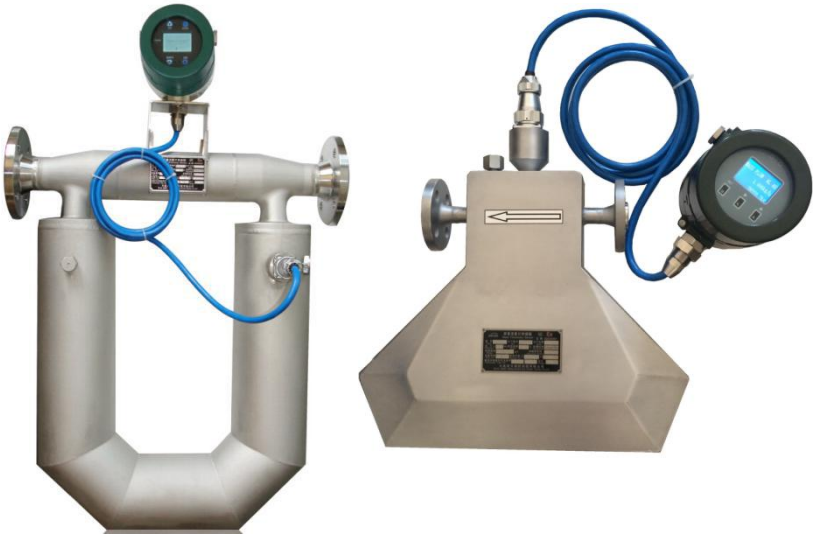
M100M Coriolis Mass Flow Meter

（FT522 Transmitter）

Operating Manual



Content

1 MT100M Mass Flow Meter Overview

Coriolis mass flow meter (MT100M) 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

- Measuring fluid flow rate directly (It is significant to the energy measurement and chemical reaction during the producing detection)
- High Measurement accuracy: (0.1%～0.5%)
- Wide Application (Besides general fluid measurement, other industrial medium which is hard to be measured by general flow meters also can be measured, such as Non-Newtonian fluid and Slurries etc.)
- Low Installation Requirement: (there is no requirement for straight pipe upstream or downstream) Reliability, low maintenance rate.

1.2 Application

The MT100M 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.

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:

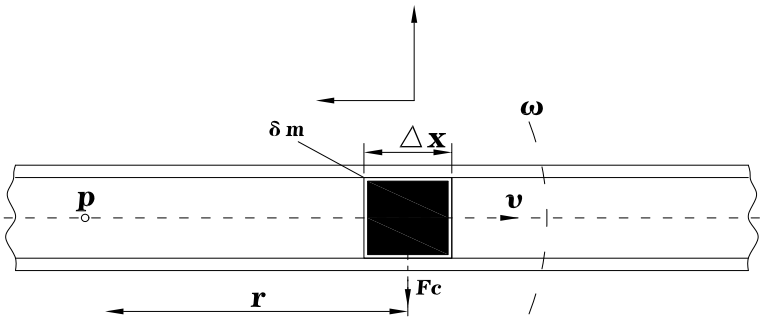


Figure1.1

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 =2wvδm. 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.

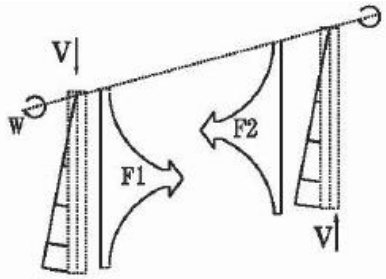


Figure 1.2

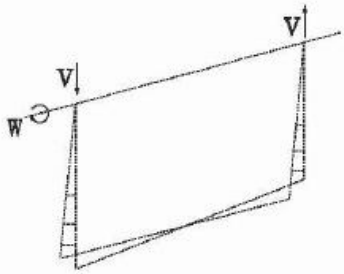


Figure 1.3

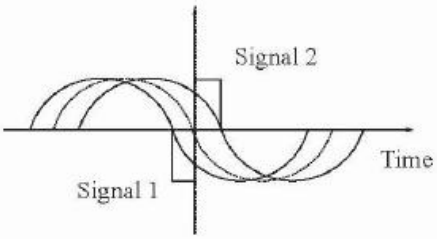
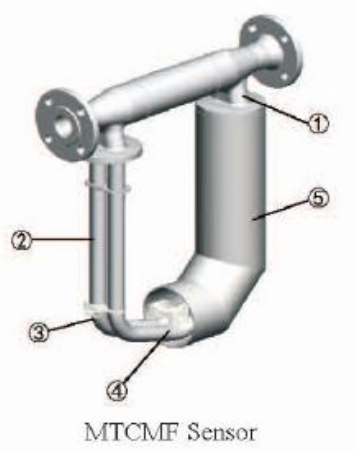


Figure 1.4

2 Sensor Structure and Main Parameters

2.1 Sensor Structure



MTCMF Sensor

MT100M 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

Specification	DN (mm)	Flow range(kg/h)
MT100M-006	6	0～600~720
MT100M-008	8	0~960~1200
MT100M-010	10	0～1800～2100
MT100M-015	15	0～3600～4500
MT100M-020	20	0～6000～7200
MT100M-025	25	0～9600～12000
MT100M-032	32	0～18000～21000
MT100M-040	40	0～30000～36000
MT100M-050	50	0～48000～60000
MT100M-080	80	0～150000～180000
MT100M-100	100	0～240000～280000
MT100M-150	150	0～480000～600000
MT100M-200	200	0～900000～1200000

- Accuracy(Liquid) :(With FT-522 Transmitter):
  Accuracy of fluid measurement: ±0.2～0.5%
  Repeatability: ±0.1～0.25%
- Density(Liquid) measuring range and accuracy (With FT-52 series transmitter)
  Range: 0～2.000g/cm^3 Accuracy: ±0.002g/cm^3
- Temperature measuring range and accuracy (With FT-52 transmitter):
  Temperature measuring range: -200～350℃ Accuracy: ±1℃
- Ambient temperature: －20℃～60℃
- Material : The measuring tube SS316L Housing: SS304
- Working pressure: 0～4.0MPa
- Explosion-proof level : Exd (ia) ⅡC T6Gb

2.3 Sensor Installation

2.3.1 Basic Requirements of installation

- MT100M sensor flow label should be in accordance with flow direction.
- Properly supporting is needed for preventing tubes vibrating.
- To prevent vibration, flexible connectors should be installed for isolation between pipe system and sensor.
- Flanges keep parallel and their center points locate 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.

2.3.2 Installation Recommendations

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

The meter shell should be installed downward when measuring liquid flow (Figure2.1), so that air cannot get trapped inside the tubes.

