MF51 Series Thermal Gas Mass Flow Meter Manual

Catalogue

1. About This Manual

Thank you for choosing our company's products.

This manual is written for professionals in the Chinese market who speak Chinese as their native language. From the date of publication of this manual, we will no longer provide English manuals with products supplied to the Chinese market. For customers with special needs, you can also contact our authorized local distributors or agents to obtain English manuals.

Through this manual, we strive to make you accurately understand the measurement principles, related concepts, professional terms, and correct methods and conditions for installation and application of thermal mass flow meters.

Symbols and meanings used in this manual:

Meaning of Graphic Symbols	
 Warn!	Incorrect or non-compliant operations or use in violation of the requirements of this manual may result in damage to the instrument and equipment.
 Attention!	Important concepts, definitions or methods
 Caution!	Improper or careless operation and application may cause the instrument to not operate properly or even be damaged.
	Grounding mark
	Specifications and requirements that must be followed when using intrinsically safe instruments

2. Safety Matters

2.1 Users

Thermal mass flowmeter is a precision instrument that uses the latest technology and processes and is produced in accordance with the ISO:9001 quality system and complies with relevant EU standards. Improper installation and use may cause abnormal operation and damage to the instrument or even the process control equipment. The engineering and technical personnel who install, set up and connect the product must read this manual carefully before using the instrument and truly understand the exact meaning, working conditions and process conditions of the application site.

2.2 Storage and Handling

Storage Temperature: -40℃~80℃

Relative Humidity: 20~90%

During storage and transportation, the instrument should be placed in the packaging box to avoid bumps or impacts.

2.3 Application Conditions

Before installation, make sure that the maximum temperature and pressure of the measured medium do not exceed the nominal temperature and pressure. Make sure that the measured gas is pure and does not contain particulate matter to avoid damage to the sensor by particulate matter.

2.4 Safety Standards and Regulations

The installation, wiring and use of this product should comply with the requirements stated in this manual as well as general international safety regulations, accident prevention measures and relevant local standards.

2.5 Intrinsic Safety and Explosion-Proof

- *In dangerous places where there is or may be a mixture of flammable gas and air at the measurement site, an intrinsically safe explosion-proof thermal mass flow meter should be used;*
- *The intrinsically safe explosion-proof thermal mass flowmeter must be used in conjunction with a suitable safety barrier that has obtained intrinsically safe explosion-proof certification;*
- *The installation, wiring and associated equipment of the intrinsically safe instrument system shall comply with the relevant standards and specifications of the country where it is located.*

2.6 Environmental Protection

The packaging of this product is made of paper material that complies with ISO:14001 standards and is naturally degradable or recyclable and will not pollute the

environment.

Please hand over the scrapped products to a professional recycling company or send them back to us to avoid polluting the environment.

3. Overview

3.1 Measurement Principle

The thermal gas mass flow meter is designed based on the principle of heat diffusion. The instrument uses the constant temperature difference method to accurately measure the gas. It has the advantages of small size, high degree of digitization, easy installation and accurate measurement.

The sensor part consists of two reference-level platinum resistance temperature sensors. When the instrument is working, one sensor continuously measures the medium temperature T1 ; the other sensor self-heats to a temperature higher than the medium temperature T2 . It is used to sense the flow rate of the fluid and is called a velocity sensor. The temperature △T =T2-T1 , T2>T1 . When fluid flows through, the gas molecules collide with the sensor and take away the heat of T2 , causing the temperature of T2 to drop. If △T is to remain unchanged, the power supply current of T2 must be increased . The faster the gas flows, the more heat it takes away. There is a fixed functional relationship between the gas flow rate and the increased heat. This is the principle of constant temperature difference.

$$V = \frac{K\left[\left[\frac{Q}{\Delta T}\right]\right]^{1}.87}{\rho_g} \qquad \text{.....(1)}$$

Where ρ_g - fluid specific gravity (related to density)

V — Flow rate

K —Balance coefficient

Q — Heating (related to specific heat and structure)

△ T — Temperature difference

30 ° C higher than the medium (ambient) temperature , thermal gas flow meters do not require temperature compensation in principle.

The applicable medium temperature range of thermal gas mass flowmeter is -40-220 ℃.

The specific gravity and density of the fluid are related to

$$\rho = \rho_n \times \frac{101.325 + P}{101}.325 \times \frac{273.15 + 20}{273.15 + T}$$

in ρ_g — Medium density under working volume (kg/m 3)

ρ n — Medium density under standard conditions (101.325 Kpa , 20 ℃) (kg/

m3)

P — Working pressure (kPa)

T —Operating temperature (℃)

from equations (1) and (2) that the functional relationship between flow rate and operating pressure, gas density, and operating temperature has been determined.

The constant temperature differential thermal gas mass flow meter is not affected by temperature or pressure. The thermal gas mass flow meter is a true direct mass flow meter, and users do not need to correct the pressure and temperature.

3.2 Technical Parameters

Thermal gas mass flow meter has the following technical advantages:

A true mass flow meter does not require temperature and pressure compensation for gas flow measurement, and is convenient and accurate in measurement. It can obtain the gas mass flow or standard volume flow.

Wide range ratio, can measure gas flow rate as high as 100Nm/s and as low as 0.5Nm/s , can be used for gas leak detection.

Good anti-vibration performance and long service life. The sensor has no moving parts and pressure sensing parts, and is not affected by vibration on measurement accuracy.

Easy to install and maintain. If the site conditions permit, installation and maintenance can be carried out without stopping production. (Special customization required)

Digital design. Overall digital circuit measurement, accurate measurement and easy maintenance.

Using RS-485 communication or HART communication can realize factory automation and integration.

Property	Technical Parameter
Structural Form	Pipe Type
Measuring Medium	All Gases (Except Acetylene)
Pipe Diameter Range	DN20～40mm
Velocity Range	1～100 Nm/s
Accuracy	±1～2.5%
Operating Temperature	Sensor：-40～+250℃ Convertor：-20～+55℃
Working Pressure	Medium Pressure≤ 3.0MPa
Power Supply	DC 24V /25W
Response Speed	1s
Output Signal	4-20mA(Maximum Load500Ω）、RS-485
Give an Alarm	/
Type of Supply	Separate Structure(High Temperature)/ Integrated Structure
Pipe Material	Anodized Aluminum、 Stainless Steel
Field Display	Four Lines of Chinese Liquid Crystal Display，can be displayed at 0℃ or 180℃
Display Content	Standard Volume Flow, Cumulative Flow,Standard Flow Rate, Etc
Class of Protection	IP64
Sensor Material	316Stainless Steel

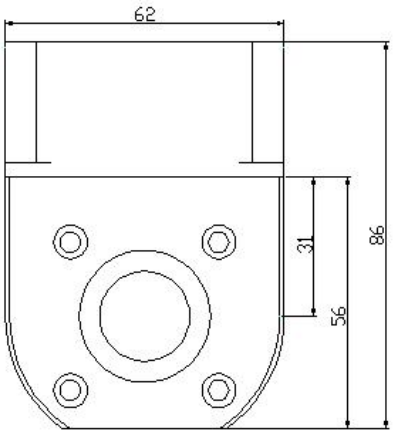
3.3 Structure Diagram

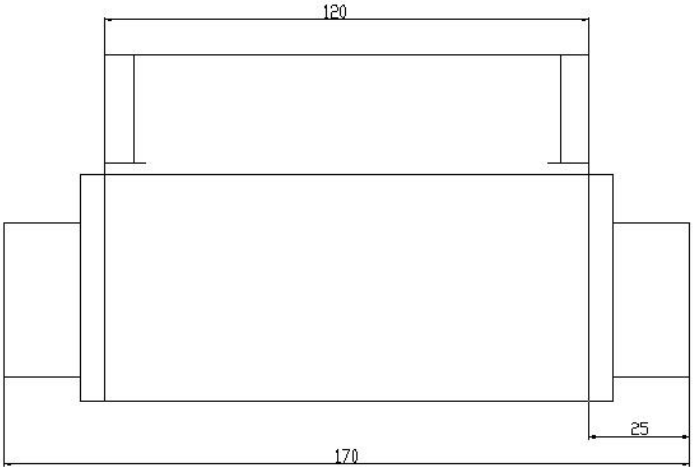
3.3.1 Appearance

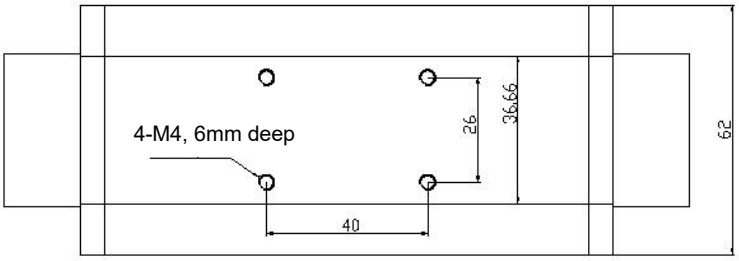
Applicable to pipe diameters above DN25 and below DN50
Threaded installation full tube type gas mass flow meter

