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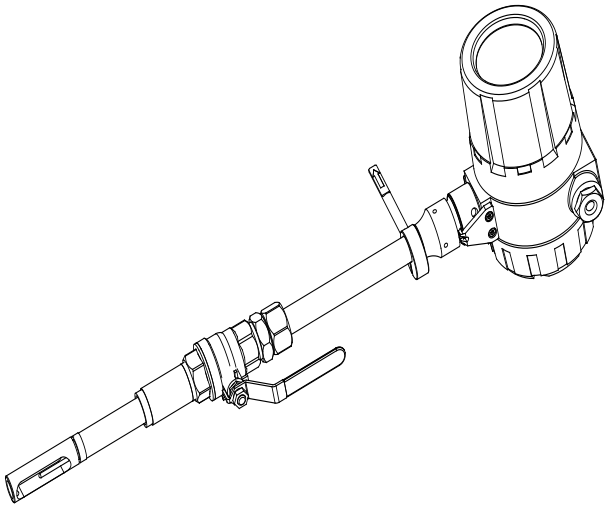
Thermal Gas Mass Flow Meter

Installation and Operation Guide



CONTENTS

1. About this manual

Thank you for choosing our products.

Through this manual, we strive to give you an accurate understanding of the thermal mass flow meter measurement principle, related concepts, terminology and installation and application of the correct methods and conditions.

Symbols and meanings used in this manual:

Graphic symbol meanings in this manual	
	Incorrect operation or infringement with the relevant regulations and the instructions of this manual may result in damage of the instrument and equipment
	Important concepts, definitions or methods
	Caution! Improper or careless operation and application may result in incorrect operation or even damage to the instrument
	Grounding mark
	The Specifications and requirements for using intrinsical safety instruments

2. Safety Information

2.1 Use personnel

The thermal mass flow meter is a precision instrument which is produced by the latest technology and technology. Improper installation and use can lead to abnormal and damage of the instrument and even the process control equipment. Engineers and technicians who install, set up and connect the product must read this manual carefully before using the instrument.

2.2 store and handling

·Storage temperature：-40 ℃~80℃

·Relative humidity：20~90%

The storage and handling process should be placed in the instrument box to avoid bumping or shock.

2.3 Application condition

Before installation should be sure that the measured medium temperature and pressure is not more than the nominal temperature and pressure. Determine whether the measured gas is pure, the gas does not contain particulate matter, so as to avoid the damage of granular materials on the sensor.

2.4 Safety standards and specifications

Installation, wiring and use of this product should comply with the requirements specified in this manual and the general international safety standards, accident prevention measures and local standards.

2.5 Intrinsic safety and explosion protection

- *Dangerous places or may be flammable gas and air mixture should use explosion-proof type thermal mass flow meter in - field measurement;*
- *he explosion-proof thermal mass flow meter with appropriate safety gate shall be obtained using supporting explosion-proof certification;*
- *Installation and wiring - intrinsic safety instrument system and related equipment shall comply with the relevant standards and norms of the country.*

2.6 Environmental protection

The packaging of this product can meet the ISO:14001 specification, and will not pollute the environment.

Please return to the professional recycling company or send back to us, so as to avoid polluting the environment.

3. Introduction

3.1 measuring principle

Thermal gas mass flow meter is designed on the basis of thermal dispersion, and adopts method of constant differential temperature to measuring gas flow. It has advantages of small size, easy installation, high reliability and high accuracy, etc.

The meter contains two platinum resistance temperature sensors. The thermal principle operates by monitoring the cooling effect of a gas stream as it passes over a heated sensor. Gas flowing through the sensing section passes over two sensors one of which is used conventionally as a temperature sensor, whilst the other is used as a heater. The temperature sensor monitors the actual process values whilst the heater is maintained at a constant differential temperature above this by varying the power consumed by the sensor. The greater the gas velocity, the greater the cooling effect and power required to maintain the differential temperature. The measured heater power is therefore a measure of the gas mass flow rate.

The format of gas velocity and power is shown as below:

$$V = \frac{K[Q/\Delta T]^{1.87}}{\rho_g} \quad \text{.....(1)}$$

Where: is specific gravity of medium

V is velocity

ρ_g

K is balance coefficient

Q is heater power

Δ T is differential temperature

The medium temperature range of meter is -40℃～220℃.