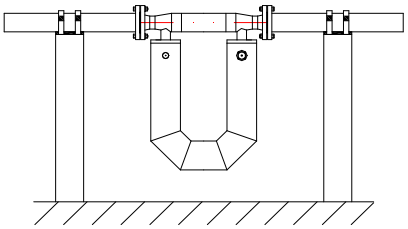


Figure 2.1

The meter shell should be installed upward when measuring gas flow (Figure2.2), so that liquid cannot get trapped inside the tubes.

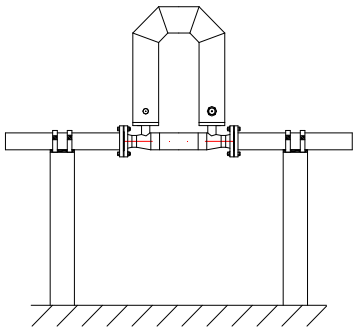


Figure 2.2

The meter shell should be installed sideward when the medium is turbid liquid (Figure2.3).

The flow direction of medium goes from the bottom up through the sensor.

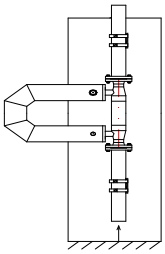


Figure 2.3

2.3.3 Dimension and Installation

U type Split-type

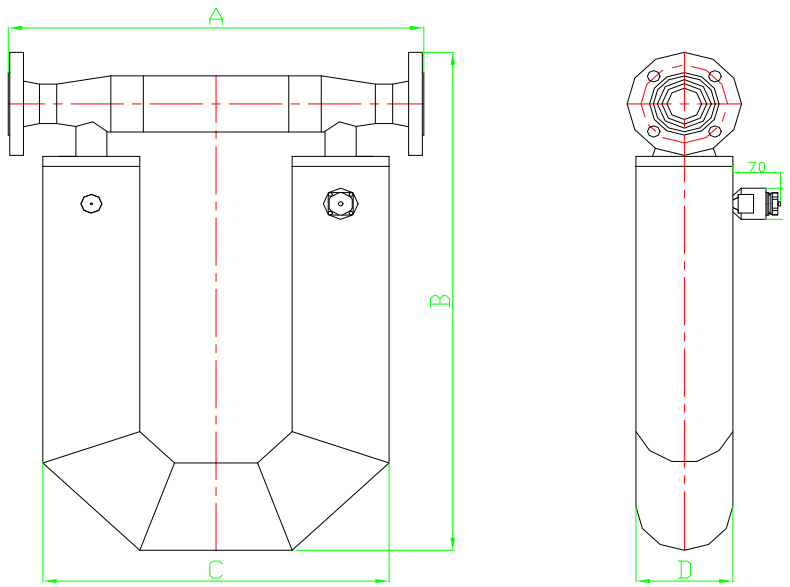


Figure2.4 Split-type sensor

Installation and Dimension Table (Split type)

Specification	A(flange space)	B(overall height)	C(width)	D(shell thickness)
	mm	mm	mm	mm
MT100M010	450	370	380	60
MT100M015	456	370	380	60
MT100M020	540	530	468	108
MT100M025	540	550	468	108
MT100M032	544	590	468	108
MT100M040	600	710	500	140
MT100M050	606	735	500	140
MT100M080	866	957	780	220
MT100M100	950	1094	830	273
MT100M150	1300	1350	1144	324
MT100M200	1300	1380	1144	400

U type Integrated-type

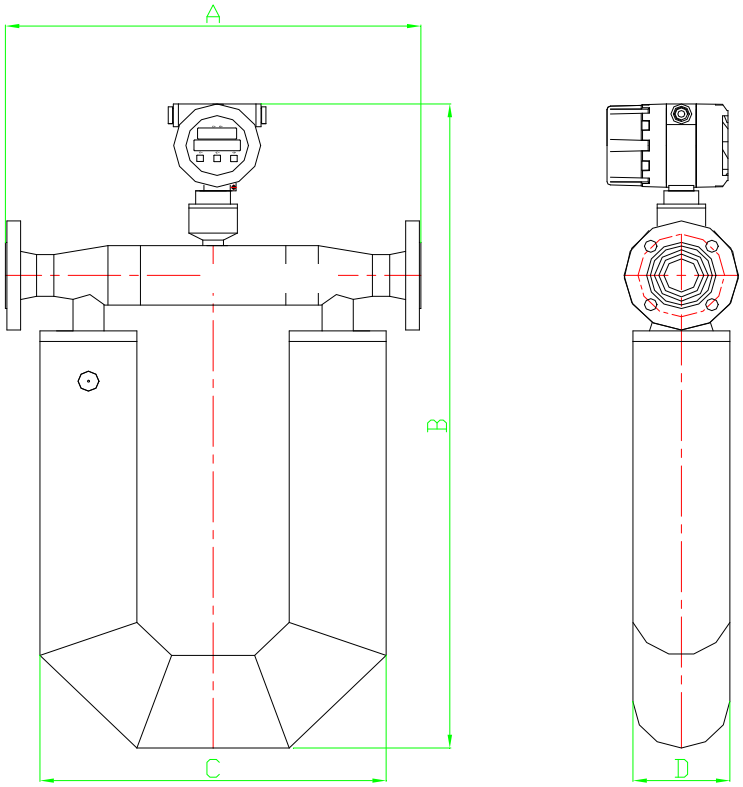


Figure2.5 Standard integrated type

Specification	A(flange space)	B(overall height)	C(width)	D(housing thickness)
	mm	mm	mm	mm
MT100M-010	450	590	380	60
MT100M-015	456	590	380	60
MT100M-020	540	740	468	108
MT100M-025	540	740	468	108
MT100M-032	545	740	468	108
MT100M-040	600	1010	500	140
MT100M-050	600	1010	500	140
MT100M-080	870	1365	780	220
MT100M-100	950	1440	830	273
MT100M-150	1300	1540	1144	324
MT100M-200	1300	1550	1144	400

Installation and Dimension Table (Integrated type)

