sisco

Coriolis Mass Flow Meter

Operating Manual

Content

Appendix

1. Mass Flow Meter Overview

Coriolis mass flow meter is a new type flow meter which is designed according to Micro Motion and Coriolis principle. This kind of new flow meter can measure the fluid directly in a sealed pipeline. It consists of two sections: Sensor and Signal Transmitter.

1.1 Main Features

- Unchallengeable performance on liquid mass flow, volume flow, and density measurement
- Unique design delivers unparalleled measurement sensitivity and stability
- Guarantees consistent, reliable performance over the widest flow range
- Designed to minimize process, mounting, and environmental effect

1.2 Application

The mass flow meter can be used in the following fields to meet the requirements of ingredient, mixing processes and commercial measurement.

- Chemical: containing chemical reaction system
- Petroleum: moisture content analysis
- Lipids: including vegetable oils, animal fats and other oils
- Pharmaceutical
- Painting
- Paper making
- Textile printing and dyeing
- Fuel: crude oil, heavy oil, coal slurry, lubricant and other fuels.
- Food: gas dissolving beverage, health drink and other liquid.
- Transportation: pipeline liquid measurement.
- Low temperature fluid, like liquid oxygen and liquid nitrogen, the low temperature up to -200℃
- High temperature fluid, the maximum temperature up to 300℃
- High pressure fluid, like slurry flow measurement for oil drilling cementing

1.3 Working Principle

If a pipe is rotated around a point (P) while liquid is flowing through it (toward or away from the center of rotation), that fluid will generate an inertial force, with reference to Figure 1.1:

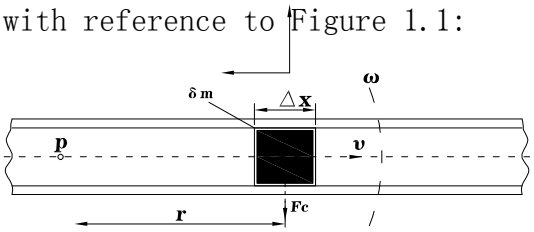


Figure 1-1

A particle (δ_m) travels to the right at a constant velocity (v) inside a tube. The tube is rotating around a fixed point (P) at angular velocity (w), in this case, this particle will get two acceleration components:

1. Normal acceleration (centripetal acceleration), its value is equal to w^2r, its direction is toward the point P
2. Tangential acceleration a_1 (Coriolis acceleration), its value is equal to 2wv, its direction is perpendicular to v

The force generated by tangential acceleration is Coriolis force, its value is equal to $Fc = 2wv\delta m$. In figure1.1 fluid $\delta_m = \rho A \times \Delta X$, So Coriolis force can be expressed as:

$\Delta Fc = 2\omega \upsilon \times \delta m = 2\omega \upsilon \times \rho A \times \Delta X = 2\omega \times \delta qm \times \Delta X$

Wherein A is the duct cross-sectional area.

$\delta qm = \delta dm/dt = \upsilon \rho A$

For special rotational pipe, its frequency is constant, ΔFc only depends on δqm. Therefore, directly or indirectly measuring the Coriolis force can be measured mass flow. This is how Coriolis mass flow meter works.

The actual flow sensor can't achieve rotational movement, replace by pipeline vibration. The principle is shown in Figure1.2、Figure1.3、Figure1.4. Both ends of a bend pipe are fixed, and the vibration force is applied to the pipe in an middle of the two fixed points (according to the resonance frequency of pipeline), taking the fixed point as axis, making pipeline vibrate at its natural frequency (w). When no fluid flows through the pipeline, the pipeline is only affected by vibration force, the vibration direction of two half-section of pipeline is the same, no phase difference. When fluid flows, by the influence of fluid medium dot Coriolis force Fc inside the pipeline (In the two half-section of pipeline, Coriolis F1 and F2 are equal in magnitude and opposite in direction Figure 1.2), two half-section of pipeline occur twist in the opposite direction to generate phase difference which is proportional to mass flow. The design of sensor is converting the measurement of Coriolis force to the measurement of phase difference for both sides of the vibrating tube. This is the working principle of Coriolis mass flow meter.

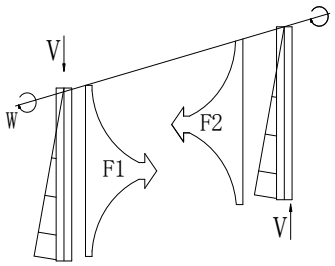


Figure 1-2

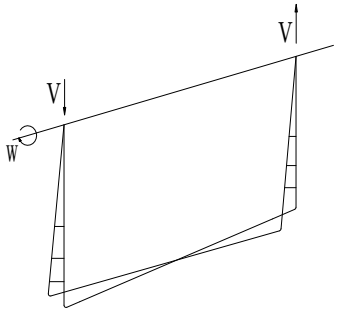


Figure 1-3

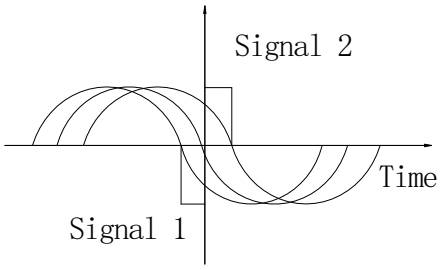
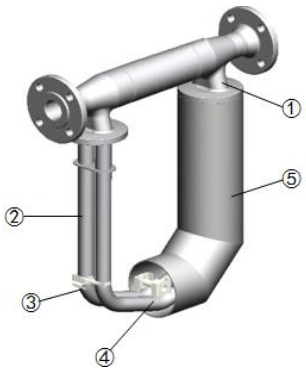


Figure 1-4

2. Sensor Structure and Main Parameters

2.1 Sensor Structure



Series mass flow meter sensor consists of measurement tube, driving device, position detector, support structure, the temperature sensor, housing, etc.

①Supporting structure: the measuring tube fixed on the supporting structure as the vibrating axis.

②The measuring tube (Vibrating tube): consist of two parallel tubes.

③Position detector: used for the measurement of measuring tube distortion.

④Drive device: generate electromagnetic force to drive measuring tube to make it vibrate close to resonance frequency.

⑤Housing: Protect the measuring tube, driving unit and detector.

2.2 Technical Parameters

■ Dimension and Measuring Range

DN (mm)	Flow range (kg/h)	Zero Stability (kg/h)
3	0~96~144	0.0144
6	0~540~810	0.081
8	0~960~1440	0.144
10	0~1500~2250	0.225
15	0~3000~4500	0.45
20	0~6000~9000	0.9
25	0~9600~14400	1.44
32	0~18000~27000	2.7
40	0~30000~45000	4.5
50	0~48000~72000	7.2
80	0~120000~180000	18
100	0~192000~300000	30
150	0~360000	36

- Accuracy(Liquid) :

  Measurement accuracy: ±0.1% ± (zero stability/measurement value) %

  Measurement accuracy: ±0.15% ± (zero stability/measurement value) %

  Measurement accuracy: ±0.2% ± (zero stability/measurement value) %

  Repeatability: 1/2 measurement accuracy %

- Density(Liquid) measuring range and accuracy:

  Range: 0.3～3.000g/cm^3 Accuracy: ±0.002g/cm^3

- Temperature measuring range and accuracy:

  Temperature measuring range: -200～350℃ Accuracy: ±1℃

- Ambient temperature: -40℃～60℃
- Material : The measuring tube SS316L Housing: SS304
- Working pressure: 0～4.0MPa
- Explosion-proof level : Ex db ia Ⅱ CT6 Gb

