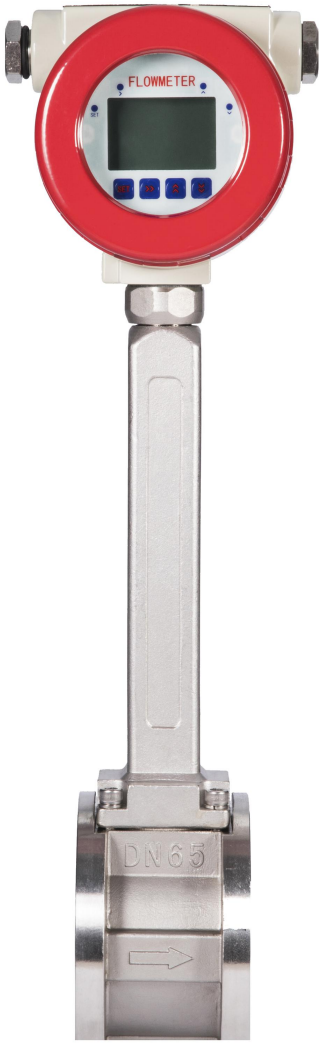


Manual VM300 Vortex Flowmeter

I.Functional characteristics of intelligent amplifier

To apply a variety of flowmeter: It be used in vortex street flowmeter, rotary vortex flowmeter and turbine flowmeter.

Manipulator setting function: A manipulator can set up multiple amplifiers of the same type.

Automatic recovery function: The amplifier has factory parameter backup function. When the instrument parameter is out of order, the user can restore the factory parameters and ensure the normal measurement of the instrument only through the "restore factory settings" function in the menu.

Temperature and pressure compensation function: Amplifier software is built with a variety of measurement compensation model with different media.

Output form: The amplifier provides a wide range of output options for the user, including "work frequency output", "equivalent pulse output", and "three wire" 4-20mA current output". The upper limit of the current output can be set in the menu by the button, so there is no need to re check zero and fullness.

The linear correction function: The amplifier software provides a linear differential coefficient algorithm for 10 point instruments, which can be adjusted linearly at most 10 points according to the actual calibration situation, so as to improve the measurement accuracy of the flowmeter.

The output protection function: The amplifier adopts isolated power supply design, with overvoltage and overcurrent protection circuit function. When the 4-20mA current output is selected, if the current corresponding to the current exceeds 20.8mA, the system will stabilize the current value at 20.8mA without increase to prevent excessive current.

The input protection function: With the over-voltage and over-current protection function at the input end, it may prevent the amplifier from the peak voltage or current.

Automatic zero adjustment function: The amplifier has automatic zero adjustment function. When the flow in the pipeline is zero, the instrument zero setting can be automatically completed by just touching the button for more than 10 seconds.

Power on and off inquiry function: It can check the power on and off time in the recent 10 times.

The measurement protocol function: Set up the upper limit and lower limit of protocol based on the value agreed by both parties.

Compensation calculation function for density and compression coefficient: When the instrument lacks compensation components (Thermal resistance, pressure sensor) and requires displaying quality and flow, the user only needs to select the compensation mode of the corresponding medium and put the working temperature and pressure of the medium, and the software can automatically calculate the working density and the mass flow of the medium; during “gas temperature pressure compensation” and “natural gas temperature pressure compensation”, the method can also be used to calculate the working conditions, compression coefficient, mass flow rate or standard volume flow rate of the gas.

II.Technical parameters

Operating voltage: 24VDC±10%

Load resistance: When the output current, load resistance should be≤300Ω (including wire resistance)

Display mode: 128×64 LED display in Chinese or English (the software setting may be in both Chinese and English)

Compensation mode: arbitrary arbitration of no compensation, temperature compensation, pressure compensation and temperature compensation

Display contents: instantaneous flow, cumulative flow, temperature, operating pressure, operating frequency (pulse equivalent / current value), working volume, input frequency, load density (compression coefficient),

limit flow accumulation, amplifier temperature, number of modifying menu, the current time, outage time, etc.