3.3.2 Overall Dimension

DN20,DN25 Overall Dimension

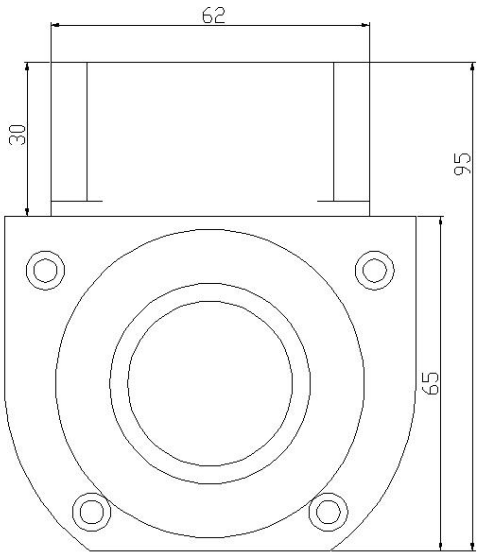


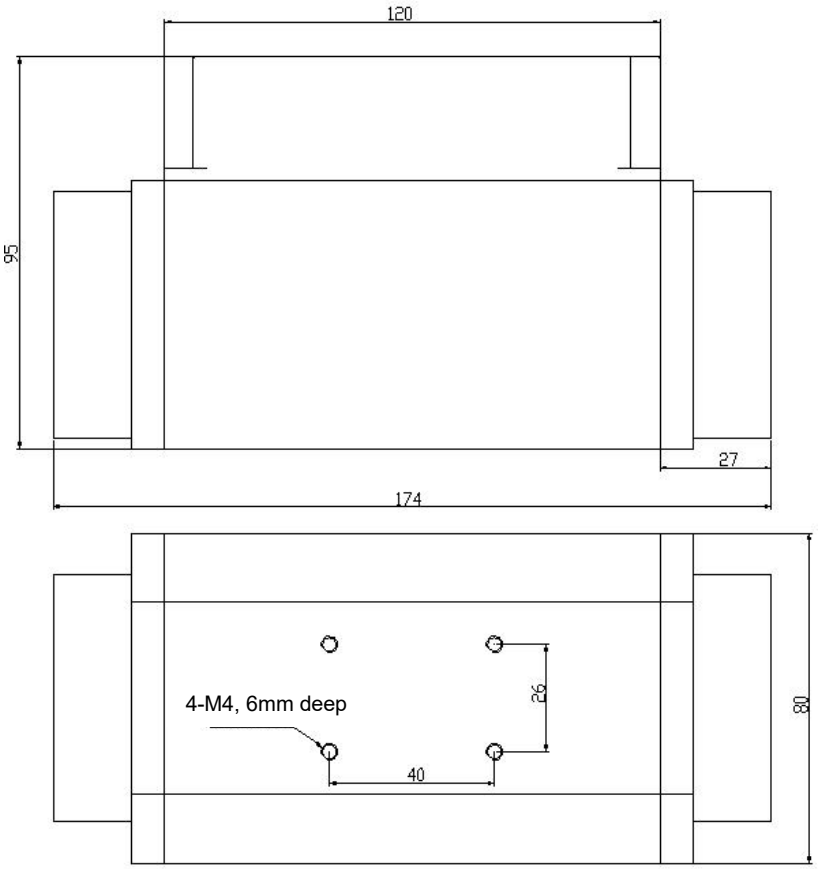




Mechanical Interface Connection Dimensions	
DN20	G3/4Internal Thread
DN25	G1Internal Thread

DN32,DN40 Overall Dimension





Mechanical Interface Connection Dimensions	
DN32	G1-1/4Internal Thread
DN40	G1-1/2Internal Thread

4. Wiring

4.1 Wiring Preparation

- Before wiring, carefully read the wiring methods and requirements of other unit instruments or systems used in conjunction with the thermal gas mass flow meter;
- When connecting external cables, it is recommended to use two-core shielded cables and ensure that the cable connections are well sealed;
- For intrinsically safe explosion-proof products, intrinsically safe instrument cables that comply with relevant standards should be selected and the cable parameters should be ensured to meet the requirements of the intrinsically safe explosion-proof instrument system;

Warn!

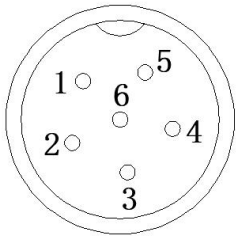
- *The working voltage range is DC18~30V. When the DC voltage is higher than DC30V , the instrument will be damaged. Measures should be taken to prevent the power supply voltage from exceeding 30V .*
- *24V DC power supply for the thermal gas mass flow meter should meet the SELV safety extra-low voltage of IEC-1010-1 or equivalent standards ;*

  Before using the DC power supply, measure the supply voltage with a

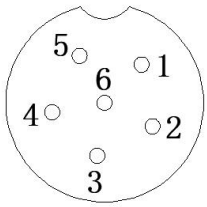
voltmeter to make sure the loaded voltage is DC24V ;

4.2 Terminal Description

6-Core Air Line Description	
Logo	Meaning
1-Pink	24V-/ Current I-
2-Black	Current I +
3-Blue	Shell Ground
4-White	24V+
5-Brown	RS485 Communication Output A
6-Gray	RS485 Communication Output B

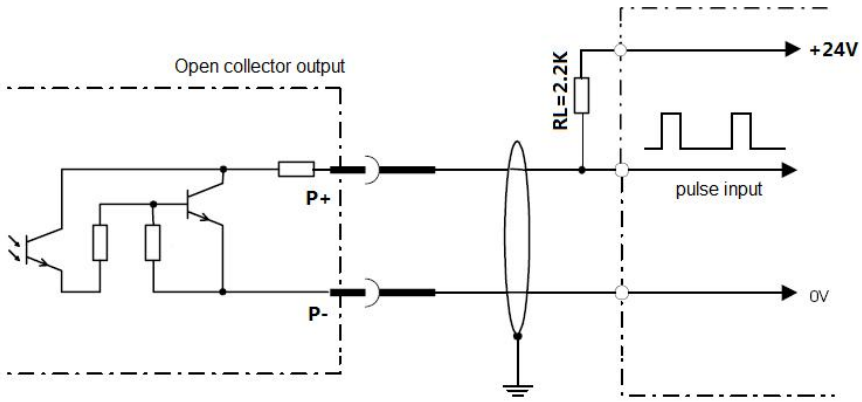
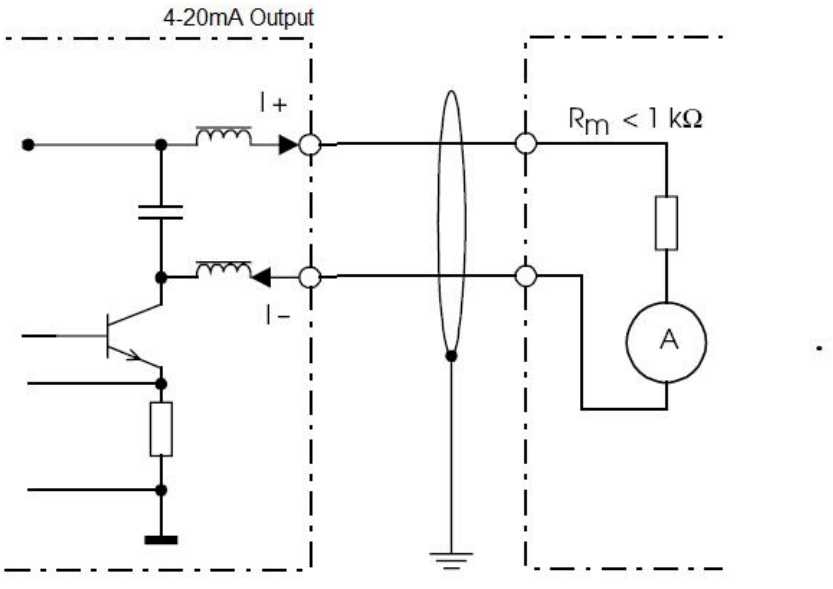


The plug is installed on the housing.



