly connected.

C. Verify that the sensor coefficient and sensor zero point are correctly set according to the sensor nameplate and factory calibration certificate.

9 Technical Parameters

9.1 Technical Parameters

Table 9 Technical Parameters

Measuring System		
Standards	JB/T9248-2015	
Measuring principle	Faraday's law of electromagnetic induction	
Function	Real-time measurement and flow accumulation of instantaneous flow, flow velocity, mass flow (when density remains constant)	
Module structure	The measuring system consists of a measuring sensor and a signal converter	
Converter		
Protection Level	Integrated type	IP65
	Remote type	Meter head: IP65
		Body: IP65/IP68
Sensor		
DN	DN10~DN 2000	
Process connection	In line with GB/T9119-2000 standard carbon steel (Optional stainless steel flanges), other standard flange can be customized	
Rated pressure level (High-pressure version is customizable)	DN10~DN250, PN<1.6MPa	
	DN300~DN1000, PN<1.0MPa	
	DN1200~DN2000, PN<0.6MPa	
	There may be difference between specifications, please refer to the nameplate as the standard; high pressure version can be customized.	

Liner material	Neoprene (CR), UR, PTFE (F4), F46, Teflon (PFA)	
Electrode	316L Stainless Steel, HB, HC, Ti, Ta, Pt	
Protection level	IP67 (IP68 available)	IP65
Medium temperature	Remote version: CR: -10 ℃ ~70 ℃ UR: -10 ℃ ~60 ℃ PTFE/F46: -10 ℃ ~120 ℃ PFA: -10 ℃ ~180 ℃	Integrated version: CR: -10 ℃ ~70 ℃ UR: -10 ℃ ~60 ℃ PTFE/F46: -10 ℃ ~120 ℃ PFA: -10 ℃ ~120 ℃
Buried depth	≤5m (Only for remote type of IP68)	
Submerging depth	≤3m (Only for remote type of IP68)	
Sensor cable	Only for the remote type; Standard cable length: 10m; Maximum customizable cable length: ⩽100m	
Communication		
Serial communication	RS-485	
MODBUS Interface	RTU format, physical interface RS-485, electrical isolation 1000V	
Function	Empty pipe identification	
Measurement accuracy		
Accuracy	Flow rate: ±0.5 % of measured value (flow rate ⩾1 m/s); ±0.5 % of measured value ±2mm/s (flow rate < 1 m/s) Heat: 2.0 class	
Repeatability	0.16 %	
User Interface		
Graphics display	High-definition backlit LCD display	

Display functions	measurement value screens (measurement, status, etc.)	
Language	Chinese/English	
Unit	Refer to 5.5 “Parameter Setting Menu”	
Operating unit	4 mechanical push buttons	
Accuracy		
Max measuring error	Flowmeter	Measurement value ±0.5% (Flow rate > 1m/s); Measurement value ±0.5% ±2mm/s（Flow speed <1m/s）
	BTU meter	2%
Repetitiveness	0.16%	
Temperature sensor measuring range	-20℃~120℃	
Maximum measurement error	±0.1℃(Within the measuring range of temperature sensor)	
Environment		
Ambient	-10℃ ~ 55℃	
Storage	-40℃~65℃	
Conductivity		
Water	Min. 20μS/cm (actual measurable conductivity should be greater than 50μS/cm)	
Other	Min. 5μS/cm (actual measurable conductivity should be greater than 50μS/cm)	
Material		
Sensor housing	Carbon steel	
Converter	Standard die-cast aluminum	