Output signal:

The instantaneous flow corresponds to the frequency pulse (low level ≤1V; high level ≥10V; Equal pulse width)

The instantaneous flow corresponds to the equivalent pulse (low level ≤1V; high level ≥10V; Equal pulse width);

Isolated three wire 4-20mA output corresponding to display instantaneous flow

Communication mode: RS485 (standard MODBUS-RTU protocol)

Measuring medium: Liquids, gases, natural gas, saturated steam, superheated steam, refined petroleum

Local air pressure: 0.101325MPa Or arbitrary settings

Standard condition temperature: 0℃ Or arbitrary settings

Ambient temperature: -20℃……+55℃; -20℃……+40℃(explosion proof type)

Environmental humidity: 5%--95%

Explosion proof grade: Explosion-proof type Exia II CT4, Explosion-proof type Exd II CT6

Protection level: IP65m IP67

Temperature sensor type: three-wire system PT100

Pressure sensor type: Four wire diffused silicon pressure sensor

Accuracy of temperature display: superior to 0.2%F.S

Accuracy of pressure display: superior to 0.2%F.S

Accuracy of density calculation: superior to 0.1%

Calculation accuracy of compression coefficient: superior to 1%

Amplifier software range:

Superheated steam temperature and pressure compensation: temperature 0~430℃; pressure -0.1~20MPa

Saturation steam compensation: temperature 0~360℃; pressure -0.1~20MPa

Water temperature compensation: temperature 0~430℃; pressure -0.1~20MPa

Oil temperature pressure compensation: temperature (-20℃~150℃) ; density ρ20=800~900kg/m3

(ρ20 is the density of oil under 20℃, 0.101325MPa)

Natural air temperature pressure compensation: absolute pressure: 0MPa＜p≤12MPa

Thermodynamic temperature: 263K≤T≤338K

Mole fraction of CO2: 0≤xCO2≤0.30

Mole fraction of H2: 0≤xH2≤0.10

High calorific power: 20MJ · m-3≤Hs≤48MJ · m-3

Relative density: 0.55≤d≤0.90

Mole fraction of other components:

CH4: 0.5≤XCH4≤1.4

N2: 0≤XN2≤0.5

C2H6: 0≤XC2H6≤0.2

C3H8: 0≤XC3H8≤0.05

III. Installation

3.1 Intelligent amplifier circuit connection

Intelligent amplifier circuit connection is shown in appendix 1.

3.2 Selection of amplifier and converter connection cable and matters needing attention

The connecting wire should select AVPV2*0.5mm2 two-core or AVPV3*0.5mm2 three- core shielded cable produced by the regular manufacturer. When the cable is connected with the terminal, it should be ensured that the connection is reliable. In connection, attention shall also be paid to the reliable connection between the shield and the amplifier housing. When stripping generally, the shielding layer will leave certain margin and the

incoming locking nut will be used to lock it. In this way, the connecting cable is locked, and the shielding layer and the shell can be tightly

connected. When the amplifier housing is not reliably grounded, it is important to ensure the reliability of the grounding from the outer ground of the amplifier housing a ground wire that is reliably connected to the ground, which is important for the stable operation of the instrument.

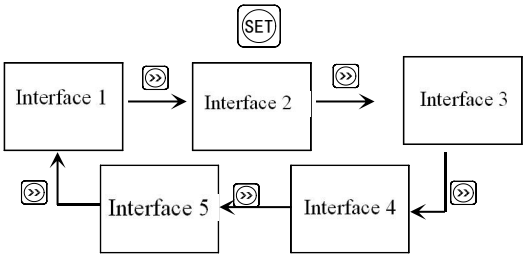
Note: The length of the connecting cable shall be less than 1000 m.

The wire circuit resistance is ≤50Ω when current output; if the wire loop resistance does not meet this requirement, the cable length or the cable cross sectional area should be considered to reduce the wire loop resistance.

IV. Interface display

Connect 24VDC power supply, display main interface, the main interface is divided into 5 pages and may be switched through K2.

When operating with manipulator, insert the connecting line of manipulator. Long press the button SET (K1) and the manipulator will begin to receive the instrument data and display the main interface.



Interface 1

Instantaneous	m^3/h
Gage pressure	MPa
Temperature	℃
Accumulation	m^3

With compensation mode (When measuring absolute pressure, the pressure item shows "absolute pressure")