6-core female connector

4.3 Wiring Connection

Pulse output wiring(optional)	
Current output wiring	

5. Technical Parameters

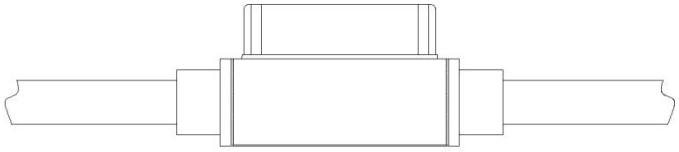
Power Supply	Operating Voltage	DC20~30V Standard: DC24V/1.5A Allowable Residual Ripple: 0~100Hz , Upp = 30Mv , Uss ＜ 10mV Maximum Noise: 500Hz~10KHz , U eff = 2.0mV AC85~265V Standard: AC110V or AC220V
	Working Current	<650mA
Output	Output Current	4~20mA/ Fixed Current (Fixed Output Value Optional)
	RS485 Output	Baud Rate: 2400/4800/9600/19200
		Data Bits: 8
		Check Digit: None/Odd/Even
		Stop Bits: 1
	Communication Protocol	MODBUS RTU

6. Installation

Attention! *A stable flow field is a prerequisite for accurate measurement of thermal instruments. Therefore, please pay attention to the following points during instrument installation.*

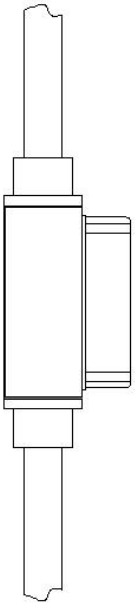
6.1 Installation

● Horizontal Installation



The maximum working pressure *when installed horizontally is 1.6 MPa .*

● Vertical Installation



The vertical installation working pressure shall not exceed 1.6 MPa .

6.2 Pipe Section Installation Requirements

If interference sources (such as pipe bends, reducers, valves, T -pieces, etc.) are located in the air inlet line of the thermal instrument, be sure to take measures to minimize their impact on the measurement performance.

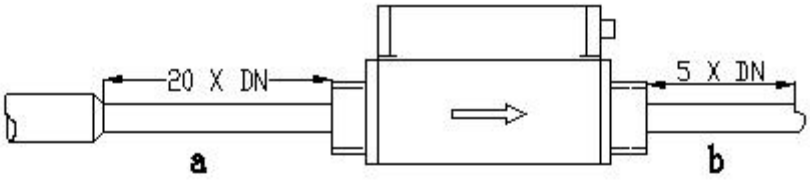
The following diagrams show the minimum recommended straight pipe lengths for different types of pipes. If the measurement space is large enough, the straight pipe length should be extended as much as possible. Without considering other factors, the minimum recommended straight pipe length of the sensor is:

Front straight pipe section:Minimum 20 × DN

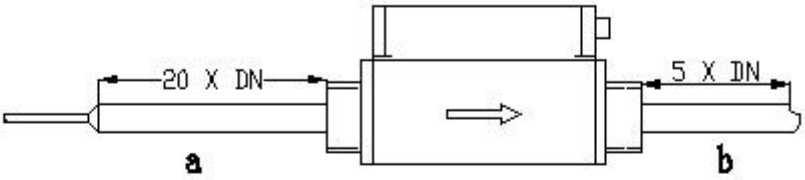
Rear straight pipe section:Minimum 5 × DN

- *Recommended values are minimum values and generally increasing the length will improve the flow meter's measurement performance.*
- *If there are two or more interference sources in the straight pipe section before the instrument, the recommended maximum straight pipe length is the absolute minimum.*
- *It is recommended to install the control valve after the thermal gas mass flow meter.*
- *For lighter gases such as helium and hydrogen, the length of the front straight pipe section should be doubled.*

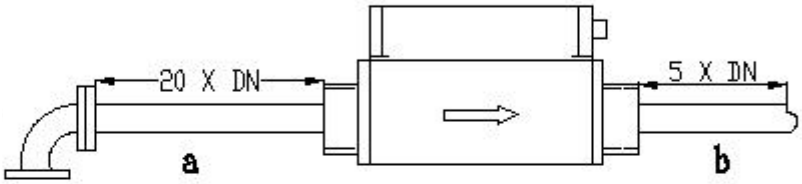
Reduce the pipe diameter



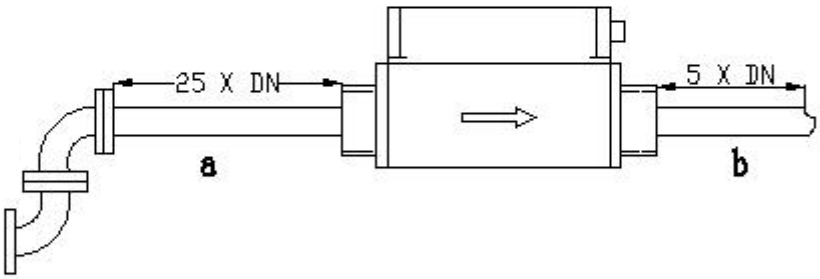
Increase the pipe diameter



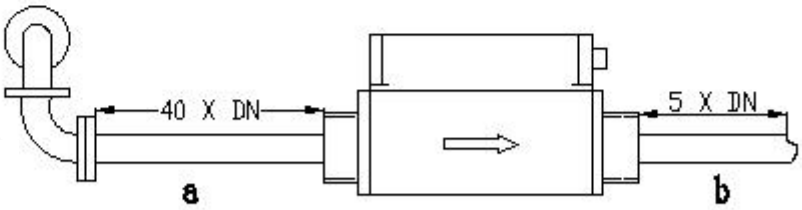
With 90-degree elbows or T-shaped pipes



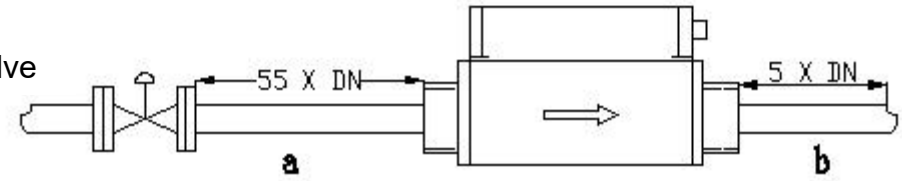
A pipe with two 90-degree elbows



3. Pipe with 2 90-degree elbows



control valve

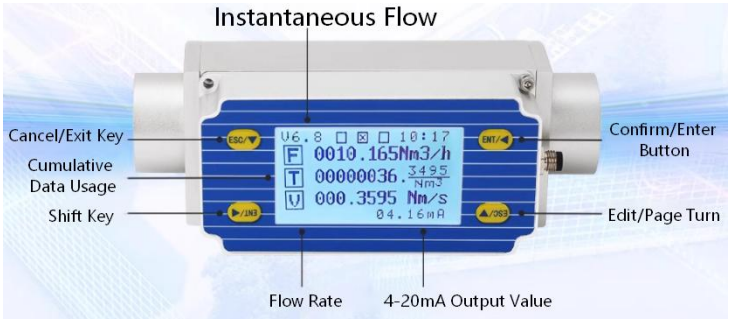


a = Front Straight Section b = Rear Straight Section

Attention! Try to install the control valve and buffer cut-off valve behind the thermal gas mass flow meter.

7. Operation

7.1 Keyboard and Display

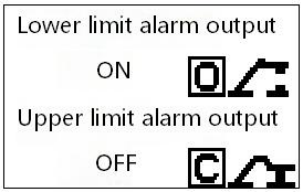


ESC	ESC: Cancel/Exit key
▶	Shift key
▲	Edit/page key
ENT	ENT: Confirm/Enter key

7.2 Menu Description

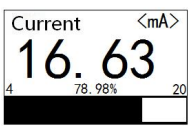
7.2.1 Display Menu

Display instantaneous flow rate、instantaneous flow rate unit、total flow and unit

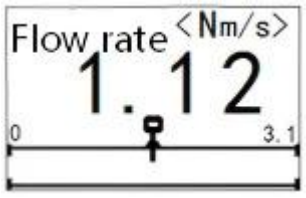


Upper and lower limit alarm flow value alarm status indication.

When there is no alarm, the relay is in the normally open state.

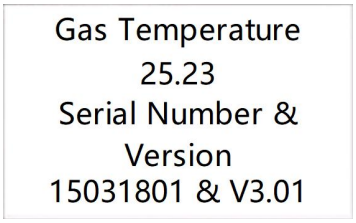


Current output current value

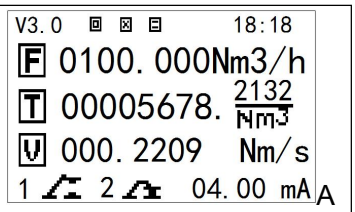


Display instantaneous flow velocity in fixed units of m/s 0 and 3.1 are the measurement range of instantaneous flow rate, which changes with the range setting value.