2.3 Sensor Installation

"U" -type Split- type

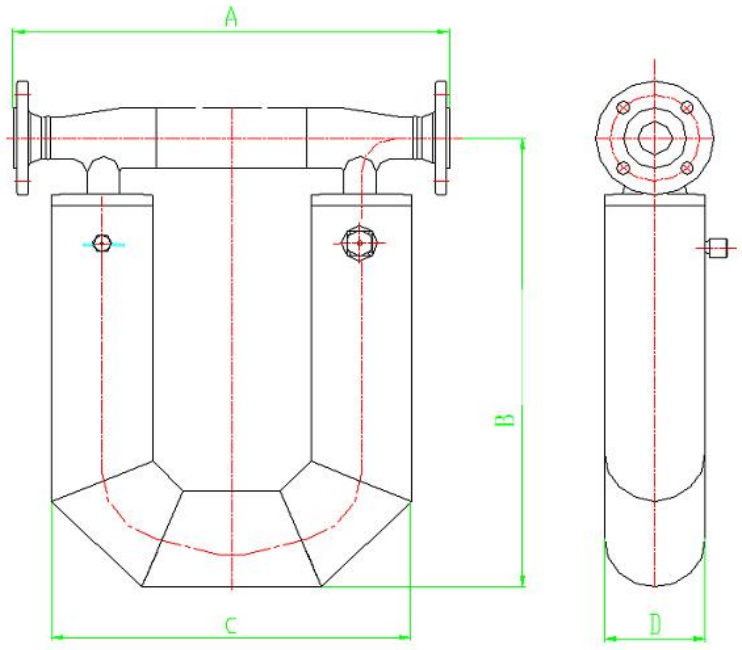


Figure2-1 Split-type sensor

“U” -type Integrated

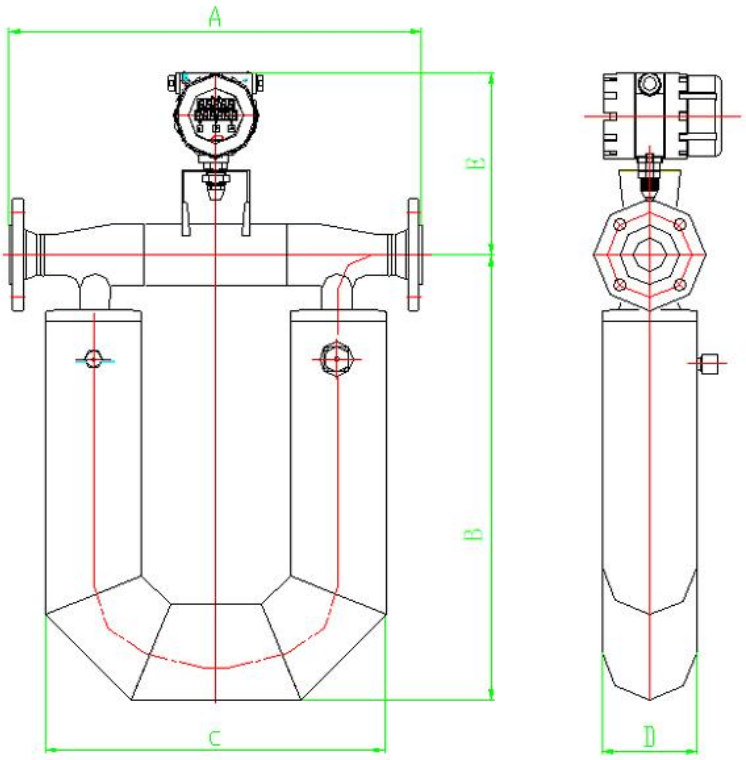


Figure2-2 Integrated type

DN (mm)	A	B	C	D	NW(only sensor)
	mm	mm	mm	mm	kg
20	540	750	468	108	17
25	540	770	468	108	17.5
32	545	810	468	108	24
40	600	930	500	140	32
50	606	955	500	140	36
80	866	1177	780	220	87.5
100	950	1335	833	273	165
150	1300	1593	1144	324	252
200	1300	1600	1144	400	350

Triangle split type

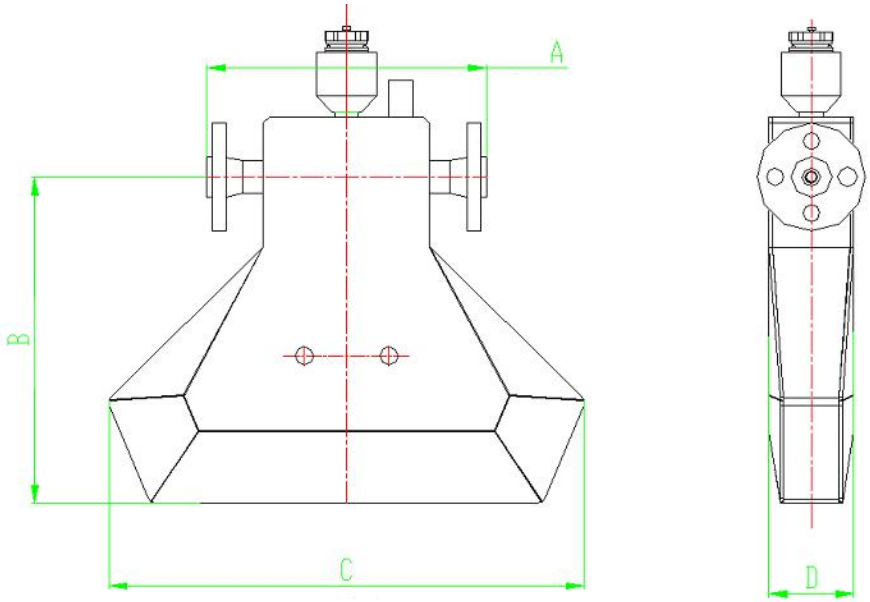


Figure 2-3 003 / 006 / 008

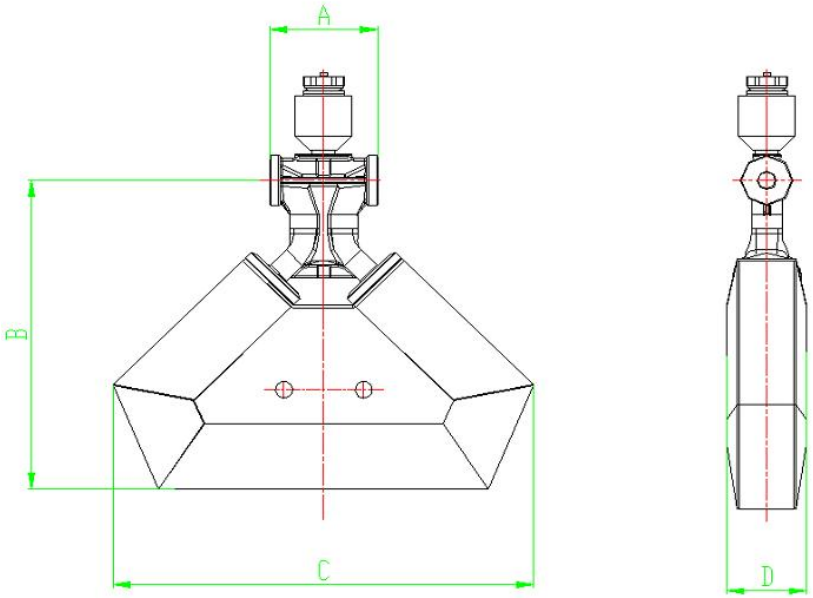


Figure 2-4 010 / 015

Triangle integral type

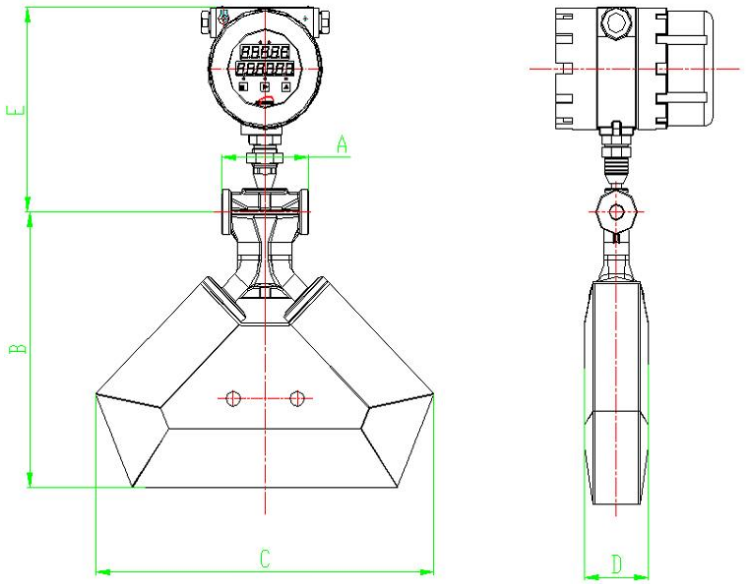


Figure 2-5 010 / 015

Model	A	B	C	D	E	NW
	mm	mm	mm	mm	mm	kg
3	178	176	250	54	244	4.8
6	232	263	360	70.5	287	8.1
8	232	275	395	70.5	290	8.2
10	95	283	370	70.5	242	6.5
15	95	302	405	70.5	242	6.5

Note: A size will be changed with the different process connection.

3. Selection and Installation

3.1 Selection

The following conditions should be considered for flow meter selection.

Medium characteristics	▪ Measurability Coriolis mass flow meter is widely used for lots of fluid, but some conditions like slug flow, pulsating flow etc, where you want to install Coriolis mass flow meter, some appropriate support measures must be taken. ▪ Corrosivity Coriolis mass flow meter measuring tube material is SS316L, housing material SS304. If the standard material is not suitable for the medium, anticorrosion wetted material should be selected. ▪ Operating temperature and pressure Standard configuration: -50~+200 ℃, 4.0MPa, please contact with manufacturer for special parameters. ▪ Ambient condition Standard ambient temperature is -40~+60℃. The flow meter will fail to display if the ambient temperature exceeds the standard range. Please contact with manufacturer for special parameters. ▪ Protection and Explosion Transmitter ex-proof: flame type, Sensor ex-proof: intrinsic type Transmitter and Sensor protection: IP67
Preferred measuring range	1/3~2/3 of standard flow range
Allowable pressure loss	Pressure loss should be considered especially for reduced pipe.

3.2 Installation

3.2.1 Basic Requirements on installation

- Flow direction should be in accordance with sensor flow arrow.
- Properly supporting is required for preventing tubes vibrating.
- If a strong pipeline vibration is inevitable, it is recommended to use a flexible tube to isolate the sensor from the pipe.
- Flanges should be kept parallel and their center points should be located on the same axis to avoid subsidiary force generation.
- Installation vertically, make the flow from the bottom up when measuring,

meanwhile, the meter should not be installed on the top to prevent air getting trapped inside the tubes.