In the format (1), the specific gravity of medium is related to the density:

$$\rho = \rho_n \times \frac{101.325 + P}{101.325} \times \frac{273.15 + 20}{273.15 + T} \quad \text{.....(2)}$$

Where: $\rho_g$is the medium density in working condition（kg/m^3）

ρ_n is the medium density in standard condition, 101.325kPa and 20℃ （kg/m^3）

P is the pressure in working condition（kPa）

T is the temperature in working condition （℃）

In the formats (1) and (2), there is a certain functional relationship between the velocity and pressure in working condition, medium density, the temperature in working condition.

Due to the sensor temperature is always 30℃ higher than the medium temperature (environment temperature), and the meter adopts method of constant differential temperature, therefore the meter do not need to do temperature and pressure compensation in principle.

3.2 Specifications

Features

- Measuring the mass flow or volume flow of gas
- Do not need to do temperature and pressure compensation in principle with accurate measurement and easy operation.
- Wide range: 0.5Nm/s～100Nm/s for gas. The meter also can be used for gas leak detection
- Good vibration resistance and long service life. No moving parts and pressure sensor in transducer, no vibration influence on the measurement accuracy.
- Easy installation and maintenance. If the conditions on site are permissible, the meter can achieve a hot-tapped installation and maintenance. (Special order of custom-made)
- Digital design, high accuracy and stability
- Configuring with RS485 or HART interface to realize factory automation and integration

Description	Specifications
Measuring Medium	Various gases (Except the acetylene)
Pipe Size	DN10～DN4000mm
Velocity	0.1～100 Nm/s
Accuracy	±1～2.5%
Working Temperature	Sensor: -40℃～+220℃ Transmitter: -20℃～+45℃
Working Pressure	Insertion Sensor: medium pressure≤ 1.6MPa Flanged Sensor: medium pressure≤ 1.6MPa Special pressure please contact us
Power Supply	24VDC or 220VAC
Response Time	1s
Output	4-20mA (optoelectronic isolation, maximum load 500Ω), Pulse, RS485 (optoelectronic isolation) and HART
Alarm Output	2 line Relay, Normally Open state, 3A/30V/DC
Sensor Type	Standard Insertion, Hot-tapped Insertion and Flanged
Construction	Compact and Remote
Pipe Material	Carbon steel, stainless steel, plastic, etc
Display	4 lines LCD Mass flow, Volume flow in standard condition, Flow totalizer, Velocity, etc.
Protection Class	IP65
Sensor Housing Material	Stainless steel (316)

3.3 Mechanical Construction

3.3.1 Appearance

Fig. 1 Standard Insertion Flow Meter

(Pipe size DN100-DN500)

Fig. 2 Flanged Flow Meter

(Pipe size DN10-DN80)

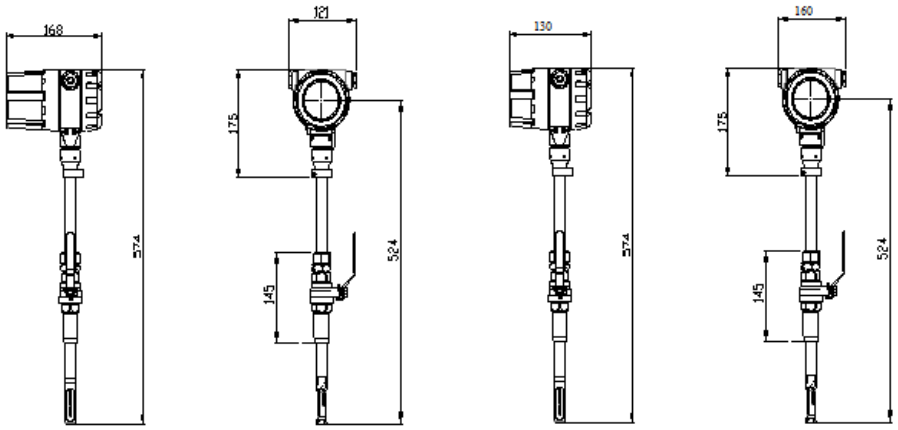
Fig. 3 Hot-tapped Insertion Flow Meter

(Pipe size DN100-DN4000. Special requirements please contact us)

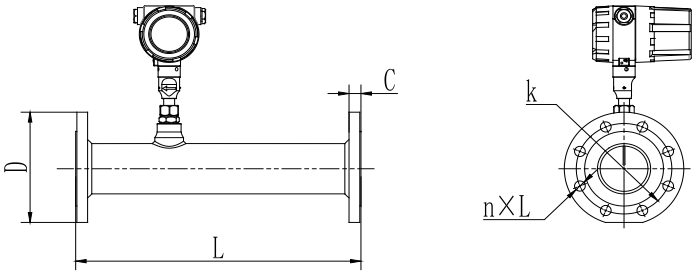
The insertion sensor of compact insertion flow meter should be inserted to axis of pipe, and the length of the insertion sensor is decided by pipe size, please confirm the pipe size when ordering. If the insertion sensor can't be inserted to axis of pipe, the manufacturer will provide a calibration factor to achieve an accurate measurement.