The flow velocity in the pipeline is dynamically displayed. The greater the flow velocity, the faster the point speed in the pipeline.



Gas temperature value and serial number and version



All information display windows

The first line: V3.0 is the software version number, and the box is the status indicator.

First from the left

☐ Displayed in a Loop.

☐ Displayed without looping

The second

☒ The backlight is always

☐ .For a moment

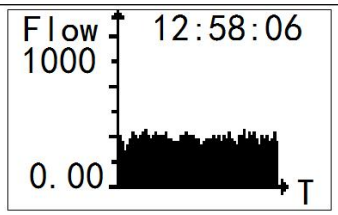
The third

☐ Communication protocol is other

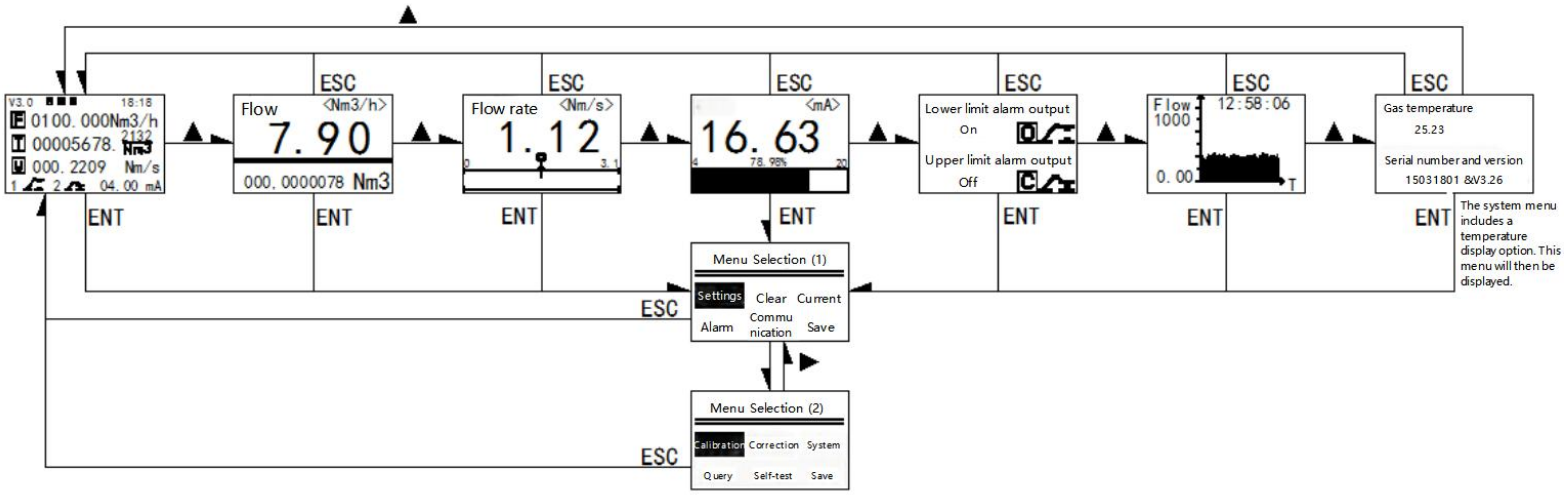
☐ MODBUS RTU Protocol

18:18 is the system time

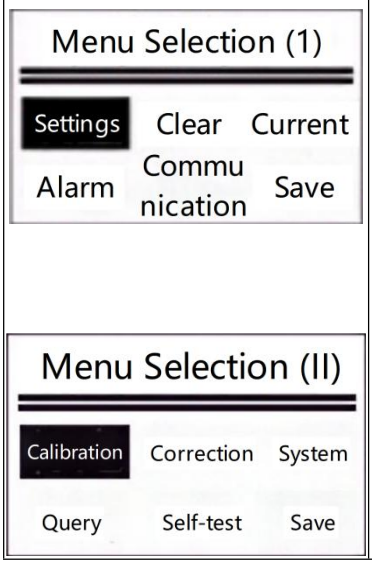
The second line is the

and current output percentage Dynamic bar display	 Historical data, the last data is the data at the current time point, and the data interval can be set.	instantaneous flow The third line is the cumulative flow The fourth line is the flow rate Line 5: Relays and Current

The five display interfaces can be viewed by pressing the 'page key', and the menu selection interface can be entered by pressing the confirm key.Press the Cancel button in the non-flow interface to return to the flow interface.



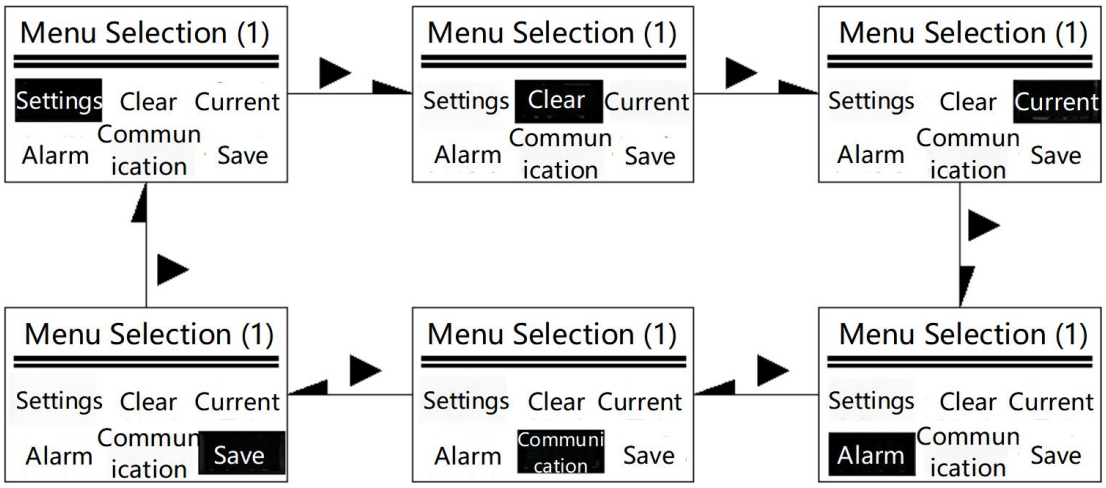
7.2.2 Menu Selection And Password Input



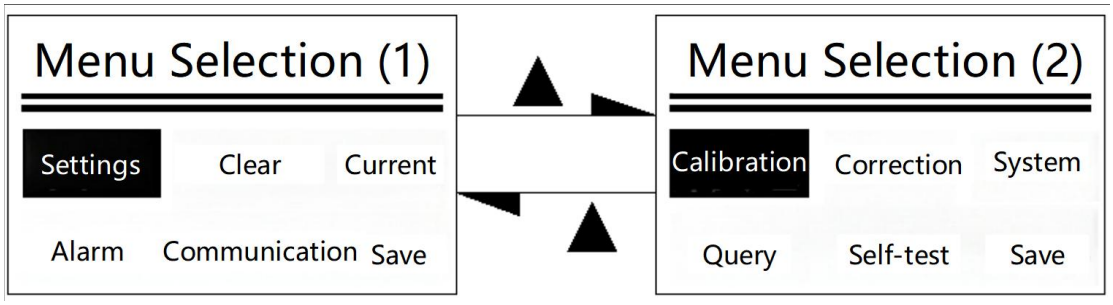
Menu Selection
Settings：Basic parameter settings
Clear：Cumulative integer and decimal settings
Current：Current parameter setting
Alarm：Setting of upper and lower alarm limits and alarm hysteresis
Communication：RS485 communication parameter setting
Save: Parameter save and restore
Calibration：Calibration settings
Correction：Secondary correction of flow
System：Setting of system parameters
Query：Query of historical data
Self-test：Automatic test of each function

Enter password ********** Password Press ENT key to enter	Setup, Clear, Current, Alarm, Communication, Correction, System Password：1000 Calibration Password：0603 Query, Self-Check, Save Password：None

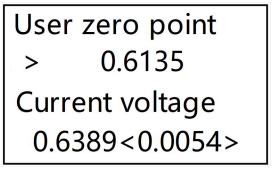
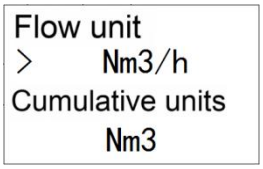
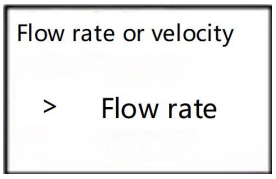
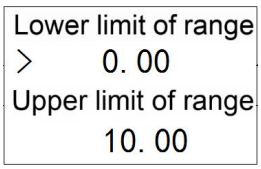
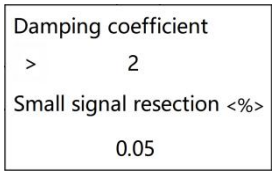
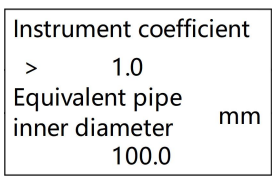
Use the shift key to select the function menu you want to enter



Set the basic parameter menu, move the black rectangular box to "Settings", press the "ENT" key, the password input menu appears, press the "ENT" key again, a flashing cursor appears, enter the password, after the password is entered, press the "ENT" key again to confirm, if the password is correct, enter the parameter setting menu directly, if the password is incorrect, the "Error" character appears, press the "ENT" key again to re-enter the password.