3.2.2 Installation Direction

In order to ensure the reliability of the measurement, the ways of installation should consider the following factors;

The meter should be installed downward when measuring liquid flow (Figure3-1), so that air cannot get trapped inside the tubes.

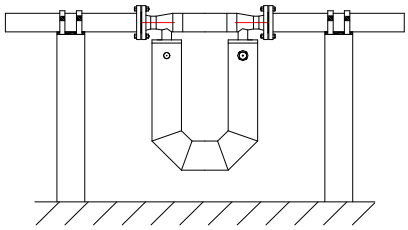


Figure 3-1

The meter should be installed upward when measuring gas flow (Figure3-2), so that liquid cannot get trapped inside the tubes.

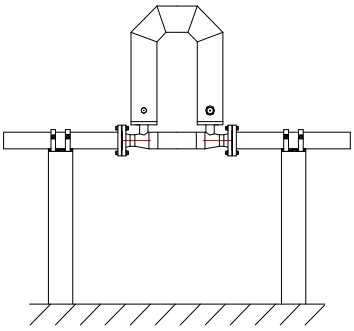


Figure 3-2

The meter should be installed sideward when the medium is turbid liquid (Figure3-3) to avoid particulate matter accumulated in the measuring tube. The flow direction of medium goes from the bottom up through the sensor.

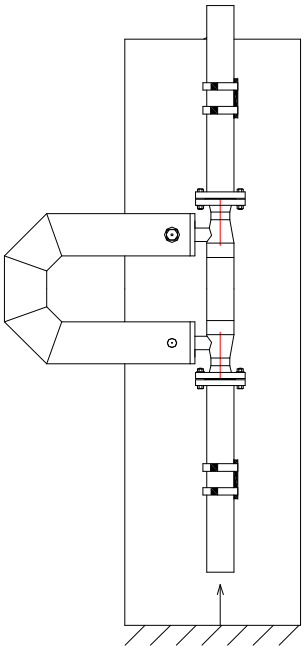


Figure 3-3

3.2.3 Sensor Fixed

Coriolis mass flowmeter is a vibrating instrument, when they work, the two vibrating tube is always in a state of vibration. Therefore, external vibration or pipeline vibration may have effect on their normal operation.

For small diameter coriolis mass flow meter, it is not easy to avoid vibration because of the small measuring tube, in this case, we provide installation bracket which is used for fixed. Please make sure that the installation bracket is installed on a stable interface. The installation diagram for small diameter is show

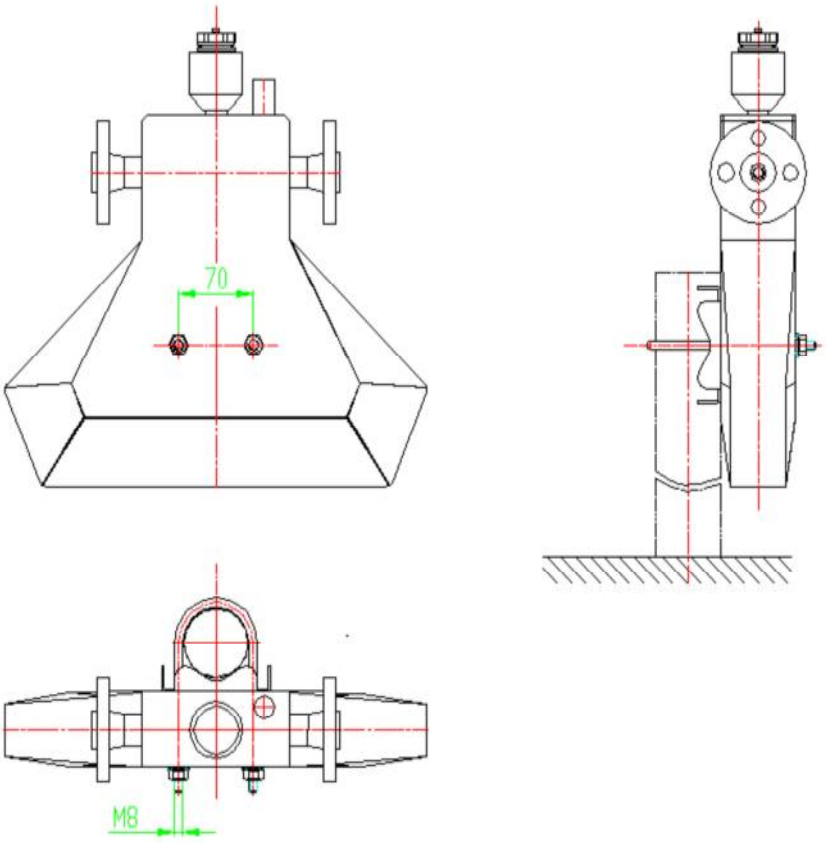


Figure 3-4 Sensor bracket installation

4 Transmitter operating manual

4.1 Overview

Flow signal transmitter is used with MTCMF coriolis mass flow meter sensor, which has sensor vibrating tube deriver, phase signal detection, flow rate operation display, flow integrating, signal remote transmitting and other functions.

4.2 Main Parameters

Display	128x64 LCD display, Window size: 54x40mm (WxH) Φ80mm
Display Accuracy	0.02%
Unit	Mass flow rate:g/h, kg/h, t/h, g/m, kg/m, t/m, t/s, kg/s, g/s, lb/h, lb/m, lb/s Total flow: g, kg, t, lb Volume flow rate: ml/h, l/h, m^3/h, ml/m, l/m, m^3/m, ml/s,, l/s, m^3/s, gal/h, gal/m, gal/s Total volume: ml, l, gal, m^3, Density: kg/m^3, g/cm^3 Temperature: ℃, F, K
Ambient Temperature	-30~+60℃
Output Signal	0~10000Hz pulse frequency signal flow signal (open collector signal) Equivalent pulse signal flow signal 4~20mA Current signal choose one signal from flow rate, density, temperature Current output load capacity is not less than 750Ω (24VDC power supply) Accuracy: Pulse signal 0.05% Current signal 0.2% Communication signal: RS485, MODBUS protocol
Power Supply	18~36VDC power:7W 85~265VAC power: 10W
Protection	Protection: IP67 Ex-proof: Ex db ia Ⅱ CT6Gb
Dimension	Φ125×180mm

4.3 Structure Description

4.3.1Transmitter Panel

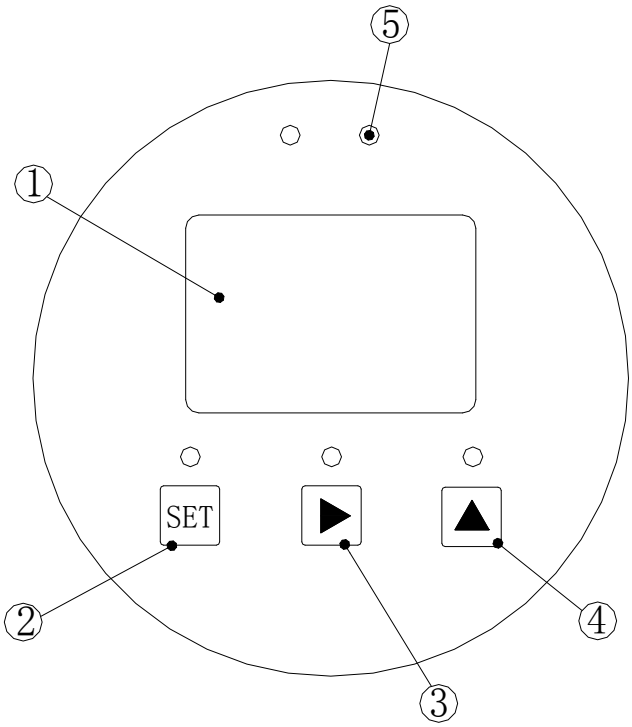


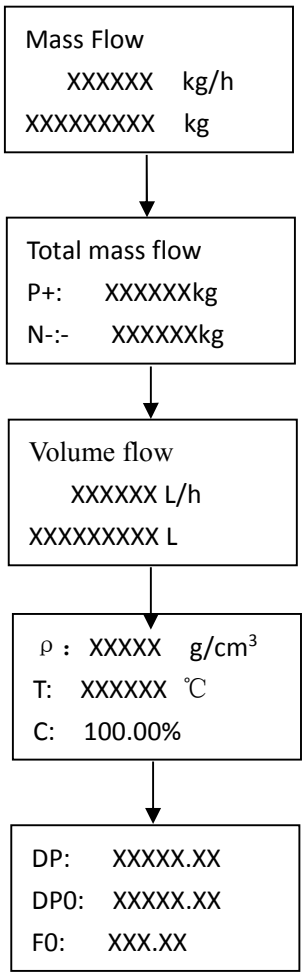
Figure4-1. Transmitter Panel

1) Measurement window

- Measurement window is 128x64 LCD displayer, three lines of characters display separately: measurement parameter, working parameter and setting parameters.
- Mass flow rate and total flow, volume flow rate and total volume, density, temperature can be displayed by page number.
- Under setting condition, the setting value of each parameter can be showed, modified and reset.