3.3.2 Dimensions

Dimensions of standard insertion sensor Dimensions of hot-tapped insertion sensor



The dimensions of flanged sensor



PN1.6Mpa Plane and surface plate flat welding steel pipe flanges (Unit: mm)

Nominal Diameter	Flange Outer diameter	Center Hole	Screw Hole	Screw Thread	Sealing Face		Flange Thickness	Pipeline Length
DN	D	k	n×L		d	f	C	L
15	95	65	4×14	M12	46	2	14	200
20	105	75	4×14	M12	56	2	16	200
25	115	85	4×14	M12	65	2	16	200
32	140	100	4×18	M16	76	2	18	200
40	150	110	4×18	M16	84	2	18	200
50	165	125	4×18	M16	99	2	20	200
65	185	145	4×18	M16	118	2	20	200
80	200	160	8×18	M16	132	2	20	200
100	220	180	8×18	M16	156	2	22	200

For DN15-DN80, the meter can be made with threading to connect.

The above table is used for rated pressure of 1.6MPa. If the rated pressure is more than 1.6MPa, please contact us for special order.

4. Wiring

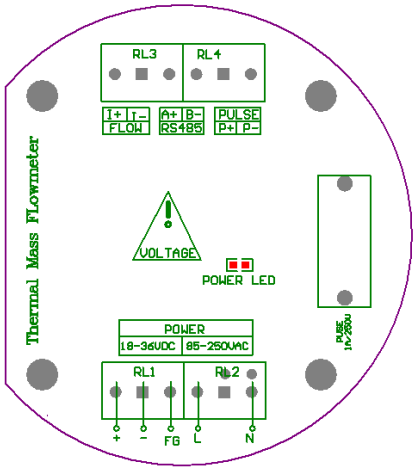
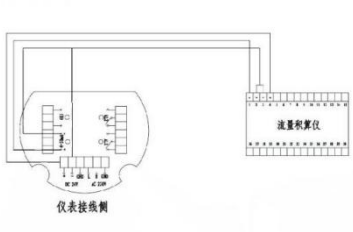
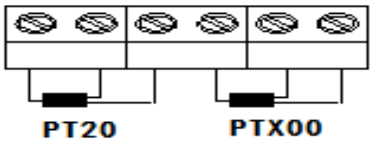
4.1 Preparation of wiring

- You should read and connection method of supporting the use of thermal mass flowmeter or other unit instrument system and requires careful - before connection;
- The external cable recommended two core shielded cable and cable connection and good sealing;
- The explosion-proof products should be selected in accordance with the relevant standard of BenAn instrument cable and make sure that the cable parameters meet the explosion-proof instrument system requirements;