Electrical Connection	
Power voltage	85VAC~250VAC, 45Hz~63Hz, 20VDC~36VDC
Power rate	≤20W
Signal cable	Only for the remote type
Output	
Current output	(4~20) mA, (0~750) Ω
Frequency output	Frequency output range: (1～5000) Hz Output electrical isolation: photoelectric isolation. Isolation current voltage: >1000VDC Frequency output drive: field effect tube output; maximum current voltage 36VDC; maximum load current 250mA
Pulse output (Remote type)	Output pulse equivalent: (0.001～1.000) m3/cp Output pulse width: 0.5 ~ 999.9 ms Output current isolation: photoelectric isolation, current voltage: >1000VDC Pulse output drive: field effect tube output, maximum power voltage 36VDC, maximum load current 250mA
Pulse output (Integrated type)	Output pulse equivalent: 0.001 ~ 59.999 m3/cp Output pulse width: 1 ~ 9999ms adjustable Output electrical isolation: photoelectric isolation, isolation voltage: > 1000VDC Pulse output drive: field effect transistor output, maximum voltage 36VDC, maximum load current 250mA

9.2 Electrode Material

Table 10

Material	Corrosion resistance
Molybdenum-containing stainless steel (0Cr18N12Mo2Ti)	Applicable: domestic/industrial water, sewage, weak acid and alkali salt solution, concentrated nitric acid at room temperature. Not suitable for: hydrofluoric acid, hydrochloric acid, chlorine, bromine, iodine and other media.
Hastelloy B	Applicable: Non-oxidizing acids such as hydrochloric acid and hydrofluoric acid of a certain concentration, non-oxidizing hydrochloric acid, and alkali solutions such as sodium hydroxide with a concentration not less than 70% Not applicable: oxidizing acids such as nitric acid
Hastelloy C	Applicable: corrosion by oxidizing acids, such as nitric acid, mixed acid, or sulfuric acid; also resistant to corrosion by oxidizing salts or environments containing other oxidants, such as hypochlorite solutions above room temperature; very good corrosion resistance to seawater. Not applicable: reducing acids such as hydrochloric acid and chlorides
Titanium	Applicable: Chlorides, hypochlorites, seawater, oxidizing acids. Not applicable: Reducing acids such as hydrochloric acid and sulfuric acid
Tantalum	Applicable: Most acidic liquids such as concentrated hydrochloric acid, nitric acid, sulfuric acid, including boiling point hydrochloric acid, nitric acid and sulfuric acid below 175°C. Not applicable: Alkali, hydrofluoric acid, fuming sulfuric acid.
Pt - Ir alloy	Various acids, bases, salts, excluding aqua regia.

Note: Due to the wide variety of media, their corrosiveness is affected by temperature, concentration, flow rate and other complex factors, so this table is for reference only. Users should make their own choices based on actual conditions. For general media, you can refer to the relevant anti-corrosion manual. For media with complex components such as mixed acid, corrosion tests should be conducted on the selected materials.

9.3 Flow Rate& Flow Velocity Reference Table

Table 11 Flow Rate& Flow Velocity Reference Table

Flow Velocity (m/s) / Flow rat (m³/h) / DN(mm)	0.1	0.2	0.4	0.5	1	5	10	15
DN10	0.02827	0.0565	0.1131	0.1414	0.2827	2.827	3.39	4.24
DN15	0.0636	0.127	0.25	0.318	0.636	6.362	7.632	9.54
DN20	0.131	0.226	0.45	0.566	1.131	11.31	13.572	16.965
DN25	0.176	0.35	0.71	0.8835	1.767	17.67	21.204	26.505
DN32	0.2895	0.58	1.16	1.448	2.895	28.95	34.74	43.425
DN40	0.4525	0.90	1.81	2.62	4.524	45.24	54.208	67.86
DN50	0.707	1.414	2.83	3.535	7.069	70.69	84.83	106
DN65	1.195	2.39	4.78	5.973	11.946	119.5	143.35	179.2
DN80	1.81	3.62	7.24	9.048	18.1	181	217.2	271.5
DN100	2.83	5.65	11.31	14.14	28.27	282.7	339.24	424.05
DN125	4.42	8.84	17.67	22.09	44.18	441.8	530.16	662.7
DN150	6.36	12.7	25.5	31.81	63.62	636.2	763.44	954.3
DN200	11.3	22.6	45.2	56.55	113.1	1131	1357.2	1696.5
DN250	17.7	35.4	70.7	88.36	176.7	1767	2110.4	2650.5
DN300	25.45	51	102	127.24	254.5	2545	3054	3878.5
DN350	34.64	69	139	173.2	356.4	3464	4156.8	5196
DN400	45.24	90	181	226.2	452.4	4524	5428.8	6786
DN450	57.3	114	229	286.3	572.6	5726	6871.2	8589
DN500	70.7	141	283	353.4	706.9	7069	8484.8	10603.5
DN600	102	203	407	508.9	1018	10179	12216	15270
DN700	139	277	554	692.7	1385	13854	16620	20775
DN800	181.0	362	723	905	1810	18096	21720	27150
DN900	229.0	458	916	1145	2290	22902	27480	34350
DN1000	283	565	1131	1414	2827	28274	33924	42405
DN1200	407	814	1628	2034.7	4069.4	40694	48832.8	61041
DN1400	554	1108	2216	2769.5	5539.4	55390	66468	83085
DN1600	723	1447	2894	3617.3	7234.6	72346	86815.2	108519