⚠ *:Parameter setting can be ONLY performed by authorized engineer, as parameter change can affect the accuracy of the flowmeter.*

The display format of flow meter is listed below under normal peration:



Mass flow and volume flow interface, the last line represents its total accumulation; Mass flow positive and negative cumulants are measured separately; ρ is the density of the measured medium, T is the temperature of the measured medium, C is the concentration of the measured medium; DP, DP0, TC, F0 and so on are the working parameters of the instrument.

Use 〖＞〗and 〖∧〗to page up and page down.

2, 3, 4 are operation keys, which is made up of photoelectric switch.

2) 〖SET〗Setting Key

Under measurement condition, press and hold〖SET〗key to enter parameter setting status. The parameter setting of flowmeter include user parameter setting and engineering parameter setting. To ensure the operation security, a password is required to enter parameter setting status.

3) 〖＞〗Shift Key

Under measurement status, pressing shift key can page down;

Under setting status, pressing shift key can select setting content.

4) 〖∧〗Add Key

Under measurement status, pressing add key can page up;

Under setting status, pressing add key can change setting value.

Press 〖∧〗key----→0 1 2 3 4 5 6 7 8 9 .

5) Status Light

The status light will flash only for zero operation and fault.

4.3.2 Wiring Terminals

The transmitter contains two kinds of wiring terminal boards: the normal wiring terminal board (24VDC power supply) and auxiliary wiring terminal board (220VAC power supply).

Power supply wiring terminals from top to bottom	24+ terminal, 24V-terminal,Grounding terminal. External 24VDC power supply line connects to 24+, 24- terminals.
Signal wiring terminals from top to bottom	Hart+,Hart-, RS485 communication interface A terminal, RS485 communication interface B terminal, Current signal output terminal, Current signal output termina2, Pulse signal output terminal, Pulse signal output termina2.
Hart+ and Hart-	For custom Hart functions, see HART protocol wiring instructions
A and B	RS485 communication signal wiring terminals.

Current output signal	Remote current output signal of flow or density measurement value
Pulse output signal	Output pulse frequency signal corresponding to the rate of flow Output pulse equivalent signal corresponding to the flow equivalent

4.3.2.1 The normal wiring terminal board, showed in Figure 2

The common end of the alarm, current output and pulse output signals is internally common..

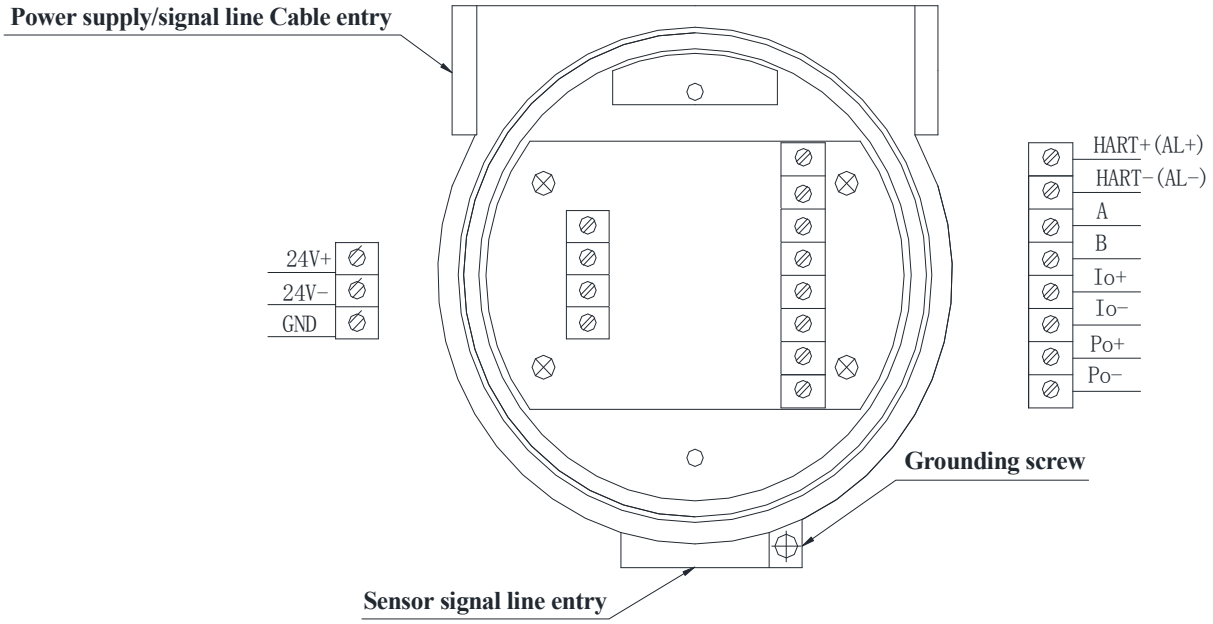


Figure 4-2 24VDC Power supply wiring board

4.3.2.2 The auxiliary wiring terminal board, showed in Figure 3

Power supply wiring terminals from top to bottom	220VAC terminal 1#, 220VAC terminal 2#,Grounding terminal
Signal wiring terminals from top to bottom	RS485 communication interface A terminal(Hart+) , RS485 communication interface B terminal(Hart-) , Current signal output terminal+, Current signal output terminal-,Pulse signal output terminal+,Pulse signal output terminal-,24V+ terminal,24V- terminal

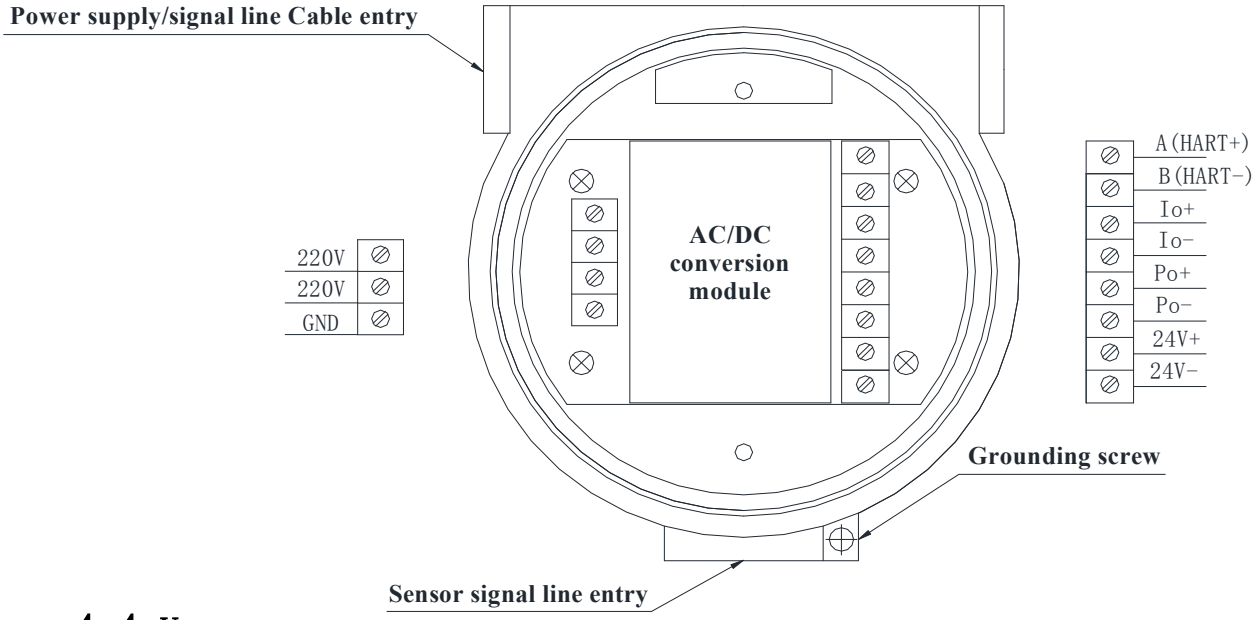
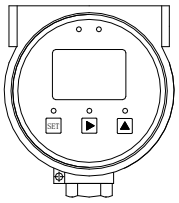
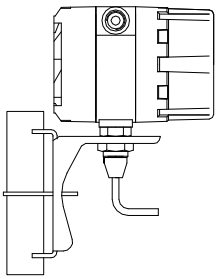


Figure 4-3 220AC Power supply wiring board

4.4 Use

4.4.1 Installation

Installation Type	Description
Figure4-4 	**Integrated type** The signal lines between sensor and transmitter have been connected well before factory, the users only need to connect external wiring.
Figure4-5 	**Remote type** Mounting bracket will be equipped for remote type. Cable length for standard configuration is 2m Side-wiring for transmitter has been connected well before factory. Use air plug to connect transmitter and senor (air plug protection is IP67)

4.4.2 Wiring

4.4.2.1 Power line access

- The normal power supply for flow meter is 24VDC. Power consumption is required to be not less than 7W. The power terminal and signal terminal in junction box is mounted separately and marked clearly.
- The power input in the flow meter has protective device for avoiding a faulty polarity connection. But for safe wiring, please note the polarity of the

power line.

- Please don’ t connect the power line to the signal wiring terminal.
- When 24V power is provided by secondary instrument or computer system, signal grounding line don’ t need another connection, which can realize three-wire work.

4.4.2.2 Pulse signal connection

The pulse signal output mode of the converter is the collector open active signal output mode.