Instantaneous	m^3/h
Gage pressure	MPa

Without compensation mode

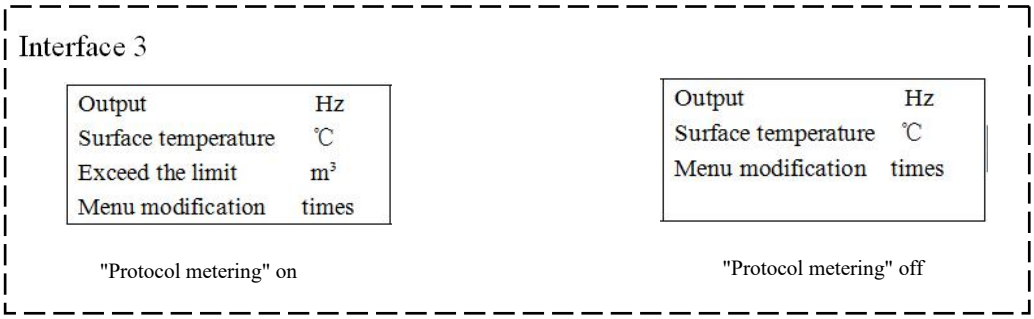
Interface 2

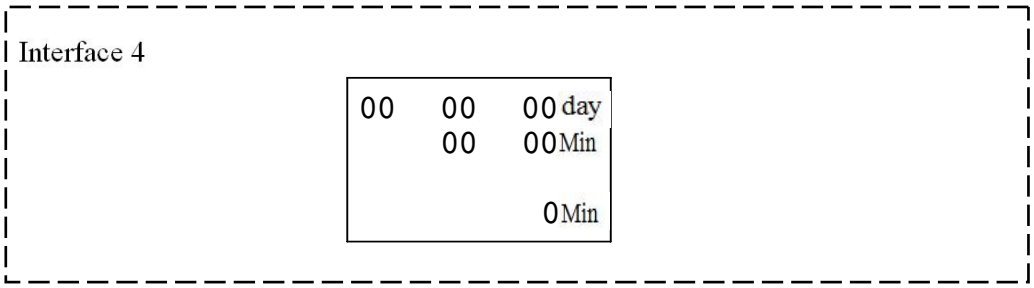
Condition	m^3/h
Density	kg/m^3
Input	Hz
Amplitude	mV

Volume unit, weight unit

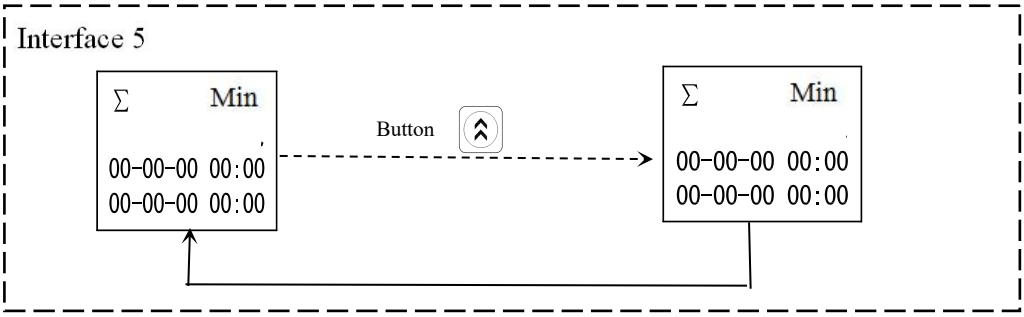
Condition	m^3/h
Coefficient	（Z）
Input	Hz
Amplitude	mV

Volume unit





Total power loss time



Power off and power on

Description of Interface display:

- "instantaneous": display range 0.000-99999999;
- "accumulation": display range 0.000-999999999;

  Note: When the accumulative flow is accumulated to 1000000000, it will be cleared and re-accumulated.

  When the unit of flow changes, the accumulated flow value remains the original value. At this point, please record the original accumulation, then reset it and re accumulate it.
- "temperature": display range -50.0…430.0℃;
- "gage pressure/absolute pressure":

  When the unit is MPa, the display range -0.1000…20.0000MPa;

  When the unit is KPa, the display range is -100.0…20000.0KPa;

  When the unit is bar, the display range is -1.0…200.0bar.
- "Condition": show instantaneous operating volume flow，display range 0.000-99999999m^3/h;
- "Density": display range 0.000-99999999kg/m^3;
- "Coefficient": "flow unit" is set to standard condition volume flow (namely Nm^3/h) and displays the compression coefficient of medium condition, display range 0.000000-9.999999;
- "Input": Display the actual frequency measured by the sensor, display range 0.000-9000.0Hz;
- "Output": Display the corresponding frequency or current output according to the "output type" settings in the menu
- "Surface temperature": Display amplifier internal temperature, display range -99.9-+99.9℃;
- "Over limit": When the metering function is opened, the cumulative flow of excess caps is displayed,

display range 0.000-999999999;

Note: When the accumulative flow is accumulated to 1000000000, it will be cleared and re-accumulated.