9.4 Accuracy

Reference conditions

① Medium: Water

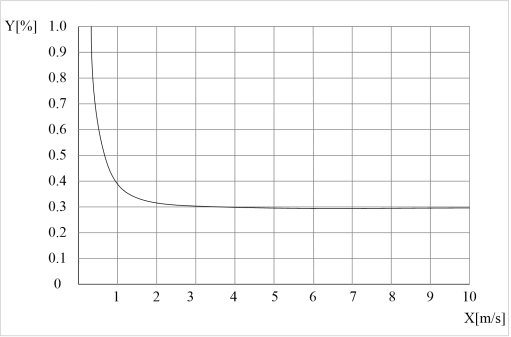
② Temperature: 20℃

③ Pressure: 0.1MPa

④ Front straight pipe section: ⩾10DN, rear straight pipe section: ⩾5DN

⑤ X[m/s]: flow velocity

⑥ Y[%]: deviated value(mV) of the actual measured



10 Communication

10.1 ModBus communication

The BTU meter supports Modbus communication. Baud rate is adjustable, and the same as the checksum, data bit (the default is 9600, N, 8, 1). Use the No. 04 function code to read data.

Table 12

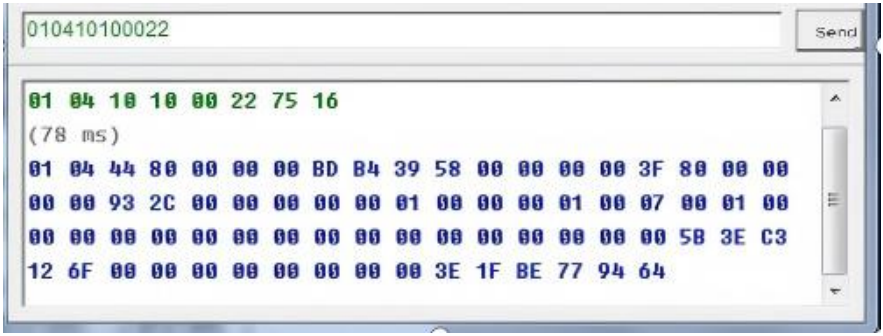
Addresses (Decimal)	Addresses (HEX)	Data Format	Register Definition
4112	0x1010	Float Inverse	Instantaneous flow rate(M3/h)
4114	0x1012	Float Inverse	Instantaneous flow rate
4116	0x1014	Float Inverse	Reserved
4118	0x1016	Float Inverse	Fluid conductivity ratio
4120	0x1018	Long Inverse	Cumulative flow-integer part
4122	0x101A	Float Inverse	Cumulative flow-fractional part
4124	0x101C	Unsigned short	Unit of instantaneous cold energy 0: MJ/h1: GJ/h2: kWh/h3: MWh/h
4125	0x101D	Unsigned short	Unit of total cold energy 0:MJ1:GJ2: kWh3:MWh
4126	0x101E	Unsigned short	Unit of instantaneous flow (Remote type only) 0: L/s 1: L/min 2: L/h 3: m^3/s 4: m^3/min 5: m^3/h
4128	0x1020	Unsigned short	Unit of instantaneous heat energy 0: MJ/h 1: GJ/h 2: kWh/h 3: MWh/h
4129	0x1021	Unsigned short	Unit of cumulative flow (remote type) 0:0.00001L 1:0.0001 L 2:0.001L 3:0.01L 4:1L 5: 0.00001m 6: 0.0001m^3 7:0.001 m^3 8: 0.01m 9:0.1m 310:1m^3 Unit of cumulative flow (Integrated type) 1, m^3
4130	0x1022	Unsigned short	Pressure range 0: 0.6 MPa