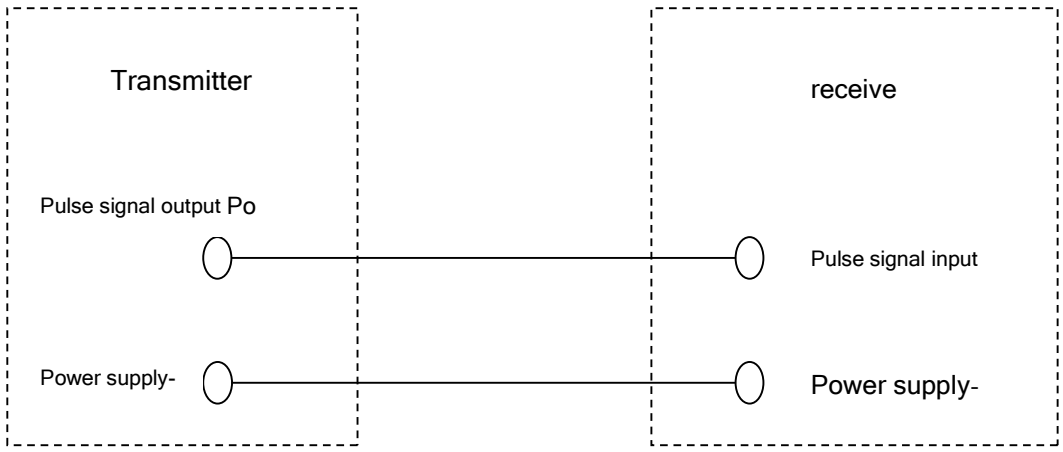


Figure 4-6 Pulse signal output wiring diagram (active output)

4.4.2.3 Current signal connection

Current output signal is active signal, shown as Figure 8

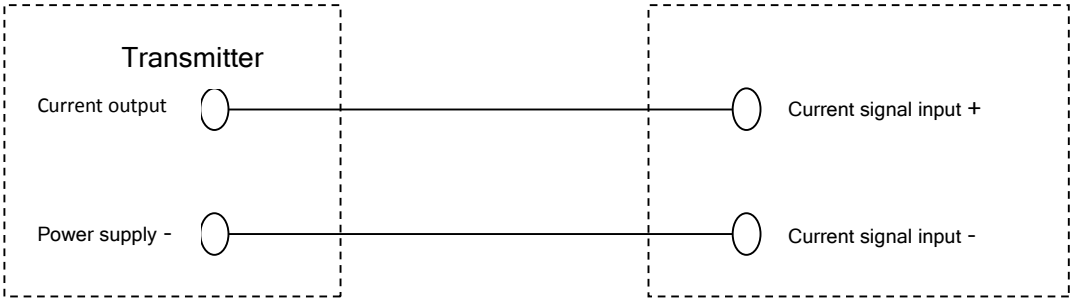


Figure 4-8 Current signal output wiring diagram

When output 1-5VDC power signal is required, access 250Ω standard resistance to the signal reception to realize the transition of current and power , which is shown as figure 9:

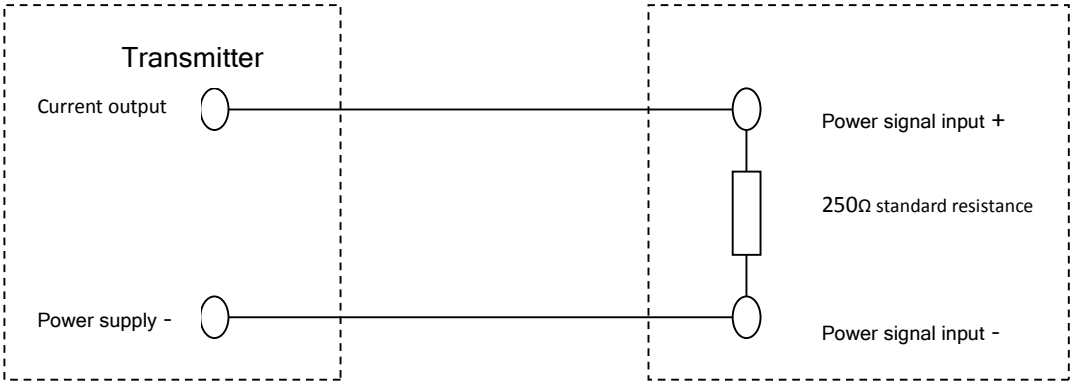


Figure 4-9 Power supply signal transition diagram

4.4.2.4 The wiring between transmitter and sensor

The junction box equipped with sensor and the terminals in the junction box are shown as Figure 10:

For integrated installation, the wiring between transmitter and sensor is in the mounting socket of transmitter and connected well before factory. The signal connection between transmitter and sensor for remote type is mentioned as below:

The wiring socket is equipped with the sensor. connect transmitter and sensor through the wiring socket. The protection level for wiring socket is IP67. The wiring socket and the terminals of lead wire are shown as figure 10:

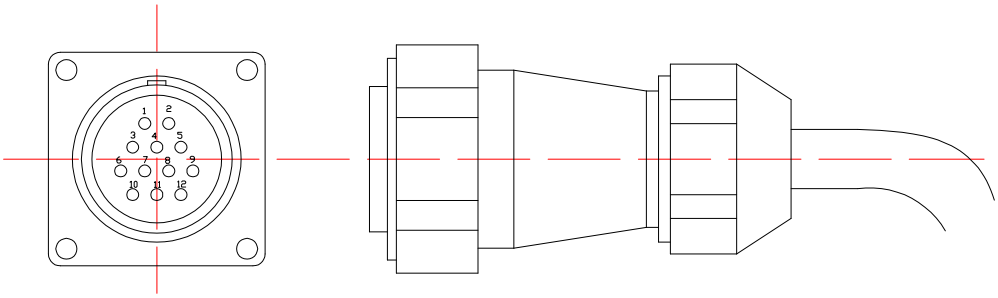


Figure 4-10

Terminal number and corresponding wiring is shown as blow:

Terminal 1、2 D group	the sensor driving signal terminal D1、D2
Terminal 3、4 L group	Measurement signal terminal L1、L2 at the left of sensor
Terminal 5、6 R group	Measurement signal terminal R1、R2 at the right of sensor
Terminal 7、8、9、10 T group	the sensor temperature measurement signal terminal T1、T2、T3、T4

Special wire should be used for the connection of sensor signal wire. Use special signal cable, wiring as the color of core wire, crimp or solder lug. Incoming line should be sealed to protect the junction box from air leakage and water leakage.

D group	red connects D1, blue connects D2, cut off shielding wire.
L group	white connects L1, yellow connects L2, cut off shielding wire.
R group	gray connects R1, purple connects R2, cut off shielding wire.
T group	green and orange connect T1.2, black and shielding connect T3.4

The shielding wire of T group should wear insulation tube. All wiring including shielding wire can not touch the housing.

⚠ *The transmitter internal wiring has been connected well before factory, the users only need to connect air plug to air socket and lock the plug.*

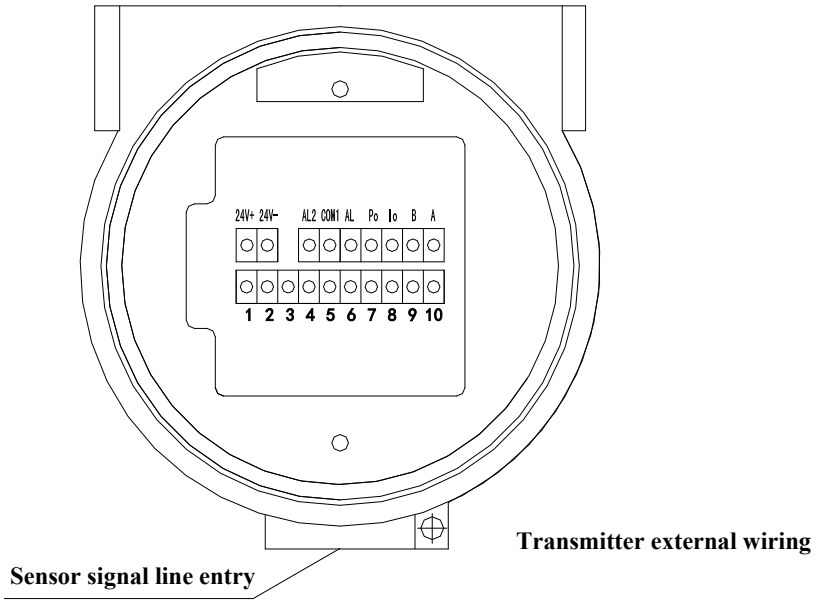


Figure4-11 Internal Wiring Terminal Diagram

1(red)	2(blue, shielding)	sensor vibration tube driving signal terminals
3(white)	4(yellow, shielding)	the right side of sensor signal terminals
5(gray)	6(purple)	the left side of sensor signal terminals
7(green)	8(orange) 9(black) 10(shielding)	temperature measuring signal terminals

4.4.3 User working parameter setting and adjustment

Generally, factory will finish the setting and adjustment of working parameter as required, users do not need to readjust in the field.