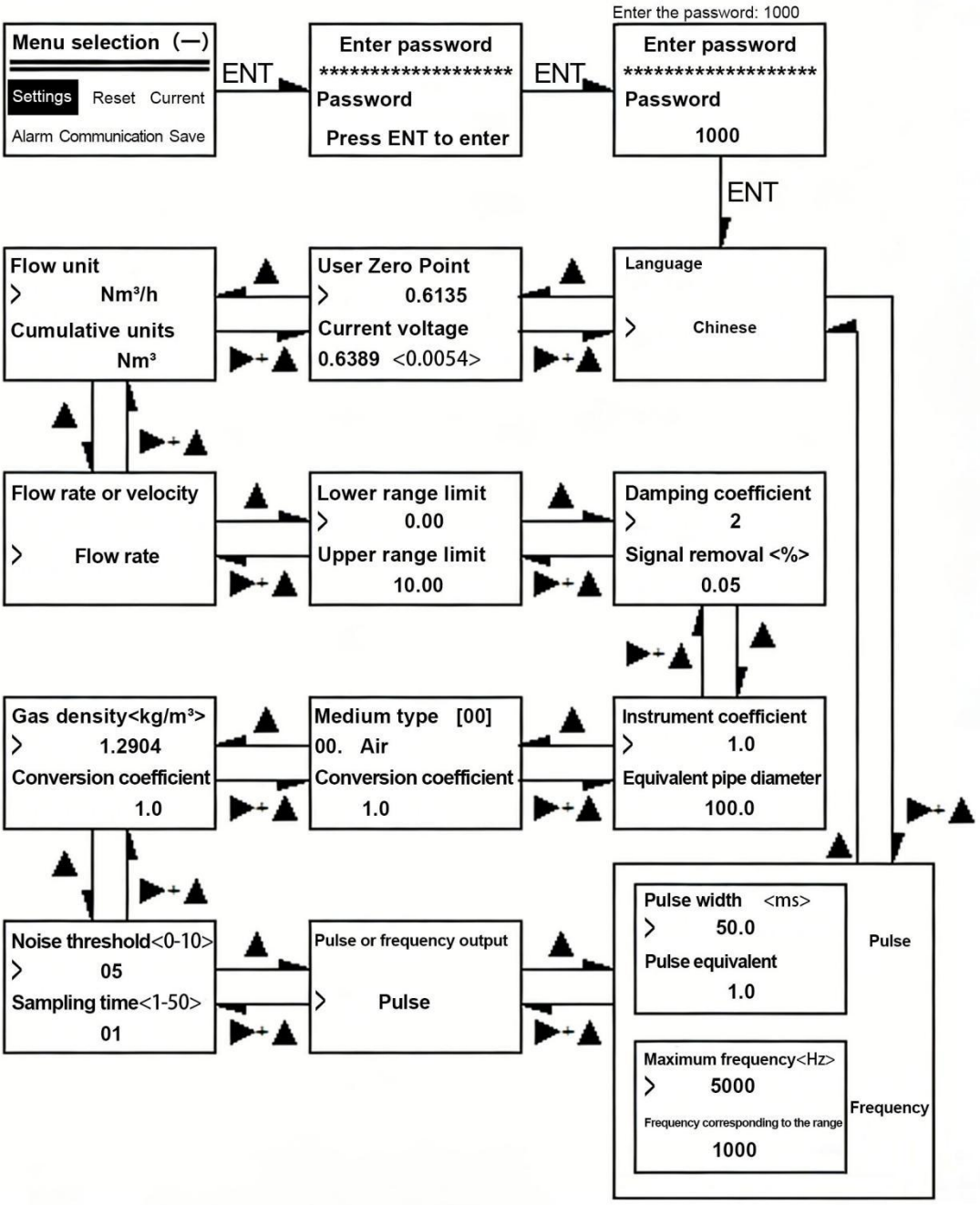


7.2.3 Setting Menu

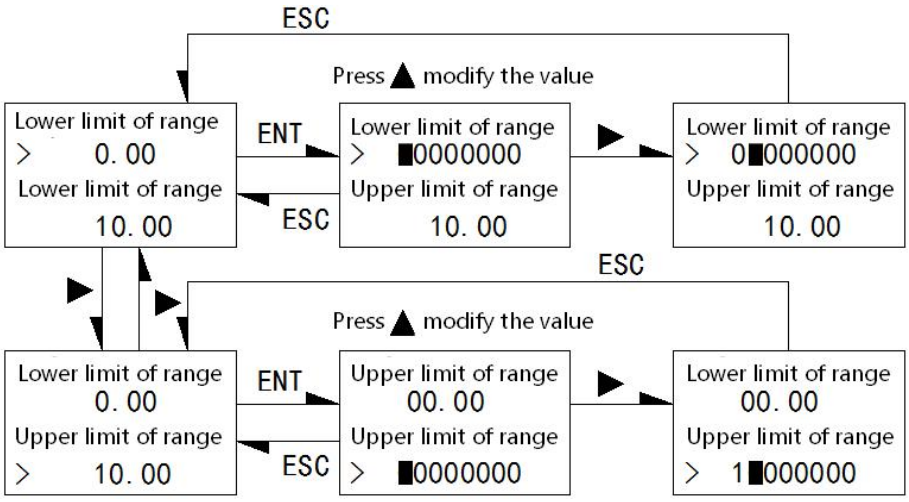
	Language selection: Chinese or English
	User zero voltage setting, the user zero voltage is different according to the different working conditions on site, the user can set the user zero point according to the on-site conditions. When the user zero point is set to zero, the instrument will automatically set the current actual voltage to the user zero voltage. When there is no flow in the pipeline, the flow displayed on the meter is not zero. It can be adjusted by modifying the zero point. The value in <> is equal to the calibrated zero point minus the user zero point.
	＞ Indicates that it can be set The flow units are as follows: g / min, g/s, Kg / min , Kg / h, Nm3/ h, Nm3 / min, N L/ h, N L/ min, SCFM Cumulative units are: g, Kg, Nm3, NL, CFM, The cumulative unit changes with the flow unit and does not need to be set separately
	Flow or flow rate: Select whether the output 4-20mA indicates flow or flow rate. If flow rate is selected, the upper and lower limits of the range are flow rate.
	＞ means it can be set. Press the shift key to switch ' ＞ ' between the upper and lower limits of the range. Press the ENT key to enter the setting, and the first character flashes after entering
	Damping coefficient: default 2, range 0-50 Reducing the damping coefficient can quickly detect the jump in flow rate. Increasing the damping factor can smooth the current flow display value. Small signal cutoff: eliminate zero fluctuations, as a percentage of the range
	Instrument coefficient: The calibration correction coefficient can be changed to compensate for the disturbance of fluid cross-sectional velocity distribution and the influence of specific application environment. The instrument factor is a multiplication factor of the linear flow signal. Display value = instrument factor x actual measured value

	Pipe inner diameter: input according to actual application, unit is mm
Media type [00] 00. Air Conversion factor 1.0	Media type: 00-59, see Appendix 2 If the value needs to be modified, modify it manually in the next menu.
Gas density <kg/m3> > 1.2904 Conversion factor 1.0	Medium density: unit Kg/m3 When the density of the measured medium is different from that of the calibration medium, it can be used to make density corrections. Also used for conversion between volume units and weight units. Conversion factor: The conversion factor between the calibration gas and the measured gas.
Noise threshold <0-10> > 05 Sampling time <1-50> 01	Noise threshold: The value is 0-10, used to eliminate noise signals. The larger the value, the larger the noise signal eliminated. Sampling period: The default value is 200ms, which means that the sampling value within 200ms is averaged. The larger the time setting, the more samples are used to take the average value, and the more stable the flow value calculated by this value. The sampling period is set to 5, and the sampling period is 5x200ms = 1S
Pulse or frequency output > Pulse	Output selection: frequency or pulse
Pulse width <ms> > 50.0 Pulse equivalent 1.0	Output pulse width time (50-1000ms) Pulse quantity: the quantity corresponding to each pulse There are four types: 1.0, 10.0, 100.0, and 1000.0. The pulse unit volume is set to 10.0, which means that each output pulse corresponds to 10 units of volume.
Maximum frequency <Hz> > 5000 Frequency corresponding range 1000	Maximum frequency is the maximum frequency of the output. Example: flow rate 0-1000Nm3/h, represented by frequency output 0-5000Hz. The maximum frequency is set to 5000Hz, and the corresponding range of frequency is 1000 Nm3/h.