- "Menu modification": Number of times the menu changes are displayed. display range is 0-9999; when adding to 10000, reset the records;
- Interface 4: display current time, total power down minutes, and system clock on display
- Interface 5: it may display the power on and off records and save the power on and off time in last 10 times and the start time of "system clock".
- Description of special display:

  A. NULL: This data is not displayed;

  B. ERROR: Data error. Please check the menu settings or display the work parameters at this time;

  C. OVERRUN: Data runs over display range

V. Menu setting

The menu setting is completed by 

5.1 Function of each button

(1) (K1) : Enter the set status and set the confirmation of the value;

(2) (K2) : Move the cursor's position downward one cycle;

(3) (K3) : A choice of 1 or function for the value of the cursor on which the cursor is located;

(4) (K4) : Returns the previous menu item.

5.2 Main menu

In the main interface state, press K1 to enter the main menu.

Press the K2 key cycle to select the menu, press the K1 button to enter.

Parameter setting
Calibration setting
Language selection
Return

5.3 Main menu of parameter setting

Parameter Change	Return	Password input
Total clearing		0000
Zero setting		
Password Modification		

After you select the menu, press K1 to enter the password authentication interface. After you enter the correct password, you can set the parameters.

Note: the system will automatically withdraw from the "set" state when the parameter setting menu is not operated for 30 seconds. At this point, the setting parameter value is invalid. The parameter value may take effect after the storage and exiting.

5.3.1 Parameter change menu directory (see table I)

Initial password: 000000

Parameter settings menu directory **Table I**

<table>
<tr><th>Menu name</th><th colspan="2">Menu contents</th><th>Description</th></tr>
<tr><td>Factory Reset</td><td colspan="2">Yes, no</td><td>Select “yes” and press the setting button.
LED displays “please waiting”.
Next, it will show “recovery is completed”.
Select “no” and enter the lower menu. It is defaulted as “no”.</td></tr>
<tr><td>Measuring menu</td><td colspan="3">Liquid uncompensated
Gas uncompensated
Gas temperature compensation
Superheated steam temperature and pressure compensation
Saturation steam temperature compensation
Saturation steam pressure compensation
Water temperature compensation
Liquid temperature subsection compensation
Oil temperature pressure compensation
Natural air temperature pressure compensation</td></tr>
<tr><td>Instrument caliber</td><td colspan="2">0000-9999mm</td><td></td></tr>
<tr><td>Instrument factor unit</td><td colspan="2">1/m^3, 1/L</td><td></td></tr>
<tr><td rowspan="4">Instrument factor</td><td colspan="2">Average instrument factor</td><td rowspan="2">Instrument coefficient setting range: 0.000000-99999999
Linear correction breakpoint frequency setting range: 0.00-9999Hz
The setting method of linearity correction is shown in VI</td></tr>
<tr><td colspan="2">Linear instrument coefficient</td></tr>
<tr><td>Linear correction factor</td><td>Frequency I</td><td rowspan="7"></td></tr>
<tr><td rowspan="6"></td><td></td><td>Frequency I</td></tr>
<tr><td></td><td>Frequency II</td></tr>
<tr><td></td><td>Frequency II</td></tr>
<tr><td></td><td>……</td></tr>
<tr><td></td><td>Frequency X</td></tr>
<tr><td></td><td>Frequency X</td></tr>
<tr><td>Flow unit</td><td colspan="2">m^3/h, km^3/h, l/min, kg/h, t/h, kg/min, (Nm^3/h, Nkm^3/h, Nl/min, Nm^3/min, Nkm^3/min)</td><td>m^3/h, km^3/h, l/min is Volume flow unit for working conditions; kg/h, t/h, kg/min is Mass flow unit; Nm^3/h, Nkm^3/h, Nl/min, Nm^3/min, Nkm^3/min are Volume unit of flow for gas gauge.</td></tr>
</table>