Only in the following cases, users can adjust parameter:

- Change measuring unit
- Output signal option adjustment and range adjustment
- The setting and adjustment for measuring parameter alarm value
- Zero adjustment and total flow reset
- The adjustment for communication parameter, ect.

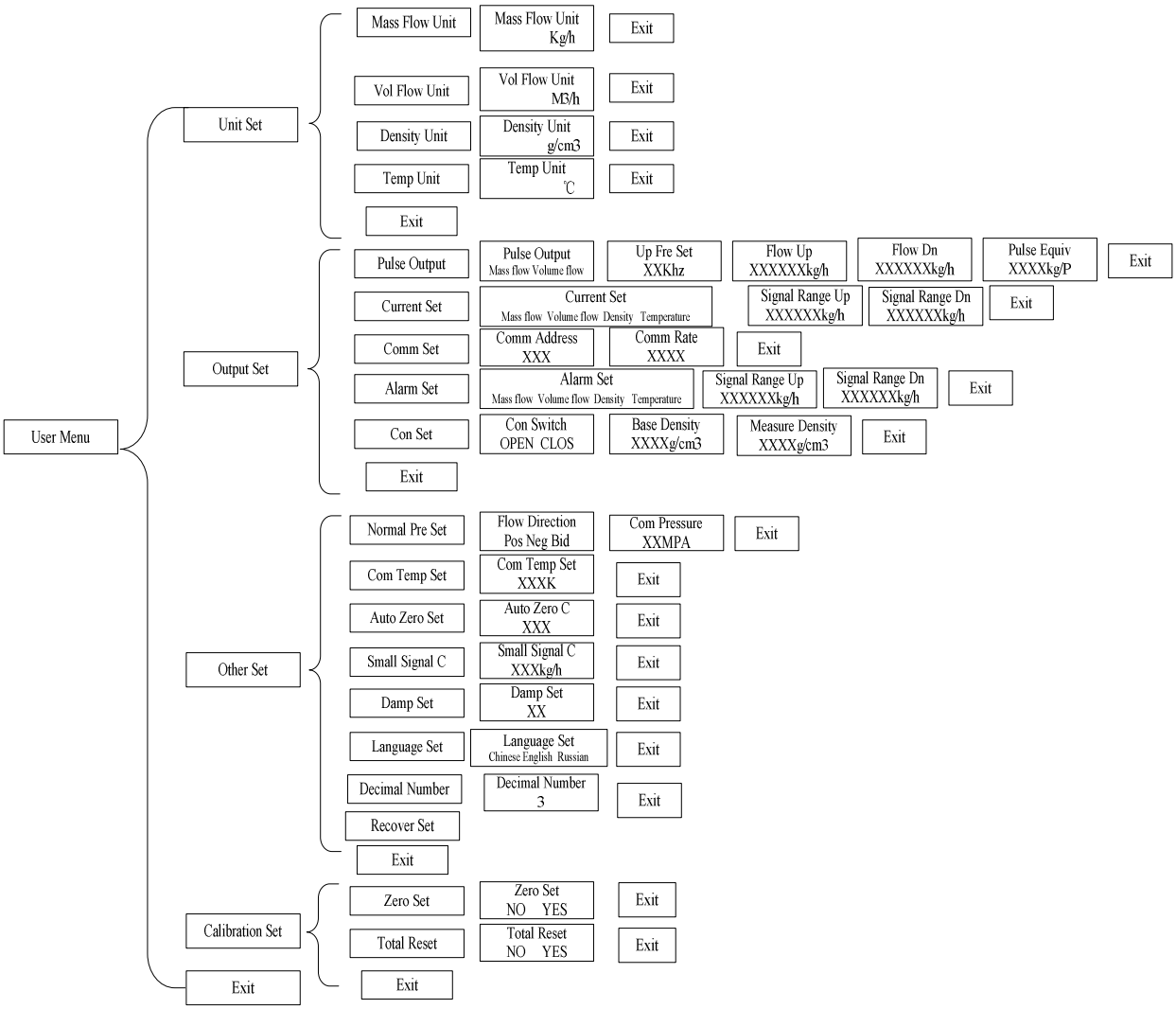
4.4.3.1 Enter user working parameter setting status

1) Under measurement status, press 〖SET〗key until screen displays parameter setting interface.
2) Press 〖＞〗key to select user setting item, then press 〖SET〗to confirm and enter password setting status.
3) Use 〖＞〗 to select operation position, use 〖∧〗to select operands, at last use〖SET〗to confirm. When password is right, the system will enter user setting

status, then user can modify parameter as prompt.

4) After finish all parameter setting, the flow meter can exit automatically or press exit options.

4.4.3.2 User working parameter setting description



(1) Unit setting

Measurement units include mass flow, volume flow, density, temperature and other 37 optional units, enter the measurement unit setting page, use the shift key to select the measurement unit, select the unit will have a shadow prompt, use the SET key to confirm.

Note: Each time the unit of flow measurement is changed, the cumulant is automatically cleared to zero.

(2) Output signal selection and range setting

The selection of the output signal of the instrument has two contents: the selection of the output signal form and the selection of the output signal

content.

Choice of output signal form:

Transmitter has two kinds of flow signal output, namely pulse output and current output. In order to ensure the accuracy of signal transmission, it is recommended to use pulse signal output when the instrument is mainly used for material measurement, and current signal output when the instrument is used for process control.

Pulse output signal:

Transmitter corresponds to the flow measurement signal as a pulse frequency signal. Pulse frequency signal corresponding to the set range output 0 ~ 10000Hz pulse frequency signal, the upper limit frequency can be freely set, generally set to 5kHz ~ 10kHz.

The equivalent pulse is calculated as follows:

Equivalent pulse = (upper limit flow of pulse signal - lower limit flow of pulse signal)/upper limit frequency

For example, the pulse signal corresponds to the mass flow rate; The upper limit of flow is 36000kg/h, the lower limit of flow is 0kg/h, and the upper frequency is 10KHz.

Ps: Pulse equivalent = (36000-0) ÷3600÷10000=0.001 kg/ pulse =1000 pulses /kg

Attention: ÷3600 to convert the flow unit to /s

Current output signal:

The transmitter has a current output function, the current output signal can correspond to the flow measurement signal, the density measurement signal, the temperature signal, the concentration signal output.

Range Setting:

When selecting the output signal, there is a prompt to select the range, and the output signal will be output corresponding to the selected range.

(3) Alarm Setting

Alarm Settings a total of mass flow, volume flow, density, temperature four items, the instrument can only select one of them to alarm . After selecting the alarm item, the alarm value should be set according to the prompt. After setting the alarm value, when the corresponding measurement value exceeds the alarm setting value, the instrument will alarm in the form of alarm prompt light flashing, and output alarm level signal.

(4) Zero adjusting

Due to the stress that may be generated during the installation process of

the instrument, the use temperature of the medium and the temperature of the calibration have a large change, etc., it is possible to change the zero point, so in order to ensure the accuracy of the instrument, in general, the zero point of the instrument should be adjusted on the spot (zero point correction) before the instrument is formally put into use after installation. The main points of site zero adjustment are as follows:

The flowmeter is preheated and the humidity sensor is used to make the temperature close to the normal operating temperature. Then stop the flow of the medium (close the valve on both sides of the flowmeter) to ensure that the sensor is in the full tube state; Wait 3 to 5 minutes to ensure that the fluid completely stops flowing; Take measures to ensure that pipes and sensors are in a static state to prevent pipe vibration from affecting the correct zero adjusting. zero adjusting operations should be performed in this state. The zero adjusting process takes about tens of seconds.

(5) Zero the Total flow value and Cumulative timing

In general, the meter cumulant does not need to be zeroed, and the difference between the two time periods is the flow cumulant for this time period. The meter has a power failure saving function for the flow accumulation measure to prevent the meter from losing the flow measurement data. **Clearing the accumulator completely loses the original traffic record data. You need to clear the accumulator only when special treatment is required.**

In order to protect the safety of the measurement data, the instrument has a timing function (displayed on the normal measurement parameter display page). The meter timing function records the accumulated time of meter power operation. Users can analyze and master the operation of the meter according to the meter timing and flow cumulative value. When the user performs the cumulative zero clearing operation, the meter timing is also cleared.

(6) Auxiliary function Settings

Auxiliary function Settings include flow measurement direction setting, common pressure value setting, common temperature value setting, gas standard flow measurement setting, etc.