In the menu selection interface, select the corresponding function menu and enter the password to enter



After entering the setting menu, press the "ESC" key to return to the menu selection interface, and press the "ENT" key to enter the value setting.



7.2.4 Cumulative Menu

Cumulative decimal settings > 0. 12 Cumulative integer setting 0	Accumulated decimals and integers clear or set

7.2.5 Current Menu

Current output mode > 4–20mA Fixed current output value 4. 0	Current output mode: 4-20mA and fixed current output When fixed current output is selected, the fixed current output value can be set. Fixed current output values: 4mA, 8mA, 12mA, 16 mA, 20 mA
Adjusting the current output zero point > 4.0 Adjust current output to full point 20.0	Example: Current output mode is 4-20mA When there is no flow, the output current value measured by a multimeter is 3.89 mA Then adjust the current output zero point to: 3.89 mA At maximum flow, the output current value measured by a multimeter is 19.75 mA Then adjust the current output zero point to: 19.75 mA

Method for calibrating current output in fixed current output mode: Step1.Connect the multimeter in series into the current loop; Step2.Set the current output mode to fixed current output (Fixed); Step3. Press the shift key to move '>' to the next line, press the confirm key to enter the setting state, press the modify/page key to select the output current value, select 4mA output, and press the confirm key to exit the setting state; Step4. Observe the multimeter display. If it is 4mA, no calibration is required. If it is 3.90mA, press the Modify/Page key to enter the calibration menu, move the '>' to before zero current adjustment (Adjust Iout Zero), press the Confirm key to enter the setting, enter 3.90, and press the Confirm key to exit the setting. Step5. Press the Shift key and the Modify/Page key at the same time, the menu returns to the previous level, move the '>' to the next line, press the Confirm key to enter the setting state, press the Modify/Page key to select the output current value, select 20mA output, and press the Confirm key to exit the setting state; Step6. Observe the multimeter display. If it is 20mA, no calibration is required. If it is 19.90mA, press the Modify/Page key to enter the calibration menu, move the '>' to before zero current adjustment (Adjust Iout Span), press the Confirm key to enter the setting, enter 19.90, and press the Confirm key to exit the setting. Step7. Press the Shift key and the Modify/Page key at the same time. The menu returns to the previous level and moves the '>' to the next line. Press the confirm key to enter the setting state, press the modify/page key to select the output current value, and observe the displayed value on the multimeter at the same time. If they are consistent, it means the calibration is successful. If there is still a difference, recalibration is required. The recalibration steps are the same as above.	
External measurement current value > 4.0 Current correction factor 1.0	HART protocol current loop calibration, example: current output mode is 4-20mA When there is no flow, the output current value measured by the multimeter is 4.02 mA The external measurement current value is set to: 4.02 mA The current correction factor will be automatically calculated.

7.2.6 Alarm Menu

Lower alarm limit <%> > 2 Upper alarm limit <%> 8	Upper and lower limit flow alarm value settings, the value is expressed as a percentage of the range For example, if you set Low Alarm to 10%, Alarm value = (upper limit of range - lower limit of range) * 10% The alarm hysteresis value is set to 5.0

Lower limit alarm hysteresis <%> > 0.5 Upper limit alarm hysteresis <%> 0.5	If the current displayed value is less than the lower limit alarm value, the alarm will be output. After the alarm, if the current displayed value recovers to above the lower limit alarm value and is greater than (lower limit alarm value + hysteresis value), the alarm is eliminated. If the current display value > upper limit alarm value, the alarm will be output. After the alarm, if the current displayed value returns to below the upper limit alarm value and is less than (upper limit alarm value + hysteresis value), the alarm is eliminated.

7.2.7 Communications Menu

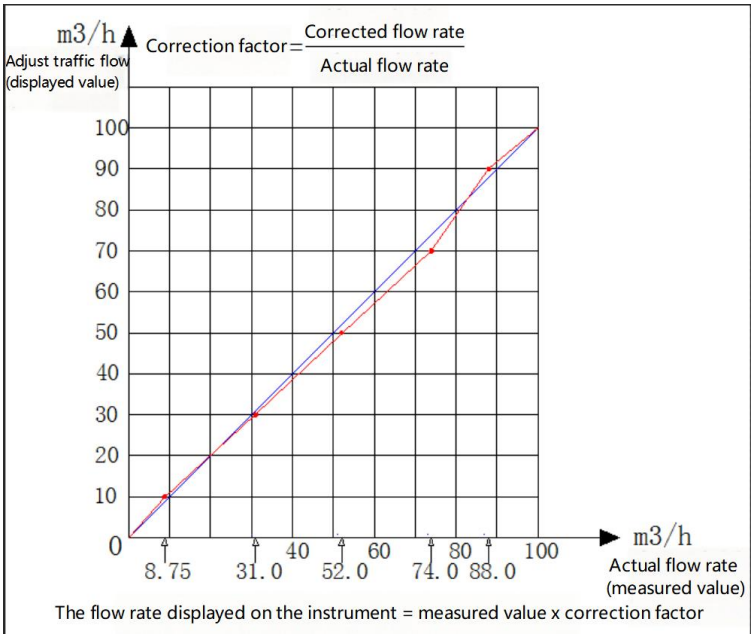
Communication Protocol > Modbus RTU	Communication protocols for RS485 and RS232 interfaces, Modbus RTU protocol, register address description see Appendix 1, others are user-defined protocols, and HART protocol
Device ID > 1	Device ID for MODBUS communication, 0-255 If the protocol selected is HART protocol, the setting range is: 0-15. If the address is set to a value other than 0, the output current is fixed to 4mA output.
Communication parameters > Baud rate 9600 Parity bit None Stop bits 1	For MODBUS communication, the communication baud rate and parity bit settings of the RS485 communication interface. The stop bit cannot be set and is fixed to 1 stop bit.

7.2.8 Save and Restore Menu

Save parameters > save Restore parameters Restore	Save parameters > save... Restore parameters Restore	Save parameters > save OK Restore parameters Restore	Save parameters > save Err Restore parameters Restore
Save Parameters	Saving	Saved	Save Failed

	Parameters...	Successfully	
Save parameters save Restore parameters > Restore Restore Parameters		Save parameters save Restore parameters Restore OK Recovery Success	Save parameters save Restore parameters Restore Err Failed Recovery