Triangle type

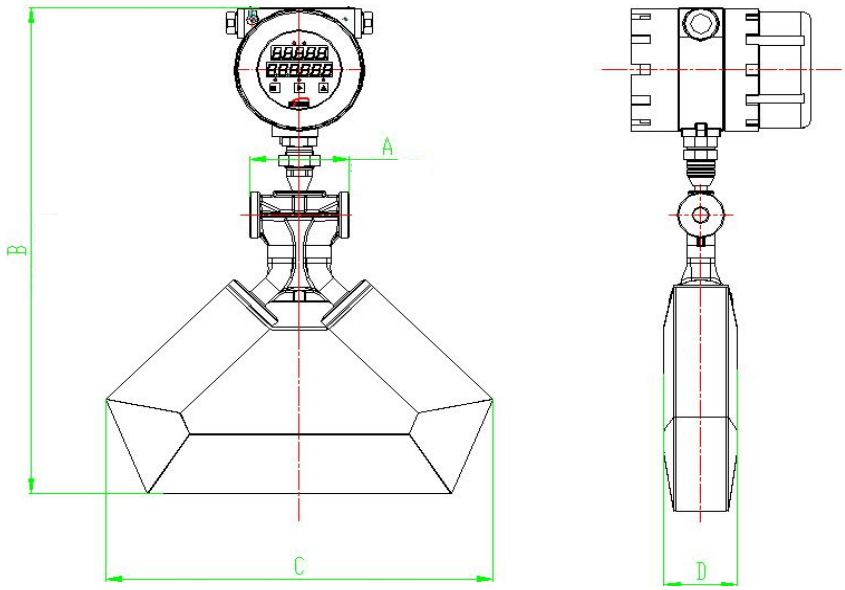


Figure 2.6 MT100M015 / MT100M010

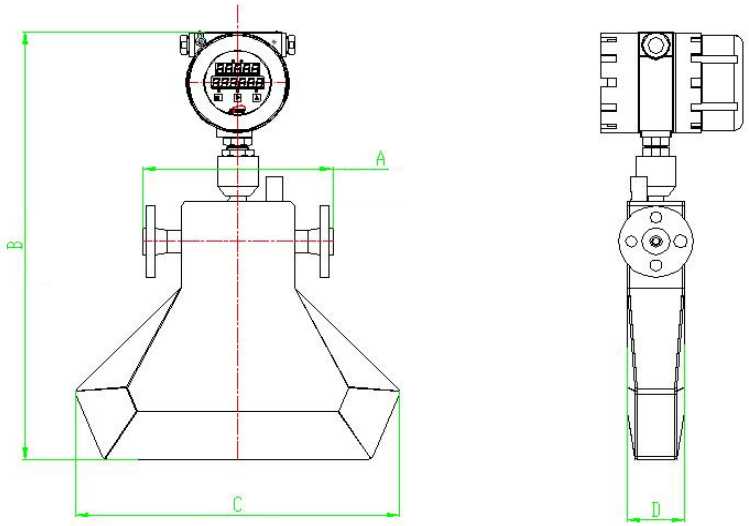


Figure 2.7 MT100M008 / MT100M006 / MT100M003

Installation and Dimension Table (Triangle type)

Model	**A(flange space) mm**	**B(overall height) mm**	**C(width) mm**	**D(housing thickness) mm**
MT100M015	95	540	405	70.5
MT100M010	95	525	370	70.5
MT100M008	232	565	395	70.5
MT100M006	232	550	360	70.5
MT100M003	178	420	250	54

3 FT-522 Transmitter operating manual

3.1 Overview

FT522 flow signal transmitter is used with MT100M 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.

3.2 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 Total flow: g, kg, t Volume flow rate: ml/h, l/h, m^3/h, ml/m, l/m, m^3/m Total volume: ml, l, m^3 Density: kg/m^3, g/cm^3 Temperature: ℃，F， K
Ambient Temperature	-20…+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 0.02% 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 d [ia] Ⅱ CT6Gb
Dimension	Φ125×180mm

3.3 Structure Description

Figure1.transmitter outline drawing

3.3.1 Transmitter Panel

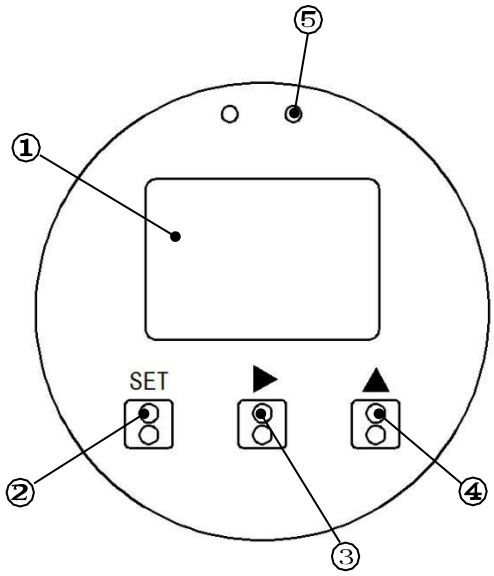


Figure2. Transmitter Panel

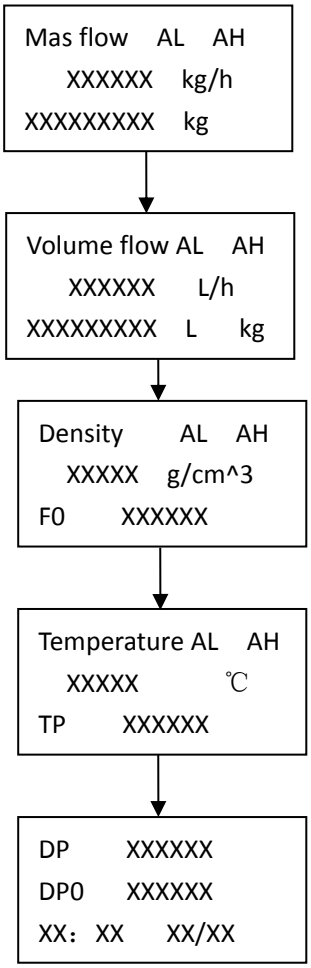
1) Measurement window

- 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 affectthe accuracy of the***

flowmeter.

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



AL and AH represent alarm, when measurement value exceeds alarm setting value, the corresponding symbol will flash; FO,TP,DP,DPO are working parameters of flowmeter; The bottom line at the last page represents working clock.

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 - -1 0. 1. 2. 3. 4. 5. 6. 7. 8. 9. -. -1.

5) Status Light

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

3.3.2 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).

1) The normal wiring terminal board, showed in Figure 3

Power supply wiring terminals from top to bottom	Grounding terminal, Null terminal, 24V-terminal, 24+ terminal. External 24VDC power supply line connects to 24+, 24- terminals.
Signal wiring terminals from top to bottom	Alarm output signal terminal, RS485 communication interface A terminal, RS485 communication interface B terminal, Current signal output terminal, Pulse signal output terminal, COM terminal, 24V+ terminal.
Alarm output signal	It's a switch signal, which can be set for output flow or density and temperature high and low alarm control signal.
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

The common terminal for alarm, current output and pulse output is 24V-, that is COM terminal.