1). Flow measurement direction setting: the flow measurement direction setting is completed in the "direction pressure" setting item. This setting is a compound setting. There are three digits in total. The first left digit is the direction of flow measurement. Set the following table:

Set	Positive flow	Reverse flow	cumulative
bidirectional	Normal output signal	Normal output signal	Positive accumulative addition and negative accumulative subtraction

Forward direction	Normal output signal	No output	Forward accumulative addition and reverse accumulative operation are not performed
Reverse direction	No output	Normal output signal	Reverse accumulative minus and forward do not do calculation

2). Common pressure value setting: the last two digits of "directional pressure" setting item set the

common pressure in MPa. The setting of common pressure value involves the determination of pressure compensation coefficient

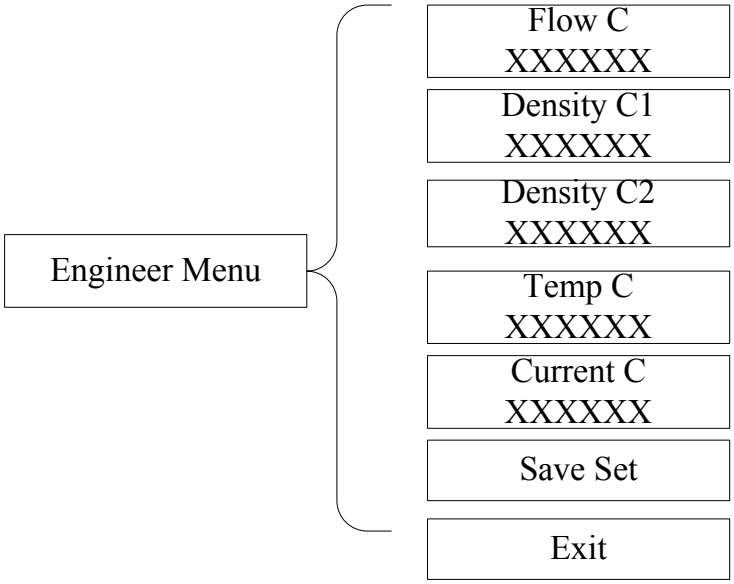
3). Common temperature value setting: the common temperature value setting unit is K, and the common temperature value setting involves the determination of temperature compensation value under the fault state of temperature measurement sensor.

4). Measurement setting of standard volume flow of gas: when it is necessary to measure the standard volume flow of gas, just set the upper and lower limits of the density alarm value as the standard density value of the gas under test. At this time, the volume flow display page shows the standard volume flow of gas, and the cumulative volume flow is also the cumulative volume of standard volume.

4.5 Meter calibration and adjustment (Engineer parameter setting) (Default password: 1234)

1. **The calibration parameters of the transmitter are set according to the results of instrument calibration before the instrument left factory, including the setting of flow coefficient, density coefficient and temperature coefficient. Random change of instrument coefficient Settings will lead to abnormal operation of the instrument.**

The adjustment setting of the instrument coefficient is carried out in the engineer's setting state. Password authentication is required in order to enter the engineer setting state safely. The password can be reset by the relevant technical personnel (the loss of the password will bring trouble to the work, the relevant personnel should be properly saved when resetting the password). The engineer setup menu is as follows:



2. Current and pulse analog output, used to detect whether the flow meter output signal is normal.

There are a total of 5 detection points, respectively 0%, 25%, 50%, 75%, 100%

3. Fault code

When the red light on the left side of the flowmeter panel alarms, the flowmeter is in an abnormal state, you can judge the cause of the problem through this fault code

4.6 Attention for Anti-explosion

When the instrument is used in explosion-proof places, explosion-proof instruments must be used or corresponding explosion-proof measures must be taken

The main anti-explosion type of transmitter is flame-proof, The part connected with sensor is mounted with intrinsically safe measure to ensure the anti-explosion performance of sensor.

The housing of transmitter is aluminum alloy. There is sealing ring silicone rubber used in the connection between terminal cover and body、the connection between the cover of transmitter display operation and body、the connection between transmitter display window and body.

The transmitter external wiring cable should use 8mm cable. Cable access to the internal of flow meter through G1/2’’ gland nut, gasket and cable silicon seal. Lock nut after wiring to ensure cable sealed.

Connection cable between transmitter and sensor uses special cable with 10mm of external diameter. The cable wiring is connected well and sealed well before delivery. Please ensure not to destroy seal in use.

Safety barrier is mounted at wiring outlet between transmitter and sensor to ensure the anti-explosion performance of sensor.

For anti-explosion safe, sealed structure can’t be destroyed in use.

You must cut off power supply if you need to open the cover of transmitter. Re-covering must ensure the seal of transmitter. Electrify after confirmation.

Note: This version of the manual for the use of local display intelligent converter, mainly for products written. With the continuous improvement of product function and performance, the product manual will be changed, we reserve the right to change the product manual, hereby declare.

Appendix

1. MODBUS communication software command description

The communication protocol is Modbus-RTU format. Compliant with standard modbus communication. But the data format part is our own defined format.

1.1 Port setting

Set serial port: Set serial port communication parameters.

A port through which a computer communicates;

Baud rate: 9600;

Parity check: none.

Data bits: 8 bits;

Stop bit: 1 bit;

The data type is a single-precision floating-point number. The received data needs to be converted to float0123.

1.2 ModBus Communication Protocol (RTU format)

1). Read N variables

Host request information frame:

Meter address +0x03+ Register start address (2 bytes, high byte first) + register read/write number 2*N (2 bytes, high byte first) + CRC check code (2 bytes, low byte first)

Slave response message frame:

Meter address +0x03+ bytes of data 4*N (1 byte) + register data (4*N bytes, the high byte before) + CRC check code (2 bytes, the low byte before)

2). Host request information frame:

Meter address + Function code 0x10+ Register start address (2 bytes, the high byte before) + register read/write number 2 x N (2 bytes, the high byte before) + data bytes 4 x N (1 byte) + data to be written (4 x N bytes, the high byte before) + CRC check code (2 bytes, the high byte before) Lower byte first)

Slave response message frame:

Meter address + Function code 0x10+ Register start address (2 bytes, high byte first) Register read/write quantity 2 x N (2 bytes, high byte first) + CRC check code (2 bytes, low byte first)

Setting instructions:

Datas	1	2	3	4	5	6	7	8
Mass flow unit	g/h	g/m	g/s	kg/h	kg/m	kg/s	t/h	t/m
Datas	9	10	11	12				
Mass flow unit	t/s	lb/h	lb/m	lb/s				
Datas	1	2	3	4	5	6	7	8
Volume flow unit	mL/h	mL/m	mL/s	L/h	L/m	L/s	m3/h	m3/m
Datas	9	10	11	12				
Volume flow unit	m3/s	Gal/h	Gal/m	Gal/s				
Datas	1	2	3					
Temperature Unit	℃	F	K					
Datas	1	2						
Density Unit	g/cm3	kg/m3						

Datas	1	2	3	4
Baud rate	9600	4800	2400	1200

Datas	1	2
Pulse mode	Mass	Mass

Datas	1	2	3	4	5
Current corresponding	Mass	Mass	Density	Temperature	Concentration

Datas	1	2	3	4
Alarm signal	Mass	Mass	Density	Temperature

Datas	1	2
Concentration	ON	OFF

Datas	1	2	3
Language	Chinese	English	Russia

Datas	1	2	3
Flow direction	Forward	Reverse	bidirectional

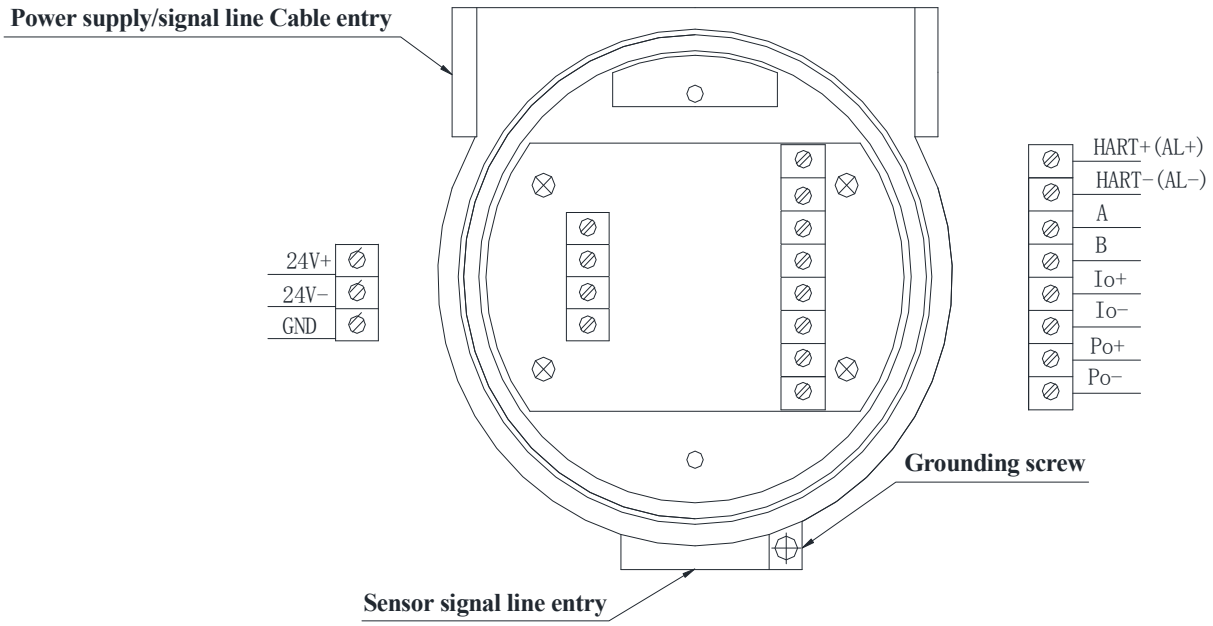
Datas	0	1	2	3
Decimal point	0digit	1digit	2digit	3digit

Read and write variable addresses are shown in Table 1:

Table 1 Addresses of ModBus communication variables

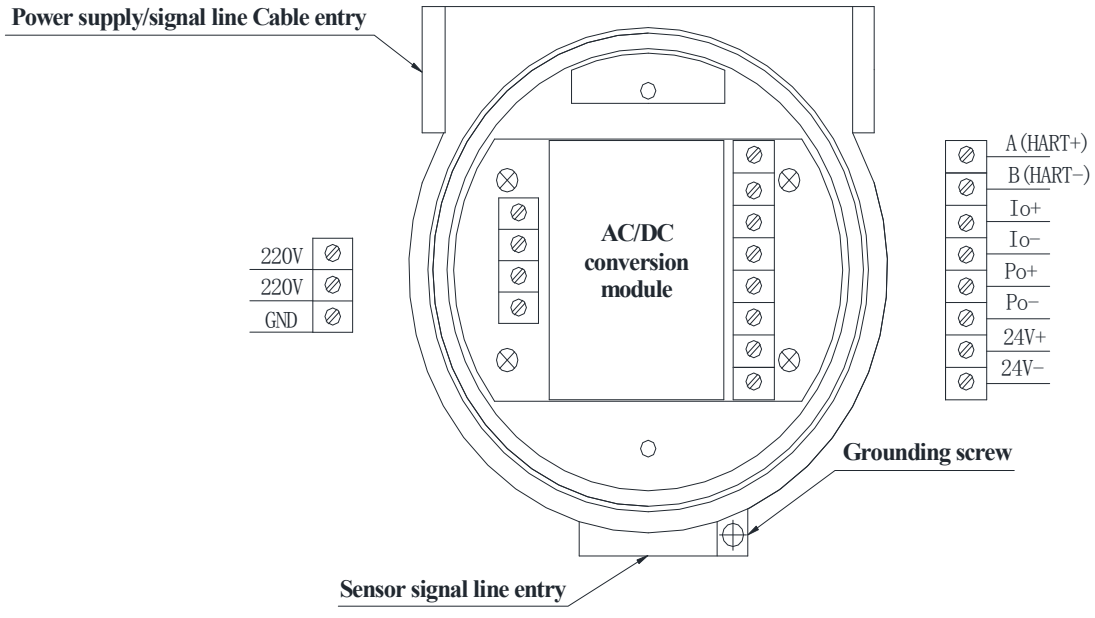
No.	Register address	Register type	Register No.	Register name	Data type
1	0002	Read	2	Mass flow	float
2	0004	Read	2	Volume flow	float
3	0006	Read	2	Density	float
4	0008	Read	2	Temperature	float
5	0010	Read	2	Concentration	float
6	0012	Read	2	Toal mass	float
7	0014	Read	2	Total volume	float
8	0016	Read	2	Positive cumulative total	float
9	0018	Read	2	Negative cumulative total	float
10	0020	Read	2	Pulse equivalent	float
11	0022	Read	2	DP value	float
12	0024	Read	2	Zero value	float
13	0026	Read	2	Store zero	float
14	0028	Read	2	Vibration frequency	float
15	0030	Read and write	2	Flow coefficient	float
16	0032	Read and write	2	Upper flow signal limit	float
17	0034	Read and write	2	Flow signal lower limit	float
18	0036	Read and write	2	Current coefficient	float
19	0038	Read and write	2	Density coefficient C1	float
20	0040	Read and write	2	Density coefficient C2	float
21	0042	Read and write	2	Upper current signal limit	float
22	0044	Read and write	2	Current signal limit	float
23	0046	Read and write	2	Service temperature	float
24	0048	Read and write	2	Upper alarm limit	float
25	0050	Read and write	2	Lower alarm limit	float
26	0052	Read and write	2	Small signal	float
27	0054	Read and write	2	Temperature coefficient	float
28	0056	Read and write	2	Communication address	float
29	0058	Read and write	2	Damp	float
30	0060	Read and write	2	Base medium density	float
31	0062	Read and write	2	Measured density	float
32	0064	Read and write	2	Baud rate	char
33	0066	Read and write	2	Pulse mode selection	char
34	0068	Read and write	2	Mass flow unit	char
35	0070	Read and write	2	Volume flow unit	char
36	0072	Read and write	2	Temperature unit	char
37	0074	Read and write	2	Density unit	char
38	0076	Read and write	2	Current corresponding	char
39	0078	Read and write	2	Alarm signal	char
40	0080	Read and write	2	Upper frequency limit	char
41	0082	Read and write	2	Concentration switch	char
42	0084	Read and write	2	Language	char
43	0086	Read and write	2	Flow direction	char
44	0088	Read and write	2	Pressure compensation	float
45	0090	Read and write	2	Automatic zero correction	int
46	0092	Read and write	2	Decimal	char
47	0094	Read and write	2	Cumulant clear(command)	char
48	0096	Read and write	2	Zero calibration(command)	char

2. Converter input and output pin wiring diagram



24VDC Structure of the power terminal board

Power supply terminals: 24V+ and 24V-
R485 communication terminals: A(R+) and B(R-) For details, see the communication protocol. For customized Hart functions, see HART protocol wiring instructions
Current signal terminals: Io+ and Io- (The output is an active signal, which can correspond to mass flow, volume flow, density, and temperature signals)
Pulse signal terminals: Po+ and Po- (the output is an active signal, which can correspond to mass flow rate and volume flow rate.)
Alarm signal terminals: AL+ and AL-(instrument fault alarm output)
Hart communication terminals: For customized Hart functions, see HART protocol wiring instructions



220VAC power terminal panel structure

Power supply terminal: L(220V) and N(220V) AC

R485 communication terminals: A(R+) and B(R-) For details, see the communication protocol. For customized Hart functions, see HART protocol wiring instructions

Current signal terminals: Io+ and Io- (The output is an active signal, which can correspond to mass flow, volume flow, density, and temperature signals)

Pulse signal terminals: Po+ and Po- (the output is an active signal, which can correspond to mass flow rate and volume flow rate.)

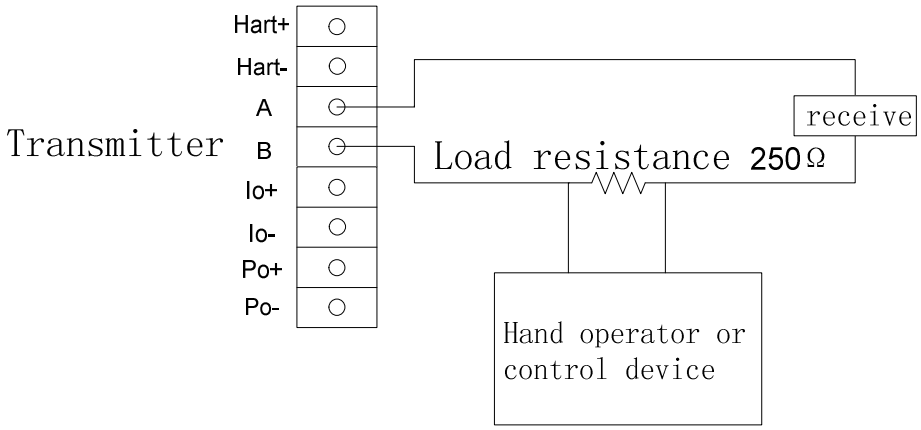
24V power supply terminals: 24V+ and 24- (power supply with 220VAC)

3. HART Protocol wiring and usage method

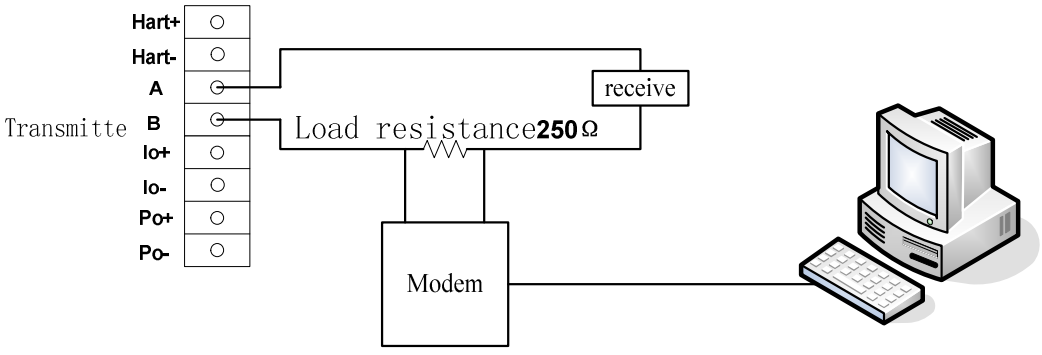
Hart is the selected function module, if there is no such module, please follow the "3 converter input and output pin wiring diagram" to connect, Hart and 485 switch to select the dip switch, the dip switch is located in the drive board (the fifth board), the dip switch is 485 in the digital end, and the reverse is Hart

3.1 Wiring method

1). Wiring diagram of hand operator or control device



2).Upper computer communication wiring diagram



3.2 Power requirements

The Hart communication module of the converter uses an internal power supply.

3.3 Load resistance

The value of the load resistance ranges from 230 to 1100Ω. The ground loop does not require a ground point. If you must ground , you can ground the load resistance at the negative terminal of the 24V power supply. Floating space is recommended for loop.

4. Menu in transmitter