			1: 1.6 MPa
4131	0x1023	Unsigned short	Unit of total heat energy 0: MJ 1:GJ 2: kWh 3:MWh
4132	0x1024	Unsigned short	Empty pipe alarm 0: normal; 1: alarm
4133	0x1025	Unsigned short	System alarm 0: normal; 1: alarm
4134	0x1026	Float Inverse	Instantaneous heat flow rate
4136	0x1028	Long Inverse	Total accumulated heat energy-integer part
4138	0x102A	Float Inverse	Total accumulated heat energy-fractional part
4140	0x102C	Unsigned short	Inlet temperature (°C)
4141	0x102D	Unsigned short	Outlet temperature (°C)
4142	0x102E	Long Inverse	Total cumulative cold energy-integer part
4144	0x1030	Float Inverse	Total cumulative cold energy-fractional part
4146	0x1032	Float Inverse	Instantaneous cold energy

10.2 Modbus Communication Example

Set the flowmeter to: baud rate 9600, no calibration, 1 stop bit, 8 data bits, and correspondence address 01.

The host computer sends 01 04 10 10 00 1D 74 C1 The flowmeter will reply data, as shown in the figure below



Appendix 1 Notes on the Nonlinearity Correction Function

(1) Remote Type

The nonlinearity correction function is primarily used for linear adjustment at low flow rates. This function is designed with four correction segments, consisting of four velocity correction points and four corresponding correction coefficients. The flow rate corresponding to the correction point must meet: correction point 1 > correction point 2 > correction point 3 > correction point 4 > 0.

The nonlinearity correction coefficients are applied on top of the original sensor calibration coefficient. Therefore, it is necessary to first disable the nonlinearity correction function, mark the sensor coefficient, and then enable the nonlinearity correction function to proceed with correction. Based on the nonlinear sections of the sensor, set the correction points and corresponding coefficients accordingly. If set properly, recalibration may not be required.

Assume that the flow velocity calculated using the sensor coefficient is the original velocity, and the velocity after applying the nonlinearity correction is referred to as the corrected velocity. The corrected velocity is defined as follows:

When Correction Point 1 > Original Velocity ≥ Correction Point 2:
Corrected Velocity = Correction Coefficient 1 × Original Velocity

When Correction Point 2 > Original Velocity ≥ Correction Point 3:
Corrected Velocity = Correction Coefficient 2 × Original Velocity

When Correction Point 3 > Original Velocity ≥ Correction Point 4:
Corrected Velocity = Correction Coefficient 3 × Original Velocity

When Correction Point 4 > Original Velocity ≥ 0:
Corrected Velocity = Correction Coefficient 4 × Original Velocity

Note: When setting correction points, the following order must be maintained:
Correction Point 1 > Correction Point 2 > Correction Point 3 > Correction Point 4
The default (neutral) correction coefficient is 1.0000. A coefficient greater than 1.0000 is considered positive correction (amplification), while a coefficient less than 1.0000 is considered negative correction (reduction).

(2) Integrated Type

The electromagnetic converter has updated its nonlinearity correction calculation method. The new method is easy to set up, clear in meaning, and produces accurate correction results.