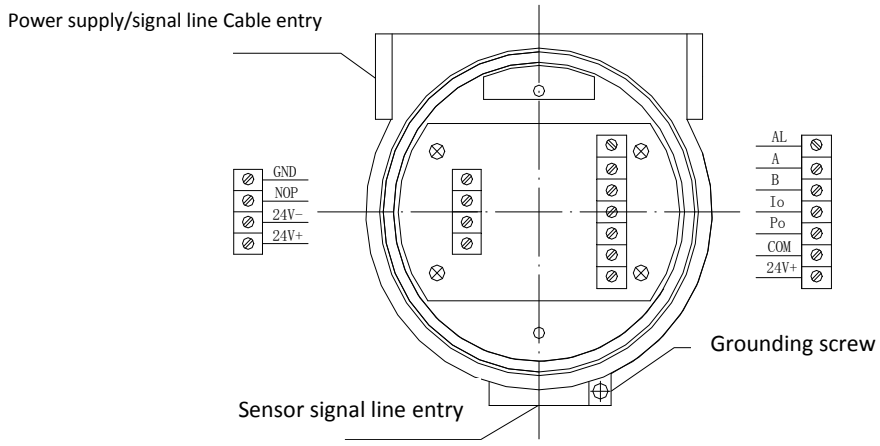


Figure 3. 24VDC Power supply wiring board

2) The auxiliary wiring terminal board, showed in Figure4

Power supply wiring terminals from top to bottom	Grounding terminal, Null terminal, 220VAC terminal 1#, 220VAC terminal 2#
Signal wiring terminals from top to bottom	Alarm output signal terminal, RS485 communication interface A terminal, RS485 communication interface B terminal, Current signal output terminal, Pulse signal output terminal, COM (24V- terminal), 24V+ terminal. The common terminal of output signal is 24V-

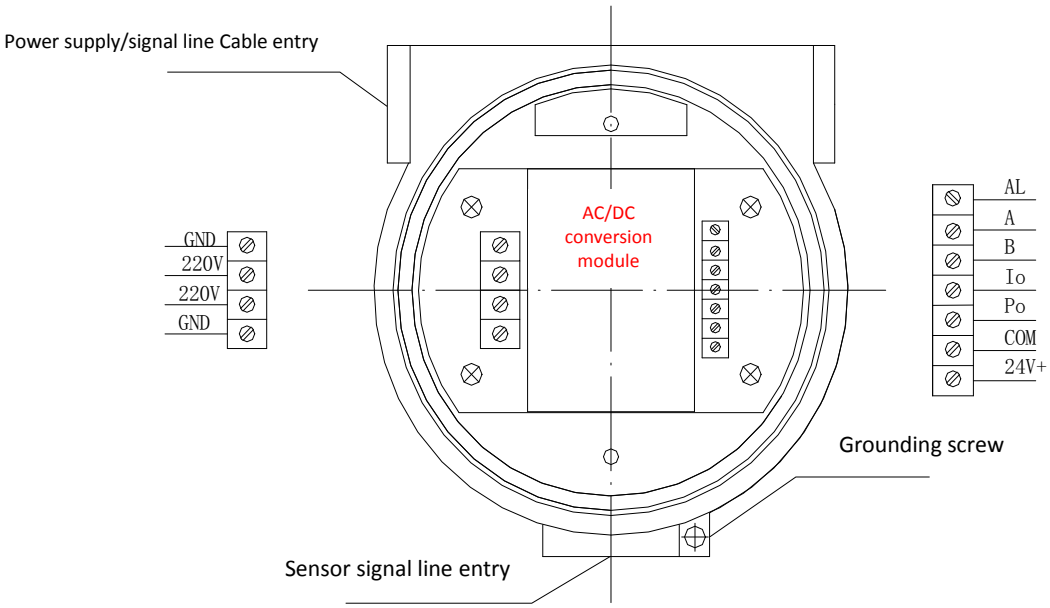
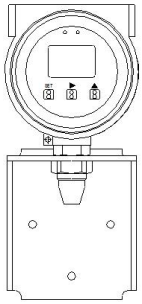
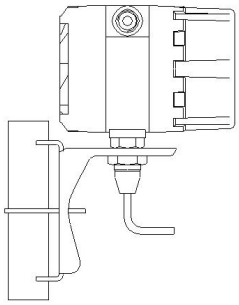


Figure 4. 24VDC Power supply wiring board

4 Use

4.1 Installation

Installation Type	Description
Figure5. 	**FT522 Integrated type** The signal lines between sensor and transmitter have been connected well before delivery, the users only need to connect external wiring.
Figure6. 	**FT522 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 delivery. Use air plug to connect transmitter and senor (air plug protection is IP67)

4.2 Wiring

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.

4.2.2 Pulse signal connection

The output type for transmitter pulse signal is open collector passive signal output. For normal wiring, relevant power supply and signal detection resistance should be provided at the side of signal reception. When the power supply is 24VDC, signal detection resistance value selects 5 KΩ/0.25W (at this time, signal transmission current is 4~5mA). In order to improve the anti-interference ability of signal transmission, passive signal output type should be used. Wiring diagram as blow:

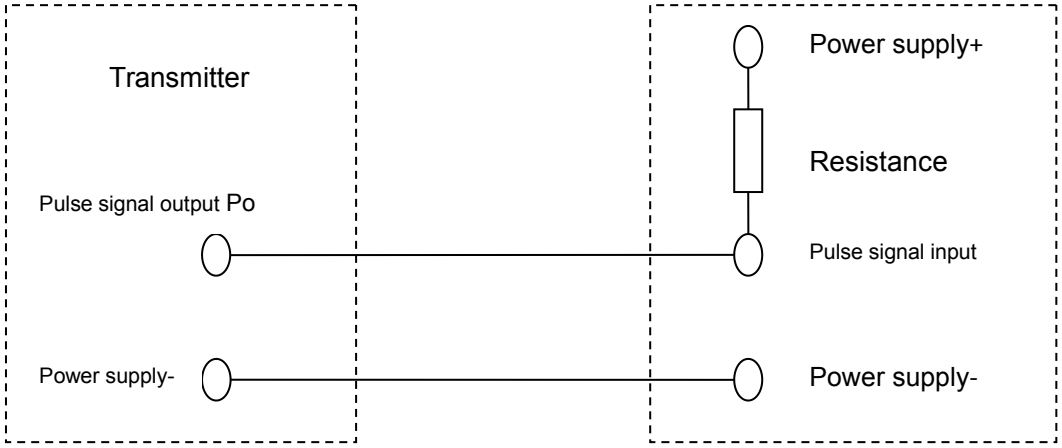


Figure 7. Pulse signal output wiring diagram (passive output)