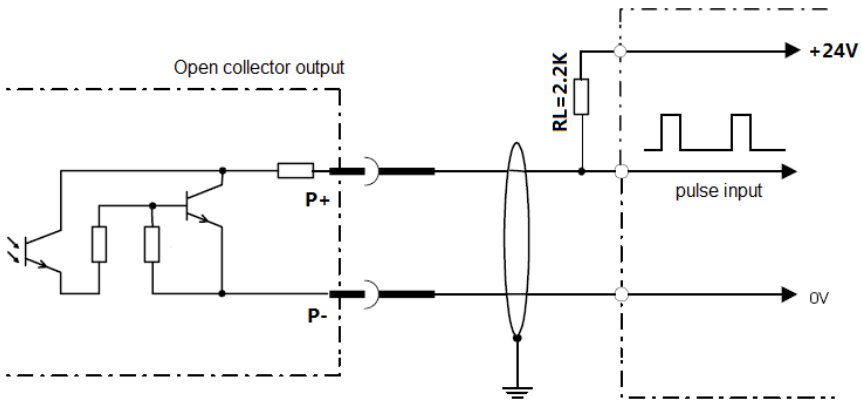
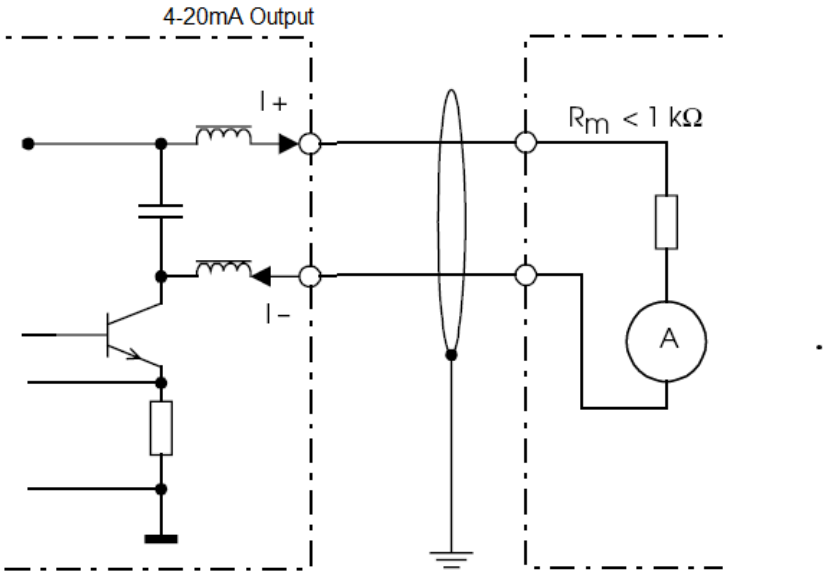
- *Working voltage range of DC18~30V. When the voltage is higher than DC30V, the instrument will be damaged, and measures should be taken to prevent the supply voltage from above 30V;*

- *To the 24V DC power supply thermal mass flowmeter shall meet the requirements of IEC-1010-1 or equivalent standard SELV safety extra low voltage;*
- *Before the connection with the voltmeter to measure the power supply voltage, the voltage is DC24V;*

4.2 Terminal description

Terminal diagram	Mark	Description
	24V+	24V Power supply positive pole
	24V-	24V Power supply 0V
	OUT24V	24V Power output
	GND	RS232 GND
	TXD	RS232 TXD
	RXD	RS232 RXD
	P+	*Pulse output positive pole*
	P-	*Pulse output negative pole*
	I+	*Current output positive pole*
	I-	*Current output negative pole*
	485+/A	RS485 communication interface A
	485-/B	RS485 communication interface B
	ALARM 1	Alarm output 1
	ALARM 2	Alarm output 2
	P-LED	*Power indicator*
	I-LED	*Analog output indicator*
		Mounting hole of circuit board and shell
		Mounting hole between *boards* and *boards*
		Sensor terminal PT20/PT300 is Default combination ， Other optional sensors PT20/PT200、 PT20/PT1000、

4.3 Terminal connection

Pulse output wiring	
Analog output wiring	

5. technical parameters

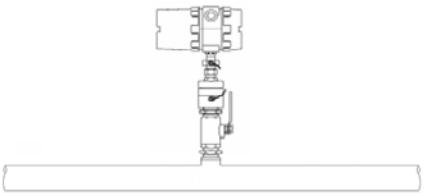
Power Supply	Supply Voltage	24VDC/1.5A Allow residual ripple：0~100Hz， Upp＝30Mv，Uss＜10mV Maximum noise：500Hz~10KHz ，U_{eff}＝2.0Mv or 85~265V AC
	Operating current	<650mA
Output	Output current mode	4~20mA/ Fixed current output
	RS485 output	Baud rate：1200/2400/4800/9600/19200
		Data：8
		Check：None/Odd/Even
		Stop：1
	RS232 output	Baud rate：9600 ，Data：8，Check：None ， Stop：1
	Communication protocol	MODBUS RTU

6. Install

stable flow field is the premise of the accurate measurement of the thermal instrument. Therfore, please note following points when installing the instrument.