Output Type	Working frequency (Calibration required) Equivalent pulse 4-20mA	
Equivalent coefficient	0.000000-99999999	The equivalent coefficient is meaningful only when the "equivalent pulse" is output. Definition: ** Unit cumulants / pulses
Upper limit of output	0.000000-99999999	The upper limit and lower limit of output are meaningful when the output form is “4-20mA”.
Lower limit of output	0.000000-99999999	
Damping coefficient	00-99	
Temperature I	-9999~99999℃	Parameter setting of “liquid temperature segment compensation” The setting method is shown in VI
Density I	0.000000-99999999kg/m^3	
Temperature II	-9999~99999℃	
Density II	0.000000-99999999kg/m^3	
……	……	
Temperature X	-9999~99999℃	
Density X	0.000000-99999999kg/m^3	
CO_2 mole fraction	0.000000-99999999	Parameter setting of natural air temperature pressure compensation
H_2 mole fraction	0.000000-99999999	
relative density	0.000000-99999999	
high calorific power	0.000000-99999999MJ/m^3	
Compression coefficient compensation mode	Automatic setting	
Compressibility	0.000000~99999999	The compression coefficient compensation mode is valid when the setting is selected.
critical pressure	0.000000-99999999MPa	"Gas temperature and pressure compensation", "mixed gas temperature and pressure compensation" parameter setting
Critical temperature	0.000000-99999999K	
Local air pressure	0.000000-99999999MPa	“Local air pressure” defaults 0.101325MPa
Standard temperature	00~99℃	
temperature compensation method	Automatic setting	
Temperature setting value	-50~430℃	"Temperature compensation mode" is valid when selecting "Settings"
Pressure unit	MPa、KPa、bar	
Pressure compensation mode	Automatic setting	

Setting value of gage pressure/absolute pressure	-0.1-+20MPa	"Pressure compensation mode" is valid when selecting settings
Medium density	0.000000-99999999kg/m^3	No compensation mode: set to medium condition density; Gas temperature pressure compensation: set to 0.101325MPa and Standard condition density of temperature; Oil temperature pressure compensation: Set to the density when the absolute pressure is 0.101325MPa and the temperature is 20℃.
Small signal resection unit	Hz, flow unit	
Small signal resection value	0.000000-99999999	
System clock	No, yes	
Time setting	MM/DD/YY 00:00	When the system clock is set to "no", it is not displayed
Communication form	No; RS485	
Communication bit number	001-255	“Communication bit number” default 001.
Baud rate	9600、4800 2400、1200	“Baud rate” defaults 9600
Even-odd check	no Odd parity Even parity	“even-odd check” defaults “no”
stop bit	1 bit, 2 bit	“stop bit” defaults “1”
Backlit display mode	Normally closed, normally open, automatic	
Parameter storage	Yes, no	Press SET for 2-3 seconds to exit from “parameter setting” menu. Select “yes” and the screen will display “success in parameter storage” and return to main menu.

Note: 1. The table lists all the menu items in the software, which are not all displayed in general; Depending on the function and settings, certain menu items are blocked;

2. When you enter the menu, you may find that a value is different from the original setting. It is normal that LED display has not been refreshed. Press K2 button to recover to normal.

5.3.2 Cumulative clearing

Flow cumulative reset Yes No	Power down reset Yes No

The "cumulative clear" menu clears accumulated traffic and power loss records.

5.3.3 Zero set

Zero value

0053

Zero setting method:

- Manual zero setting:

Enter the zero settings menu, modify the zero value, and then save it;

(Note: Non professional personnel cannot adjust manually)

- The automatic zero adjustment:
  1. Single button zeroing: On the main interface, press zero button or until the indicator is on. It will enter the automatic setting status. When the indicator is on, the zero adjustment will end.
  2. Menu status zeroing: enter the automatic resetting menu. When the zero point is stable, press SET to save it.

Note: when checking the zero, the pipe flow shall be guaranteed to be zero.

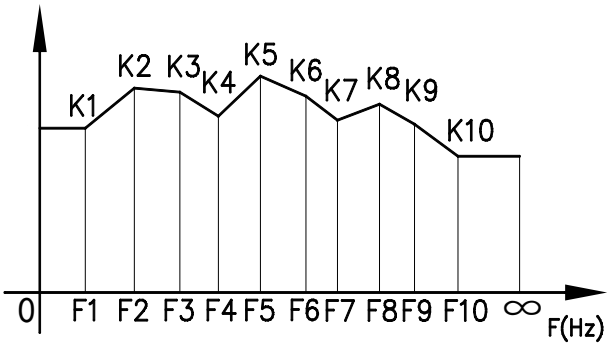
VI. Setting method of linear correction coefficients (Liquid temperature compensation setting method can be referred to)

F1……F10、K1……K10 is the frequency and coefficient corresponding to the actual target location of the instrument. The frequency and coefficient of the 10 groups are not set at all, but it must be continuously set from small to large starting from "frequency I" and "coefficient I".

The rest Break point frequency and coefficient must keep the original default value 0.