If active pulse output signal provided by the transmitter is required, connect signal transmission resistance to both flow meter power supply + and pulse signal output terminal, shown as figure 8

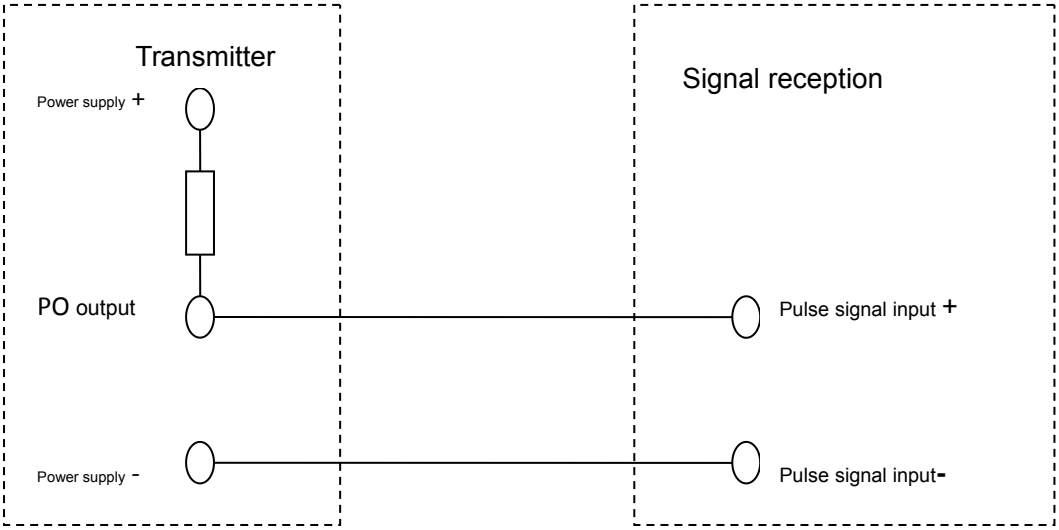


Figure 8. Pulse signal output wiring diagram (active output)

4.2.3 Current signal connection

Current output signal is active signal, shown as Figure 9

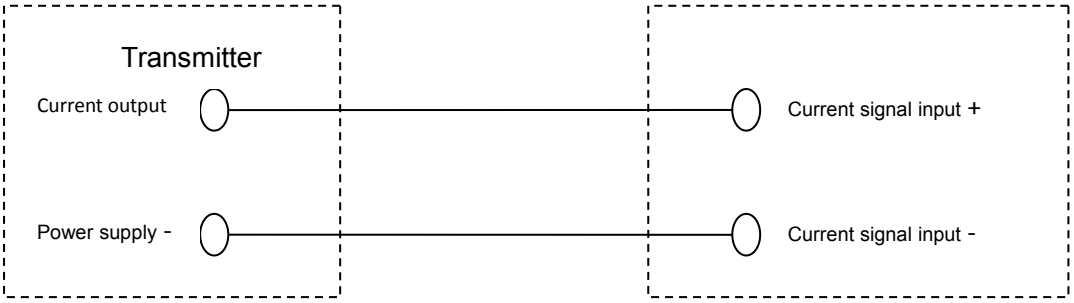


Figure 9. Current signal output wiring diagram

When output 1-5VDC power signal is required, access 250Ωstandard resistance to the signal reception to realize the transition of current and power , which is shown as figure 10:

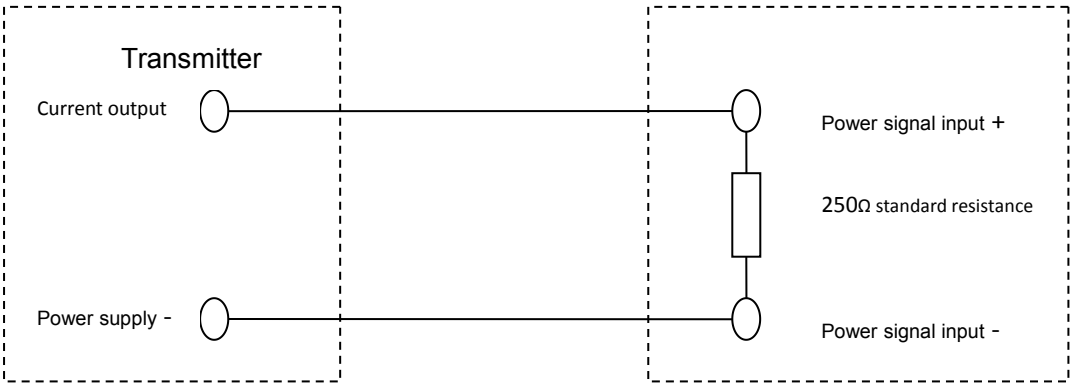


Figure 10. Power supply signal transition diagram

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 11:

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

The wiring socket is equipped with the sensor. connect FT522 type 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 11:

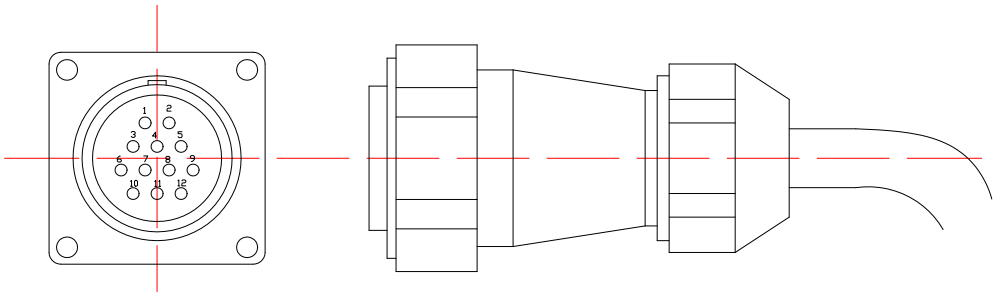


Figure 11

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 delivery, the users only need to connect air plug to air socket and lock the plug.***