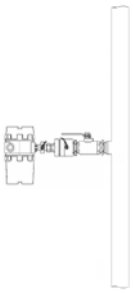
6.1 Installation direction

●Horizontal installation



The process pressure must not exceed 2MPa when installing

●Vertical installation



The process pressure must not exceed 2MPa when installing

6.2 Pipe requirements

If the Interference sources (i.e. bends, reduce, valves, T tubes, ect.) exist on the instrument intake pipe, measures must be taken to minimize their impacts on measurement performance

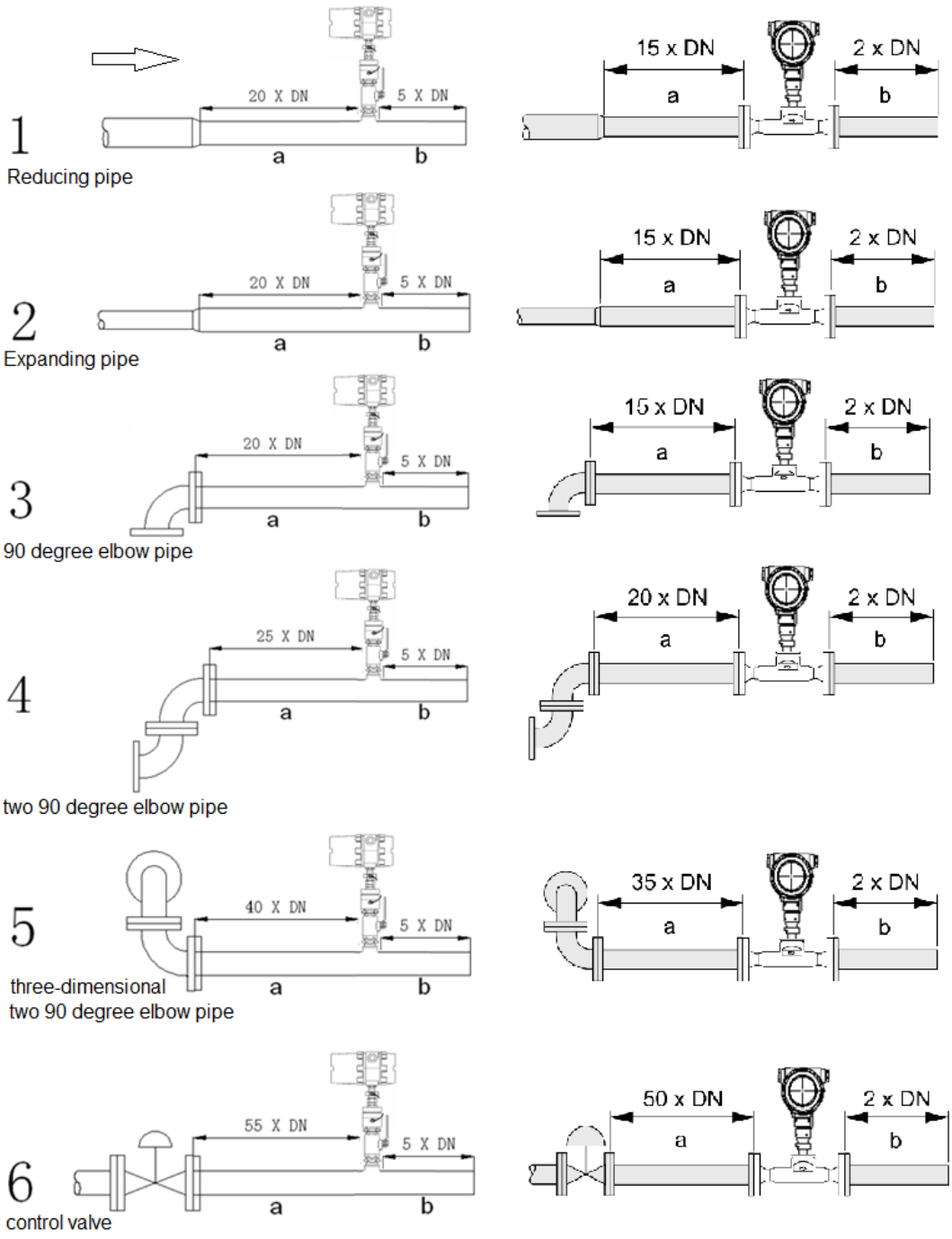
The following diagrams describe the recommended minimum straightway lengths of some types of pipe.

The straightway length should be as long as possible while the room is sufficient. Without the consideration of other factors, the recommended minimum straightway lengths are:

front straightway length: 20×DN

rare straightway length: 5×DN

- *The recommended straightway lengths are minimum, increased straightway lengths improve the instrument performance.*
- *If multiple Interference sources exist in front of instrument, the recommended straightway lengths are absolute.*
- *The contorl valves are recommended to be place at rare of instrument.*
- *For the light gases, such as helium and hydrogen, front straightway lengths should be doubled.*



a = front straightway length *b = rare straightway lengths*

Control valves and shut-off valves should be palced at rare of instrument.