Linear correction instrument coefficient algorithm:

1. When F＜F1, K=K1;
2. When F1≦F＜F2, K=(F-F1)(K2-K1)/(F2-F1)+K1;
3. When F2≦F＜F3, K=(F-F2)(K3-K2)/(F3-F2)+K2;
4. When F3≦F＜F4, K=(F-F3)(K4-K3)/(F4-F3)+K3;
5. When F4≦F＜F5, K=(F-F4)(K5-K4)/(F5-F4)+K4;
6. When F5≦F＜F6, K=(F-F5)(K6-K5)/(F6-F5)+K5;
7. When F6≦F＜F7, K=(F-F6)(K7-K6)/(F7-F6)+K6;
8. When F7≦F＜F8, K=(F-F7)(K8-K7)/(F8-F7)+K7;
9. When F8≦F＜F9, K=(F-F8)(K9-K8)/(F9-F8)+K8;
10. When F9≦F＜F10, K=(F-F9)(K10-K9)/(F10-F9)+K9;
11. When F10≦F, K=K10



Wherein: F—frequency corresponding to current flow (Hz)

K1……K10—Calibration instrument factor corresponding to F1……F10

Note: if only setting "frequency 1" to "frequency 3" and "coefficient 1" to "coefficient 3", the rest bending frequency and coefficients will be set to 0. When the measuring frequency is larger than or equal to "frequency 3", it will be calculated based on "coefficient 3".

VII. Communication functions

7.1 Relevant parameter

This instrument has RS485 communication interface and adopts standard MODBUS-RTU communication protocol. The related parameters are as follows:

Start bit: 1 bit	Data bit: 8 bits	parity check bit: setting
Stop bit: setting	Baud rate: setting	Response speed: 0.05s

7.2Data format

IEEE754 format of Standard single precision floating point number

7.3 data address

This instrument supports only 03 commands to read data, and each data register address is as follows:

1.0000H: Instantaneous flow value

2.0002H: Cumulative flow value

3.0004H: Working condition temperature (No compensation model; 0.0000)

4.0006H: gauge pressure/absolute pressure (No compensation model; 0.0000)

5.0008H: Operating volume flow rate

6.000AH: Working condition density

7.000CH: compressibility (Nonstandard unit of volume, 0.0000)

8.000EH: input frequency

9.0010H: Working frequency output (when it is the output, it is 0.0000)

10.0012H: Equivalent pulse output (not output, 0.0000)

11.0014H: current output (not output, 0.0000)

12.0016H: 0.0000(This address system remains independent of the display data on the instrument interface)

13.0018H: gauge temperature

14.001AH: Transfinite cumulative flow (when the protocol metering is off, it is 0.0000)

15.001BH: Total power loss time (when the system clock is off, it is0.0000)

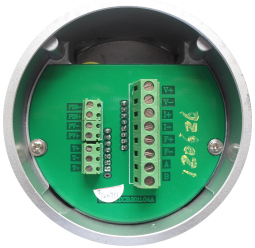
16.001EH: Menu modification times

7.4 Special transmission data

Transmission data when liquid crystal displays the following information:

- NULL: Transmit data is 0
- ERROR: Transmit data is -1234
- OVERRUN: Transmit data is-8888

Appendix 1 Connection diagram of intelligent amplifier

X4 and D4 connecting terminal		E4 connecting terminal
		
Terminal description	V+, V-	working power supply +, -
	I+, I-	current output+, -
	F+, F-	pulse output +, -
	A, B	A, RS485+; B, RS485-
	T+, T-, T-	PT100 Thermal resistance terminal
	PV+, PV-, PI+, PI-	Pressure sensor terminal

Appendix 2 Calibration method

(1) When the instrument is calibrated, the “output form” should be set to “frequency of working conditions” and “small signal cutting number” should be set to 0; after the calibration, set “instrument coefficient” according to the actual calibration and then restore “output form” and “small signal cutting number” to the original setting.

(2) Fixed point flow stability time: ≥60s

Appendix 3 Basic formula

(1) Instantaneous volume flow

$$Qv = 3600 \times \frac{F}{K}$$

Where: Q_v—Operating volume flow rate (unit: m^3/h)

F—Current working frequency (unit: Hz)

K—Instrument coefficient (unit: pulse number $/m^3$)

(2) Instantaneous mass flow rate

$$Qm = 3600 \times \rho \times \frac{F}{K}$$

Where: Q_m—Working condition mass flow rate (unit: kg/h)

ρ—Medium condition density (unit: kg/m^3)