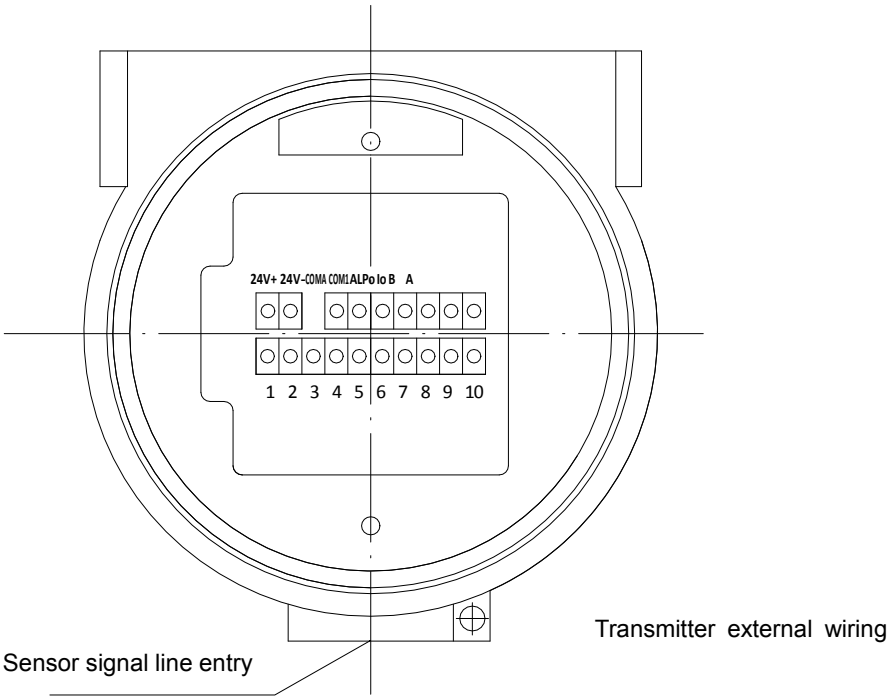


Figure12. Internal Wiring Terminal Diagram

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

The sensor housing should be grounding,the wire cross-sectional area should not be less than 1mm^2

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.

4.3.1 Enter user working parameter setting status

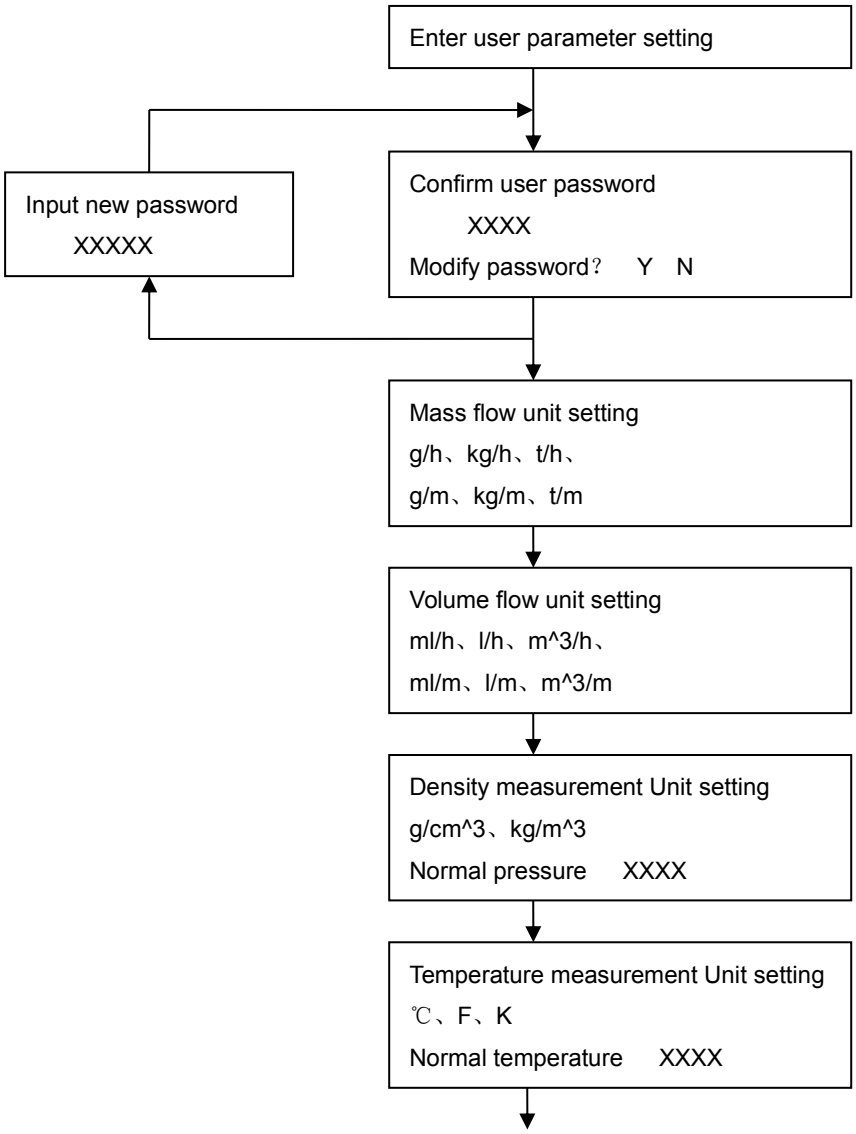
1) Under measurement status, press 〖SET〗key until screen displays parameter setting interface.