6.3 Installation Steps

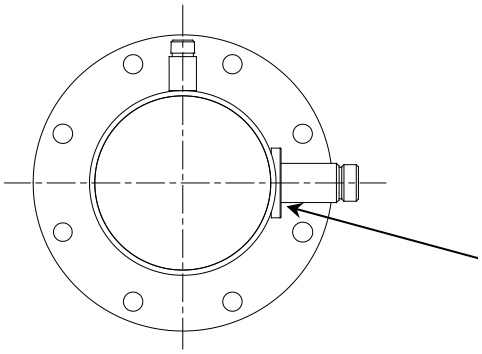
The base of thermal flowmeter

The base of Hot-tapped insertion type The base of standard insertion type

No welding in explosive environment

Carry out the welding operation in accordance with the requirements of special environment.

When installing, place the base on the top of pipe, and make the through-hole of base be perpendicular to axis of pipe. The good welding location of base and welding process is as below.



Before Welding, the base should be processed as the same as the circular arc of pipe to ensure sealing

Good welding location of base

The installation of standard insertion type

Identify an appropriate location for the flow meter.

Confirm the inner diameter and wall thickness of pipe

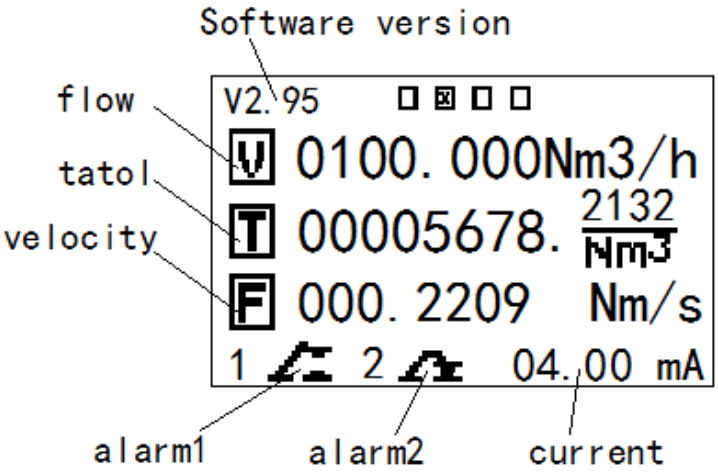
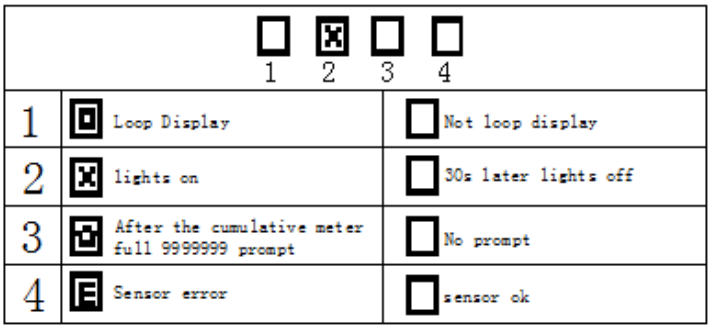
- Place the other part of meter into ball valve, and calculate the insertion depth according to the inner diameter and wall thickness of pipe. This step doesn't need to screw the nut by hand.
- Turn the connecting rod of sensor to make the mark direction of sensor as the same flow direction.
- According the calculated data on site, ensure the insertion depth by corresponding calibration on the connecting rod, and then screw the nut tightly.
- If the meter is horizontal installation, the display of the meter can be installed in the direction of 90°, 180° or 270° to meet various requirements.

The installation of hot-tapped insertion type

- Before installation, please conform the connection type and install fittings.
- Before installation, the site must be shut down, and strictly follow the rules of factory.
- Identify an appropriate location for the flow meter.
- According to length requirement of meter, cut the pipe, and install the flanges and bolts on the pipe.
- Ensure the mark direction of meter is as the same flow direction, the display is perpendicular to horizontal plane, the axis of pipeline is paralleled to horizontal plane, the error can't be more than ±2.5, and then fix the meter by bolts.