Parameter definition:

Qpn — The actual flow rate value selected for correction (correction point: $Qp1$ -- $Qp5$)

Qcn — The desired flow rate value after correction (corrected value: $Qc1$ -- $Qc5$)

The electromagnetic converter is designed with 5 velocity correction points and 4 flow correction values. The fifth correction point is also the fifth correction value. Their corresponding relationship is as follows:

Flow Correction Point	Correction Value
Point 1	Value 1
Point 2	Value 2
Point 3	Value 3
Point 4	Value 4
Point 5	Value 5

When configuring, users must follow the principle of increasing flow correction points from low to high:

Correction point 5 > Correction point 4 > Correction point 3 > Correction point 2 > Correction point 1 > 0.

Flow rate correction formula: $K=\frac{Q_{c1}}{Q_{p1}}+\frac{Q_X-Q_{P1}}{Q_{p2}-Q_{P1}}\times(\frac{Q_{c2}}{Q_{p2}}-\frac{Q_{c1}}{Q_{p1}})$

$$Qcx=K\times Qx$$

Where: Qcx ---Corrected flow rate

Qx ---Flow rate before correction

K---Intermediate variable

Note: If the user only needs to correct some of the points, the remaining correction points and values can be set to the maximum flow rate point.

Example: If only Correction Points 1–3 are needed, then set Correction Points 4–5 and their corresponding Correction Values 4–5 equal to the maximum flow rate.

Appendix 2 Heat Measurement and Wiring

1. Remote type

(1) Pt 1000 RTD temperature measurement calibration method:

Pt 1000 thermal resistance three-wire bridge connection method is applied in temperature measurement, wiring is as below:

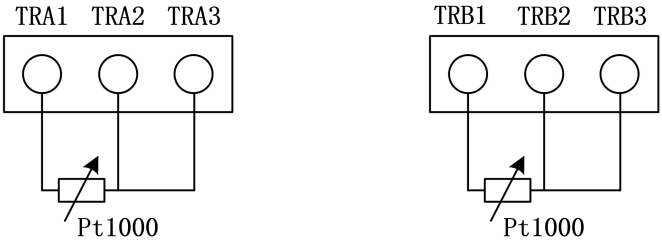


Fig.43

If the user needs to adopt Pt1000 thermal resistor two-wire bridge connection mode, the wiring is shown in the figure below:

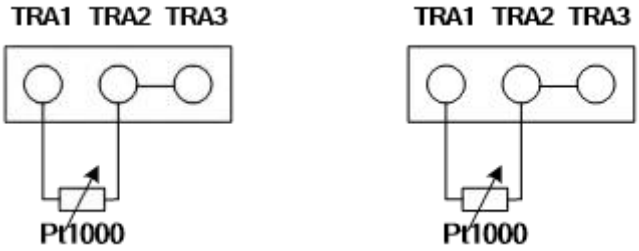


Fig.44

The RTD measurement circuit requires zero-point adjustment and range calibration in the parameter settings. The converter has been calibrated with a resistance box before delivery. If further calibration is required, proceed as follows:

① **Calibration Using a Resistance Box (Three-wire connection)**

- **Step 1:** Set the standard resistance box to 100 Ω. In the inlet (or outlet) temperature zero-point parameter, adjust the zero correction value (typically around 32768) until the upper line of the display reads 0.
- **Step 2:** Set the standard resistance box to 153.58 Ω. In the inlet (or outlet)

temperature calibration parameter, adjust the range correction value (typically around 2.6) until the upper line of the display reads 14000.

② **Calibration Using a Blackbody Furnace (Three-wire connection)**

- **Step 1:** Immerse the RTD in an ice-water groove. In the inlet (or outlet) temperature zero correction coefficient, adjust the zero correction value (typically around 32768) until the upper line of the display shows ±0.
- **Step 2:** Set the blackbody furnace to 140°C and place the RTD inside. In the inlet (or outlet) range correction parameter, adjust the range correction coefficient until the upper line of the display reads 14000.