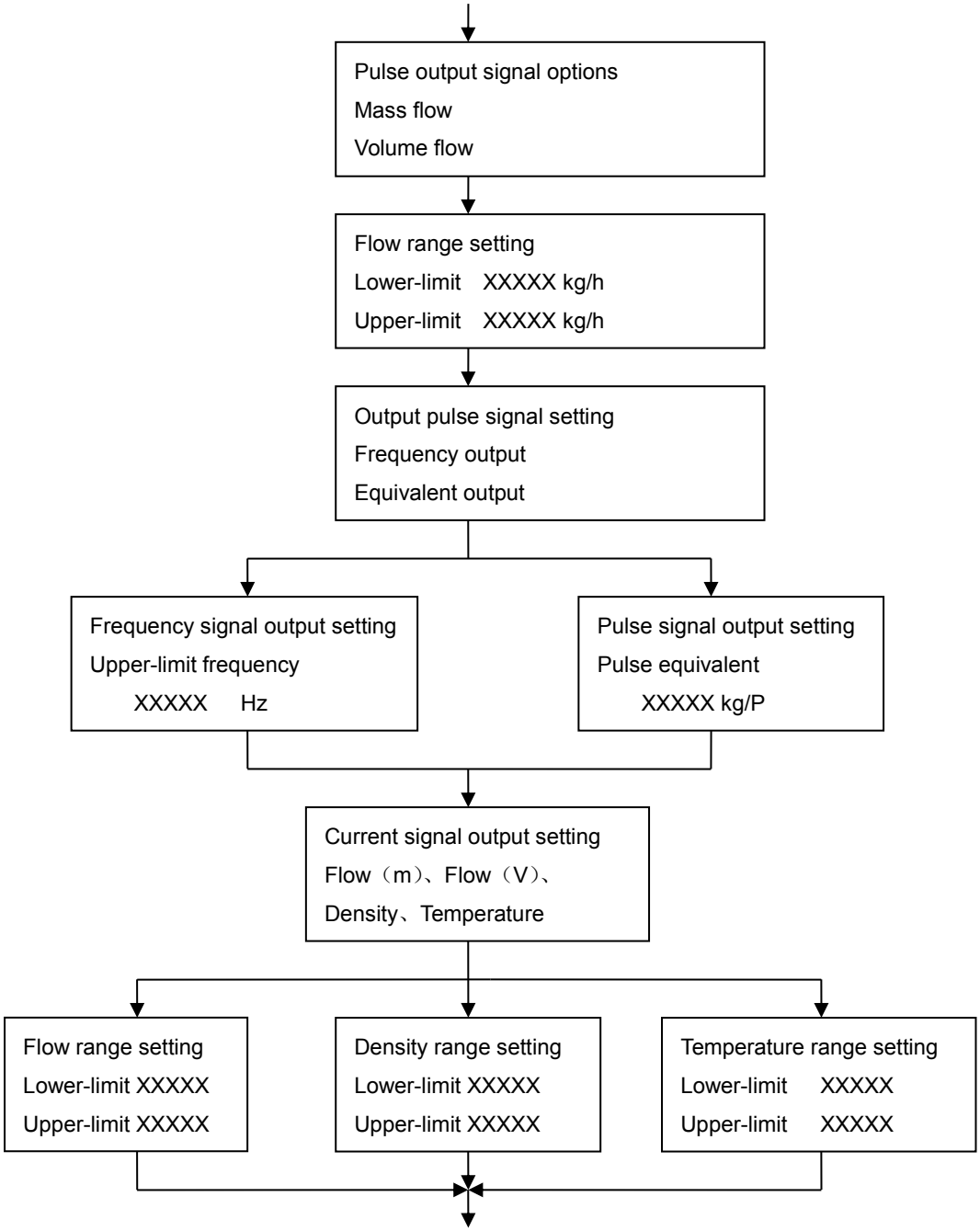
2) Press 〖＞〗key to select user setting item, then press 〖SET〗to confirm and enter password setting status.

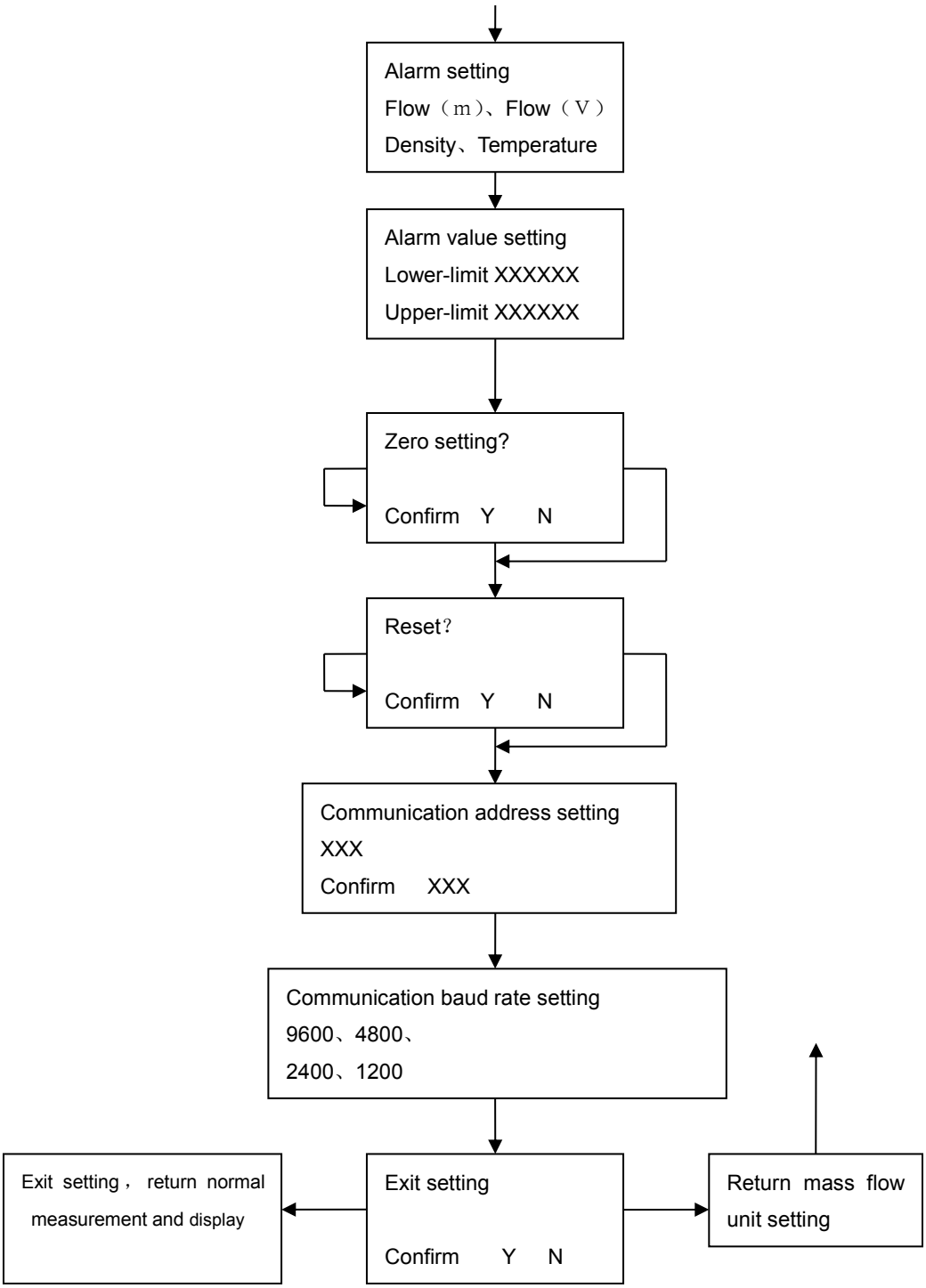
3) Use 〖＞〗to select operation position, use 〖∧〗to select operands, at last use 〖SET〗to confirm. When password is right, the system will enter user setting status, then user can modify parameter as prompt .