7. Operating the instrument

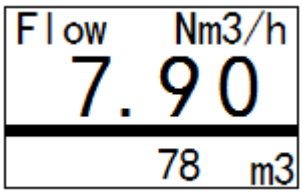
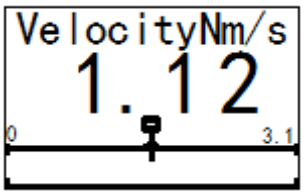
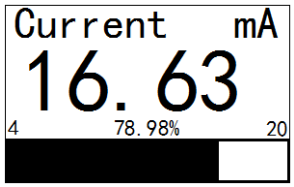
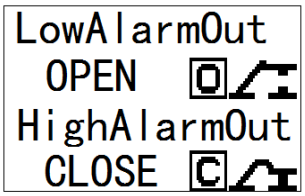
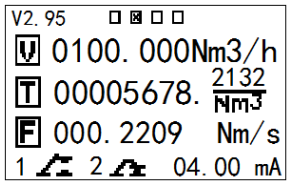
7. 1 Keyboard and display

Display



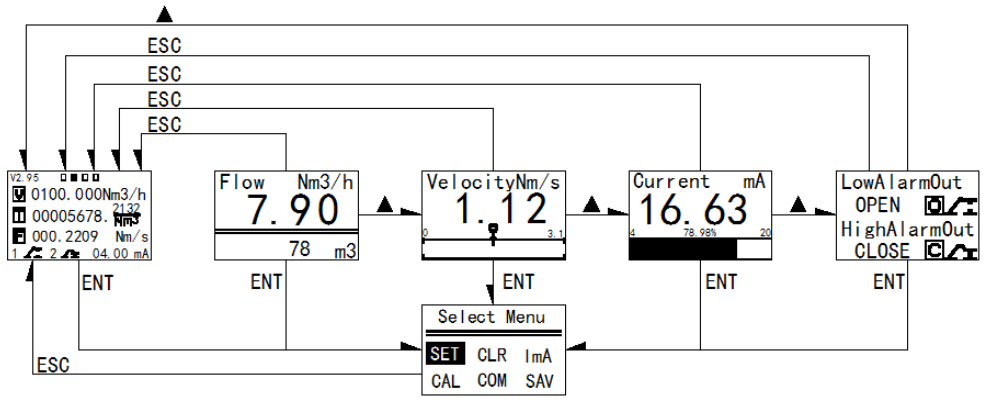
Keyboard	
ESC	Cancel/Exit Key
▶	Shift Key
▲	Modify/Page down Key
ENT	Confirm/Enter Key

7．2 Menu Instruction

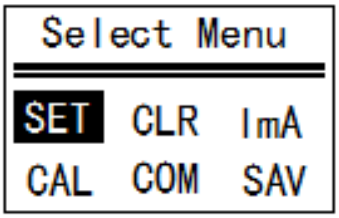
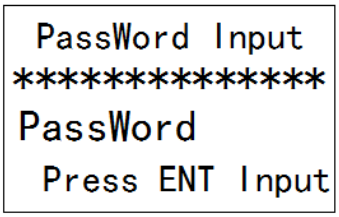
7．2．1 Display sreens

		
Display the instant flow rate and the unit of instant flow rate. Cumulative flow and the unit of Cumulative flow The cumulative flow has 10 digits dsiplay, if the cumulative flow is greater than 9999999, a carry is generated and indicated by	Display the instant flow velocity, the unit is fixed as m/s. 0 and 3.1 indicate the range of velocity while this range is varied with the setting instrument measuring range. The velocity of medium is displayed dynamically.	Present value of output current. The bar at bottom indicates the percentage of output current in its range.
		
The indicators of upper and lower alarm states. The ralies are nomally on without alarm.		Didplay of all information.

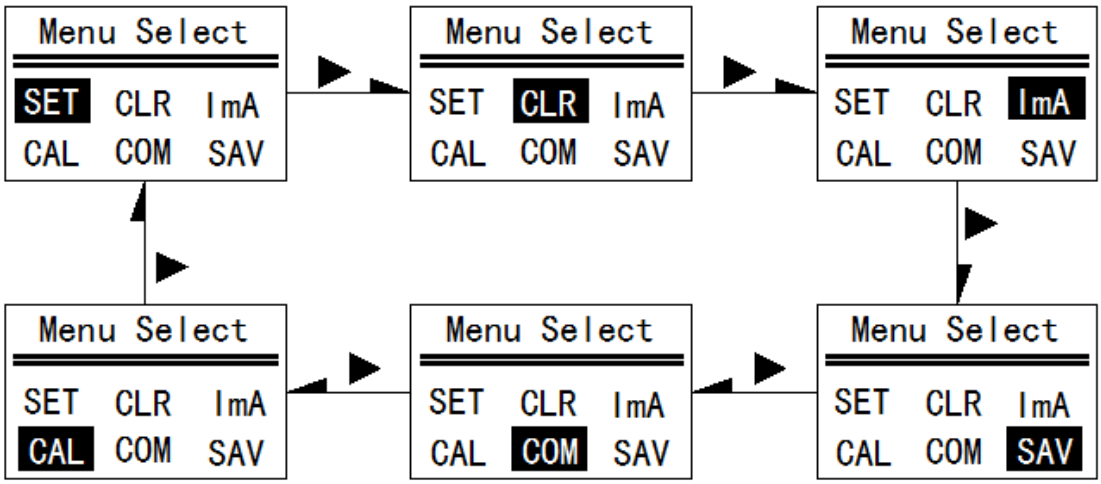
Switch between 5 display screens by pressing  (the page down key). Pressing Entrer key can enter currently displaied menu. Back to flow dispaly screen from non flow display screens by pressing Cancel key.