(2) Pt100 RTD Temperature Measurement Calibration Method

The temperature measurement section of the heat meter adopts a three-wire bridge connection with a Pt100 RTD, as shown below

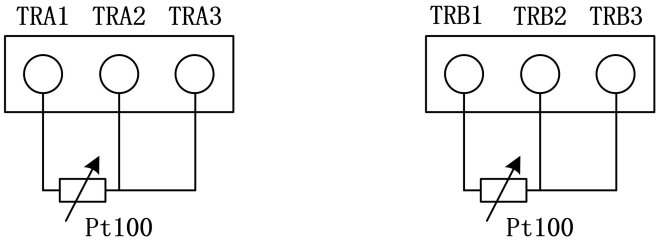


Fig.45 — Three-wire connection of Pt100 RTD

If a two-wire bridge connection is used, wiring should be as follows:

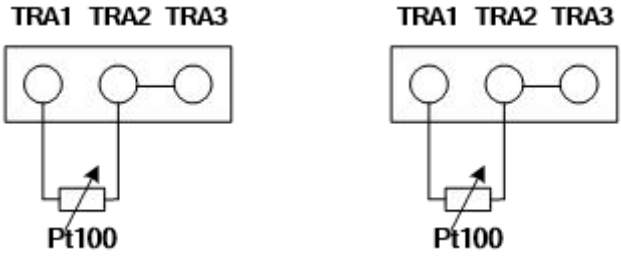


Fig.46 Two-wire connection of Pt100 RTD

The RTD measurement circuit requires zero-point adjustment and range calibration in the parameter settings. The converter has been calibrated with a resistance box before delivery. If further calibration is required, follow these steps:

③ **Calibration Using a Resistance Box (Three-wire connection)**

- **Step 1:** Set the standard resistance box to 100 Ω. In the inlet (or outlet) temperature zero-point parameter, adjust the zero correction value (typically around 32768) until the upper line of the display reads 0.
- **Step 2:** Set the standard resistance box to 153.58 Ω. In the inlet (or outlet) temperature calibration parameter, adjust the range correction value (typically around 2.6) until the upper line of the display reads 14000.

④ **Calibration Using a Blackbody Furnace (Three-wire connection)**

- **Step 1:** Immerse the RTD in an ice-water groove. In the inlet (or outlet) temperature zero correction coefficient, adjust the zero correction value (typically around 32768) until the upper line of the display shows ±0.
- **Step 2:** Set the blackbody furnace to 140°C and place the RTD inside. In the inlet (or outlet) range correction parameter, adjust the range correction coefficient until the upper line of the display reads 14000.

2. Integrated Type

(1) Temperature measurement and calibration method:

The temperature measurement part of the hot and cold meter adopts a Pt1000 thermal resistance four-wire bridge connection mode by default before shipping. The wiring is shown in the following figure:

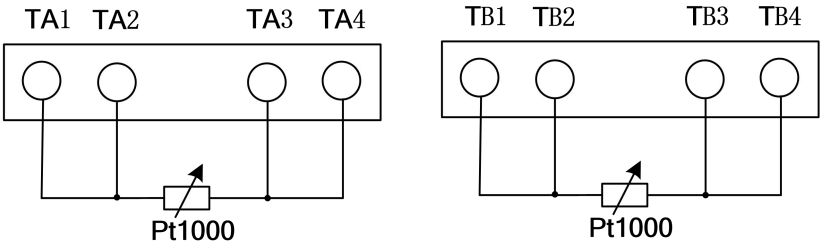


Fig.47

If the Pt1000 thermal resistor two-wire bridge connection mode is adopted, the wiring is shown in the figure below:

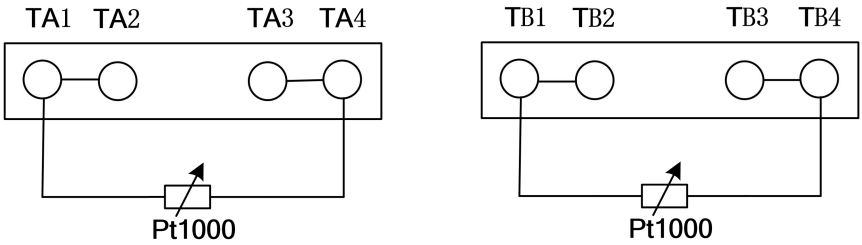


Fig.48

If the Pt1000 thermal resistor three-wire bridge connection mode is adopted, the wiring is shown in the figure below:

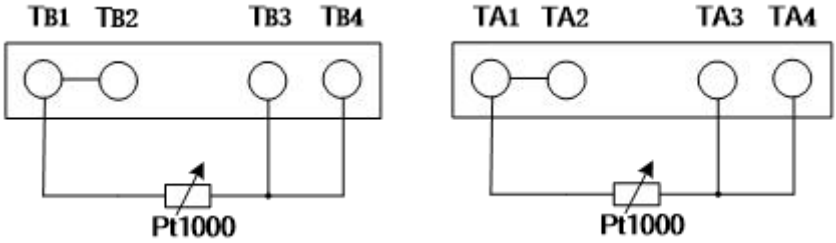


Fig.49

The RTD measurement circuit requires zero-point adjustment and range calibration in the parameter settings. The converter is calibrated with a resistance box before leaving the factory. If further calibration is needed, proceed as follows:

A. Using a Resistance Box (Three-Wire Connection)

- **Step 1:** Set the standard resistance box to 1000 Ω. In the inlet (or outlet) temperature zero-point parameter, adjust the zero correction value (typically around 34800) until the upper line of the display reads 0.
- **Step 2:** Set the standard resistance box to 1535.8 Ω. In the inlet (or outlet) temperature calibration parameter, adjust the range correction value (typically around 0.7500) until the upper line of the display reads 1400.

B. Using a Blackbody Furnace (Three-Wire Connection)

- **Step 1:** Immerse the RTD in an ice-water groove. In the inlet (or outlet) temperature zero correction coefficient, adjust the zero correction value (typically around 34800) until the upper line of the display shows ±0.
- **Step 2:** Set the blackbody furnace to 140°C and place the RTD inside. In the inlet (or outlet) range correction parameter, adjust the range correction coefficient until the upper line of the display reads 1400.

(2) Heat Calculation Method

This electromagnetic heat/cold meter complies with the CJ128—2007 “Heat Meters”.

Heat Measurement:

When water flows through an integrated electromagnetic heat/cold meter or a combined electromagnetic heat/cold meter installed in a heat exchange system, the system calculates and displays the heat energy released or absorbed based on:

$$Q = \int_{t0}^{t1} q_m \times \Delta h \times dt = \int_{t0}^{t1} \rho \times q_v \times \Delta h \times dt$$

Where:

Q—thermal energy released or absorbed by the system, in joules (J);

q_m —mass flow rate of the medium passing through the thermal energy meter, in kilograms per hour (kg/h);

qv—volumetric flow rate of the medium, in cubic meters per hour (m^3/h);

ρ — density of the medium, in kilograms per cubic meter (kg/m^3);

Δh — specific enthalpy difference of the medium between inlet and outlet, in joules per kilogram (J/kg);

t — time duration, in hours (h).

The **density** and **enthalpy** values in the formula must comply with **Appendix A of the CJ128—2007 standard**. If the temperature is a non-integer, **interpolation should be applied**.

Note: Heat measurement is calculated by multiplying the inlet and outlet enthalpy values by the flow rate. Therefore, the calculated heat depends on the **incremental flow of the cumulative volume**. Each incremental change in cumulative flow triggers a heat calculation. To avoid excessively long intervals before a flow increment occurs, the **cumulative flow unit should not be set too large**.

The cumulative flow is represented as a **9-digit decimal number (999,999,999)**. Four flow units are available: **0.001 m³, 0.01 m³, 0.1 m³, and 1 m³**. The flow unit should be chosen such that the meter **does not overflow within 2–3 years**.