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

4.3.2 User working parameter setting description




Pulse output signal options
Mass flow
Volume flow
Flow range setting
Lower-limit XXXXX kg/h
Upper-limit XXXXX kg/h
Output pulse signal setting
Frequency output
Equivalent output
Frequency signal output setting
Upper-limit frequency
XXXXX Hz
Pulse signal output setting
Pulse equivalent
XXXXX kg/P
Current signal output setting
Flow（m）、Flow（V）、
Density、Temperature
Flow range setting
Lower-limit XXXXX
Upper-limit XXXXX
Density range setting
Lower-limit XXXXX
Upper-limit XXXXX
Temperature range setting
Lower-limit XXXXX
Upper-limit XXXXX


Alarm setting
Flow（m）、Flow（V）
Density、Temperature
Alarm value setting
Lower-limit XXXXXX
Upper-limit XXXXXX
Zero setting?
Confirm Y N
Reset?
Confirm Y N
Communication address setting
XXX
Confirm XXX
Communication baud rate setting
9600、4800、
2400、1200
Exit setting
Confirm Y N
Exit setting， return normal measurement and display
Return mass flow unit setting

4.3.3 Output signal option setting

Output Signal Type	Output Signal Content
Pulse Output	1) When the flow meter is used for material measurement, pulse output is recommended. 2) Pulse frequency signal output 0-10000Hz corresponding to setting range, upper frequency can be set as 5KHz~10KHz 3) Equivalent pulse signal is to output a pulse signal corresponding to a certain flow, which is mainly used for flow integrating control, the frequency is 1~100Hz.
Current Output	There is one way current output, which can be corresponding to the measurement of flow, density or temperature.

4.3.4 Zero adjustment

Normally, factory has finished zero adjustment, the users do not need to adjust zero at the field. But some time incorrect installation will cause great stress to make zero change, in this case, zero adjustment at the field is necessary.

The users must ensure the medium does not flow and pipe and sensor are in the stationary state when zero adjustment.

4.3.5 Total flow reset

The total flow will be saved after power off.
The previous flow records will be lost completely after total flow reset.
Total flow reset is required only when total flow requires special handling.

⚠***Each time you change the unit of measurement, the total flow will automatically be cleared.***

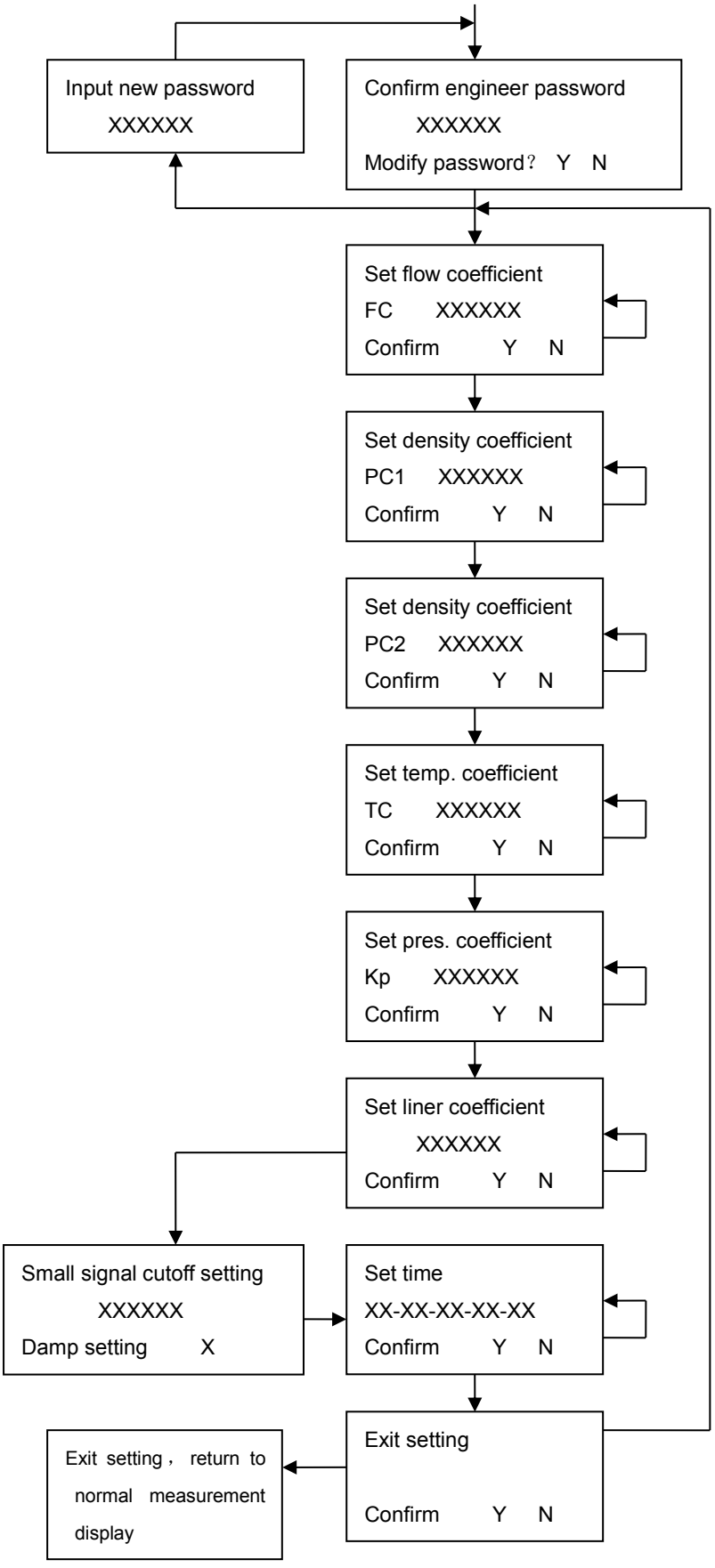
5.Calibration and Adjustment (Engineering parameter setting)

The calibration and adjustment for transmitter should be carried out in the laboratory.

The calibration parameter is set based on the result of calibration before delivery, including flow coefficient setting, density coefficient setting, temperature coefficient setting. So changing the coefficient of flowmeter may cause abnormal work.

The adjustment for flowmeter coefficient is carried out under engineering setting status. To enter engineering setting status safely, a password is required. The password can be reset by technical staff. (The lost of password will cause the trouble of work, so technical staff should save new password carefully).

Engineering setting menu is shown as below:


Input new password
XXXXXX
Confirm engineer password
XXXXXX
Modify password？ Y N
Set flow coefficient
FC XXXXXX
Confirm Y N
Set density coefficient
PC1 XXXXXX
Confirm Y N
Set density coefficient
PC2 XXXXXX
Confirm Y N
Set temp. coefficient
TC XXXXXX
Confirm Y N
Set pres. coefficient
Kp XXXXXX
Confirm Y N
Set liner coefficient
XXXXXX
Confirm Y N
Small signal cutoff setting
XXXXXX
Damp setting X
Set time
XX-XX-XX-XX-XX
Confirm Y N
Exit setting
Confirm Y N
Exit setting， return to normal measurement display

6.Attention for Anti-explosion

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 cableshould 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.