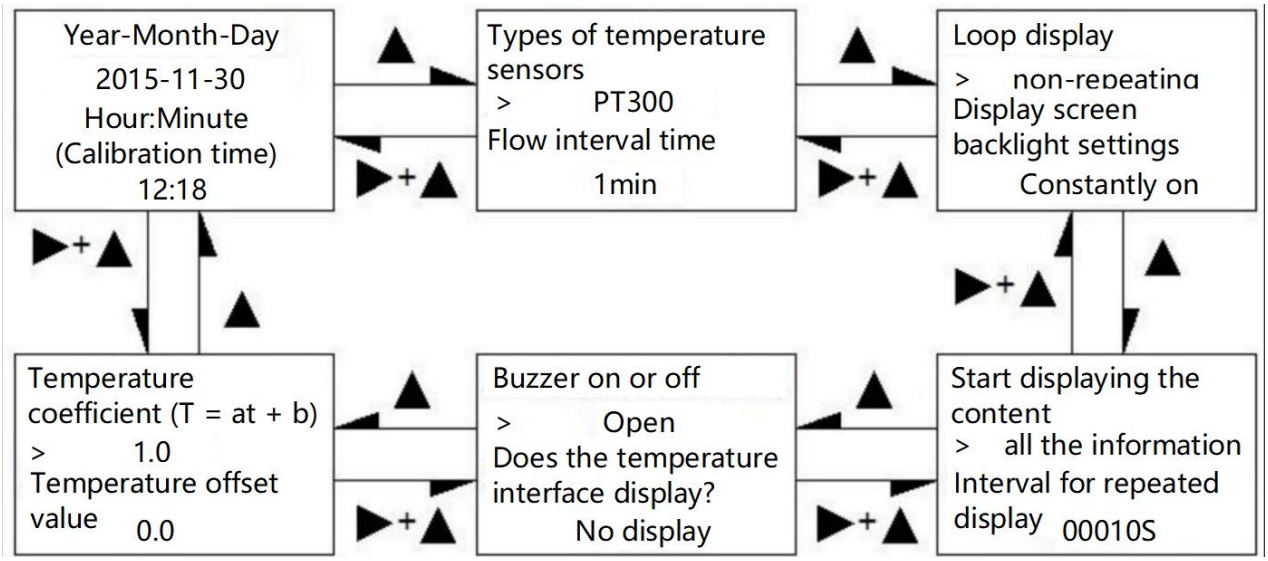
7.2.9 Correction Menu

Flow correction >>01 > 10.00<10.00> Correction factor >>01 1.143 <8.75> Flow correction >>02 > 30.00<30.00> Correction factor >>02 0.899 <31.00> Flow correction >>03 > 50.00<50.00> Correction factor >>03 0.952 <52.00> Flow correction >>04 > 70.00<70.00> Correction factor >>04 0.909 <74.00> Flow correction >>05 > 90.00<90.00> Correction factor >>05 1.429 <88.00>	For secondary flow correction, up to 5 sections can be set. When correcting, they must be arranged in order from small to large. The number of corrections can be less than 5 sections, but the corrections must be made continuously starting from the first section.  The flow rate displayed on the instrument = measured value x correction factor Correction Factor 1.143 = 10.00/8.75 Correction Factor 0.899 = (30.00-10.00)/(31.00-8.75) Correction Factor 0.952 = (50.00-30.00)/(52.00-31.00) Correction Factor 0.909 = (70.00-50.00)/(74.00-52.00) Correction Factor 1.429 = (90.00-70.00)/(88.00-74.00)

7.2.10 System Menu

Year-Month-Day 2015-11-30 Hour:Minute (Synchronization Time) 12:18	System time calibration
Temperature correction resistor selection > 300R Flow interval time 1min	The selection of temperature correction resistor is based on the model of the temperature sensor. It is fixed by default at the factory and does not need to be modified. The flow interval time is the interval time for updating the historical data curve. The historical data curve displays 60 points of historical data, and the interval time between two adjacent data is the interval time.
Cyclic display > No cyclic display Display backlight settings Always on	Cycle display, select Cycle, then all information, flow, flow rate, current, relay, historical data, temperature (set to display) will be displayed in a cycle. Backlight settings: always on and momentarily. A momentarily means the display backlight turns on for 30 seconds and then turns off.
Startup display content > All information Cycle display interval time 00010 S	Startup display content is used to set the content displayed when powering on. The loop display interval is the interval time between loop displays of different interfaces when the interface is set to loop display.
Buzzer on or off > On Temperature interface: Display or not? No display	The buzzer is turned on or off. On means that when a key is pressed, the buzzer sounds. Off means that when a key is pressed, the buzzer does not sound. Whether the temperature interface is displayed, if it is set to display, the temperature value can be queried in the display interface.
Temperature coefficient (T=at+b) > 1.0 Temperature offset value 0.0	The temperature coefficient is the a coefficient in the formula, and the temperature offset value is the b coefficient in the formula. T= at+b

In the menu selection interface, select the corresponding function menu and enter the password to enter



7.2.11 Query Menu

Query daily historical data 2015-11-30 Flow 0.0000 Cumulative 0000312001	Enter the date value to be queried, and the flow value and cumulative value will appear in the two lines below. The instrument automatically saves the current flow and cumulative value at 8 am every day.

7.2.12 Self - Diagnosis Menu

Clock √ Memory √ Power supply √ AD converter √ Sensor √	Press the confirmation key to perform self-check. If √ appears, it means that each functional module is working normally. If × appears, it means that an error has occurred in the module.

8 . Quality Assurance and After-Sales Service

Following the ISO9001:2000 quality management and control system, this product is produced with brand new raw materials and components and has undergone strict factory testing. The product quality and performance meet the relevant standards and technical specifications. However, due to the uncertainty that may arise during transportation or use, we promise the following service guarantee terms:

- Within two weeks from the date of delivery, if the product you purchased has a recognized quality defect, we will replace it free of charge;
- Within one year from the date of product delivery, if the product you purchased is damaged during normal use and not caused by improper use or human factors, we will repair it free of charge;
- Equipment damage caused by the following reasons during use is not within the scope of free replacement or repair:
  - ↗ Installation or use conditions that violate the relevant requirements and regulations of this manual;
  - ↗ Incorrect or violation of relevant instrument installation, wiring or usage regulations of the country;
  - ↗ Use with other products that are electrically incompatible with this product or have no definite quality assurance and valid certification;
  - ↗ Dismantle or repair by yourself;
  - ↗ Natural aging or loss of equipment that is more than one year old;
  - ↗ Force majeure as defined by applicable law
- For products within the warranty period, the user shall bear the shipping cost of the product, and we shall bear the replacement or repair and return costs of the product;
- When the products sent by the user are confirmed by us to be free of defects or damage, the relevant shipping and insurance costs incurred shall be borne by the user;
- Once the product sent by the user is confirmed, unless there are special circumstances, we will send out the new or repaired product within 48 hours or two working days;
- If you find any defective or damaged product, please contact your local supplier or us.

Appendix 1 Modbus Register Address Table

Communication baud rate: 9600,8,1,NONE, floating point data arrangement: 2143
Read data function code: 03 (HOLDING REGISTER)
Instrument address: can be set through the menu, 0-255, communication protocol needs to be selected: MODBUS RTU

Register Address	Register Name	Number of Registers	Data Types	Data Format
4x0001-4x0002	Instantaneous Flow	2	float	IEEE754
	Send	01 03 00 00 00 02 C4 0B		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0003-4x0004	Instantaneous Flow Rate	2	float	IEEE754
	Send	01 03 00 02 00 02 65 CB		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0005-4x0006	Current Value	2	float	IEEE754
	Send	01 03 00 04 00 02 85 CA		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0007-4x0008	Accumulating Integers	2	Unsigned long	Unsigned long integer
	Send	01 03 00 06 00 02 24 0A		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0009-4x0010	Cumulative Decimals	2	float	IEEE754
	Send	01 03 00 08 00 02 45 C9		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0011-4x0012	Cumulative Floating Point Number	2	float	IEEE754
	Send	01 03 00 0A 00 02 E4 09		
	Take Over	01 03 04 00 00 00 00 FA 33		
4x0013-4x0014	Medium Temperature	2	float	IEEE754
	Send	01 03 00 0C 00 02 04 08		
	Take Over	01 03 04 BA 4A 41 F8 CF 2F		
4x0015-4x0016	Current Acquisition Signal Value	2	float	IEEE754
	Send	01 03 00 0E 00 02 A5 C8		
	Take Over	01 03 04 82 1F 40 36 52 5B		
4x0017-4x0018	Flow Rate	2	float	IEEE754

	Lower Limit			
4x0019-4x0020	Flow Rate Upper Limit	2	float	IEEE754
4x0021	Lower Limit Relay Status	1	Unsigned int	Unsigned integer
4x0022	Upper Limit Relay Status	1	Unsigned int	Unsigned integer
4x0051-4x0052	Product ID Number	2	Unsigned long	Unsigned long integer
4x0053	Modbus Device ID	1	Unsigned int	Unsigned integer
4x0054	Baud Rate	1	Unsigned int	Unsigned integer
4x0055	Check Digit	1	Unsigned int	Unsigned integer
4x0056	Stop Bits	1	Unsigned int	Unsigned integer
4x0057	Language	1	Unsigned int	Unsigned integer
4x0058	Instantaneous Flow Unit	1	Unsigned int	Unsigned integer
4x0059	Total Flow Unit	1	Unsigned int	Unsigned integer
4x0060	Current Output Mode	1	Unsigned int	Unsigned integer
4x0061	Fixed Current Output Value Guide	1	Unsigned int	Unsigned integer
4x0062	Pwm Value Corresponding to The Fixed Current Output Value	1	Unsigned int	Unsigned integer
4x0063	Current Pwm Value Zero Point	1	Unsigned int	Unsigned integer
4x0064	Current Pwm Value Full Point	1	Unsigned int	Unsigned integer
4x0065	Output Pulse Or Frequency	1	Unsigned int	Unsigned integer
4x0066-4x0067	Pulse Width	2	float	IEEE754
4x0068-4x0069	Pulse Output Corresponding	2	float	IEEE754

	to The Single Quantity			
4x0074-4x0075	Zero Current Calibration	2	float	IEEE754
4x0076-x40077	Full-Point Current Calibration	2	float	IEEE754
4x0078-4x0079	Lower Range Limit	2	float	IEEE754
4x0080-4x0081	Upper Limit of Range	2	float	IEEE754
4x0082-4x0083	Lower Alarm Limit	2	float	IEEE754
4x0084-4x0085	Alarm Upper Limit	2	float	IEEE754
4x0086-4x0087	Lower Limit Alarm Hysteresis	2	float	IEEE754
4x0088-4x0089	Upper Limit Alarm Hysteresis	2	float	IEEE754
4x0090-4x0091	Damping Coefficient	2	float	IEEE754
4x0092-4x0093	Small Signal Removal	2	float	IEEE754
4x0094-4x0095	Gas Standard Density	2	float	IEEE754
4x0096-4x0097	Gas Conversion Factor	2	float	IEEE754
4x0098-4x0099	Spare			
4x0100-4x0101	Spare			
4x0102-4x0103	Instrument Factor	2	float	IEEE754
4x0104-4x0105	Pipe Inner Diameter	2	float	IEEE754
4x0106-4x0107	Sampling Time Period	2	float	IEEE754
4x0108-4x0109	Noise Figure	2	float	IEEE754

Appendix 2 Conversion Coefficient Table of Gases Relative To Air

At present, laboratories cannot calibrate the mass flow rate according to the gas actually used by users. Usually, the calibration is performed after converting the actual gas flow rate into air flow rate. When the user is using it, the direct output shows the actual mass flow rate or volume flow rate of the gas used.

	Gas Body	Specific Heat (Cal / g ℃)	Density (g / L 0 ℃)	Conversion Factor
00	Air	0.24	1.2 93	1.0000
01	Argon	0.125	1.6605	1.4066
02	Arsenic AsH_3	0.1168	3.478	0.6690
03	Boron tribromide BBr_3	0.0647	11.18	0.3758
04	Boron trichloride BCl_3	0.1217	5.227	0.4274
05	Boron trifluoride BF_3	0.1779	3.025	0.4384
06	Borane B_2H_6	0.502	1.235	0.5050
07	Carbon tetrachloride CCl_4	0.1297	6.86	0.3052
08	Carbon tetrafluoride CF_4	0.1659	3.9636	0.4255
09	Methane CH_4	0.5318	0.715	0.7147
10	Acetylene C_2H_2	0.4049	1.162	0.5775
11	Ethylene C_2H_4	0.3658	1.251	0.5944
12	Ethane C_2H_6	0.4241	1.342	0.4781
13	Propylene C_3H_4	0.3633	1.787	0.4185
14	Propylene C_3H_6	0.3659	1.877	0.3956
15	Propane C_3H_8	0.399	1.967	0.3459
16	Butyne C_4H_6	0.3515	2.413	0.3201
17	Butene C_4H_8	0.3723	2.503	0.2923
18	Butane C_4H_{10}	0.413	2.593	0.2535
19	Pentane C_5H_{12}	0.3916	3.219	0.2157
20	Methanol CH_3OH	0.3277	1.43	0.5805
21	Ethanol C_2H_6O	0.3398	2.055	0.3897
22	Trichloroethane $C_3H_3Cl_3$	0.1654	5.95	0.2763
23	Carbon Monoxide (CO)	0.2488	1.25	0.9940
24	Carbon dioxide CO_2	0.2017	1.964	0.7326
25	Cyanide gas C_2N_2	0.2608	2.322	0.4493
26	Chlorine Cl_2	0.1145	3.163.	0.8529

27	Deuterium D_2	1.7325	0.1798	0.9921
28	Fluorine gas F_2	0.197	1.695	0.9255
29	Germanium tetrachloride $GeCl_4$	0.1072	9.565	0.2654
30	Germane GeH_4	0.1405	3.418	0.5656
31	Hydrogen H2	3.4224	0.0899	1.0040
32	Hydrogen bromide HBr	0.0861	3.61	0.9940
33	Hydrogen chloride HCl	0.1911	1.627	0.9940
34	Hydrogen fluoride HF	0.3482	0.893	0.9940
35	Hydrogen iodide HI	0.0545	5.707	0.9930
36	Hydrogen sulfide H_2S	0.2278	1.52	0.8390
37	Helium	1.2418	0.1786	1.4066
38	Krypton	0..0593	3.739	1.4066
39	Nitrogen N_2	0.2486	1.25	0.9940
40	Neon	0.2464	0.9	1.4066
41	Ammonia NH_3	0.5005	0.76	0.7147
42	Nitric Oxide NO	0.2378	1.339	0.9702
43	Nitrogen dioxide NO_2	0.1923	2.052	0.7366
44	Nitrous Oxide N_2O	0.2098	1.964	0.7048
45	Oxygen O_2	0.2196	1.427	0.9861
46	Phosphorus trichloride PCl_3	0.1247	6.127	0.3559
47	Phosphine PH_3	0.261	1.517	0.6869
48	Phosphorus Pentafluoride PF_5	0.1611	5.62	0.3002
49	Phosphorus oxychloride $POCl_3$	0.1324	6.845	0.3002
50	Silicon tetrachloride $SiCl_4$	0.127	7.5847	0.2823
51	Silicon Tetrafluoride SiF_4	0.1692	4.643	0.3817
52	Silane SiH_4	0.3189	1.433	0.5954
53	Dichlorosilane SiH_2Cl_2	0.1472	4.506	0.4095
54	Trichlorosilane $SiHCl_3$	0.1332	6.043	0.3380
55	Sulfur hexafluoride SF_6	0.1588	6.516	0.2624
56	Sulfur dioxide SO_2	0.1489	2.858	0.6829
57	Titanium Tetrachloride $TiCl_4$	0.1572	8.465	0.2048
58	Tungsten Hexafluoride WF_6	0.0956	13.29	0.2137

59	Xenon	0.0379	5.858	1.4066

The conversion of different gases is done through conversion coefficients. The conversion coefficients of single-component gases can be found in the table. See the table below:

Appendix 3 Troubleshooting

Flow Meter Troubleshooting

Before taking any hardware maintenance work, please confirm whether the following contents are correct, as they will affect the system performance.

1. Check whether the instrument has power supply and whether its voltage level and polarity are correct.
2. Check whether the instrument wiring is correct as described in Chapter 2 .
3. Check whether the instrument has the upstream straight pipe length as described in 6.2.
4. Check whether the instrument direction pointer is pointing directly downstream.
5. Ensure that there is no leakage in the measured pipeline.

Disconnect the power supply before removing the instrument!
Please make sure the pipe is free of pressure before maintenance!

question	Possible causes	Solution
Abnormal or fluctuating speed	Abnormal or irregular flow	See 6.2 for the required straight pipe section for installation
	The rectifier is not installed in front of the sensor	Correct the orientation of the table body
	Probe component damaged	Return to the manufacturer for replacement
	Electronic component abnormality	Return to the manufacturer
	Ground Loop	Check the wiring
Speed measurement is too high or too low	The sensor and fluid direction are not aligned properly	Flow direction indicator needs to indicate the downstream of the fluid
	The rectifier is not installed in front of the sensor	Correct the orientation of the table body
No response to	No power supply	Turn on the instrument power
	Water vapor in the air	Install a dehydrator or filter upstream
	Low flow cutoff setting too high	Set via keyboard or host computer software

traffic	The flow rate is lower than the minimum flow rate level of the instrument	Set the user range, reduce the flow rate to the maximum calibration value or contact the manufacturer for recalibration.
	Sensor failure	Return to the manufacturer
	Circuit board failure	Return to the manufacturer

Appendix 4 Flow Range Table

Pipe Inner Diameter (mm)	Minimum Flow Rate (Nm/s)	Maximum Flow Rate (Nm/s)	Minimum Flow Rate (Nm3/h)	Maximum Flow Rate (Nm3/h)
25	1	100	1.7	170
32	1	100	2.8	280
40	1	100	4.5	450
50	1	100	7	700

Appendix 5 HART Protocol Command Description

Order	Description of Supported HART Protocol Commands
Command 00	Read the primary variable sensor serial number
Command 1	Read Primary Variable (PV)
Command 2	Read the primary variable current value and percentage
Command 3	Read primary variable current, PV, SV, TV, QV
Command 6	Write POLLING Address
Command 12	Read Message
Name 13	Read Tag, Descriptor and Date
Command 14	Read primary variable sensor information
Command 15	Read main variable output information
Command 16	Read final assembly number
Command 17	Write Message
Command 18	Write TAG, descriptor and date
Command 34	Write the main variable damping value

Command 35	Write the main variable range value
Command 40	Enter/Exit Fixed Primary Variable Current Mode
Command 44	Write primary variable unit
Command 49	Primary variable sensor serial number