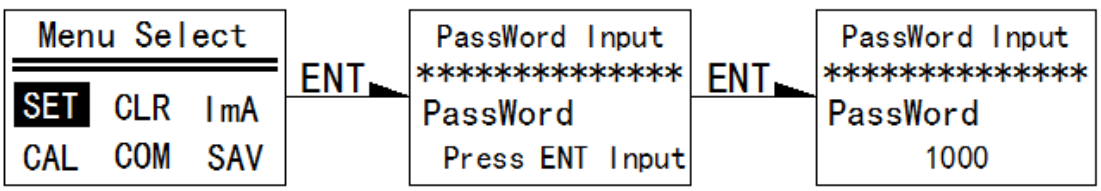
7．2．2 Menu selecting and password entering

	**Menu Selecting** SET: Setting of basic parameters CLR: Setting the integer and decimal of cumulative flow ImA: Setting the current parameters CAL: Calibrate instrument COM: settings of RS485 communication SAV: Save and restore paramters
	To set basic parameters, enter:1000 To set backlit, enter:2000 To clear cummulative flow, enter:1000 To set the current parameters, enter:1000 To calibrate instrument, enter:0603 To set communication parameters, enter:1000 None password required for saving parameters

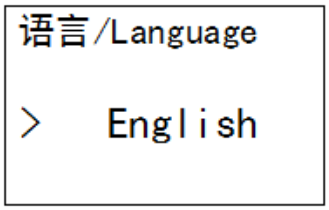
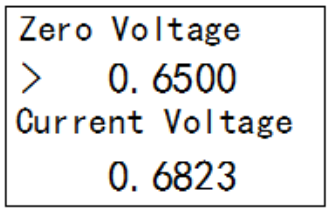
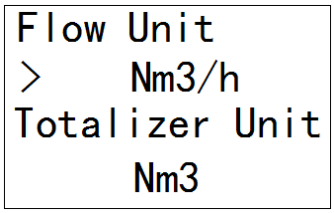
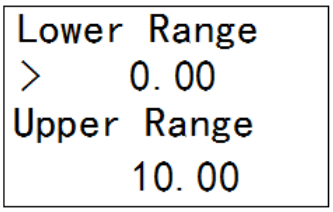
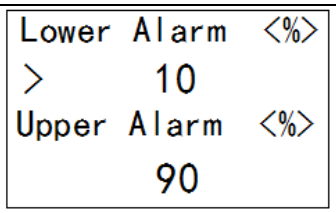
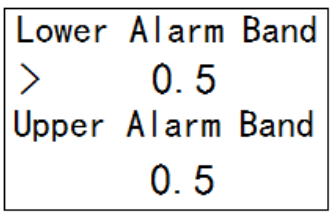
Press Shift Key to select the menu item.



To set the basic parameters, move the black background cursor to "SETTINGS" item, press Enter key and the password entering screen appears. Press Enter Key once more, to switch to password entering model (prompted by blinkong cursor). Enter the password and press Enter key again. Once the password is correct, the basic parameter setting screen appears or an "Error" message is given if the password is incorrect.



7．2．3　Basic Paramters

	Language: Simplified Chinese/English
	User Zero point and present voltage If there is no medium flow but the isntrument does not display the zero flow rate, adjust the user zero point to make set the display to zero.
	> signal indicates that this field is adjustable Flow rate unit is selectable from: g/min、g/s、 Kg/min、 Kg/h、Nm3/h、Nm3/min、NL/h、NL/min、SCFM Cummulative flow unit could be one of: g、Kg、Nm3、NL、CFM， The cummulative flow unit is cahnged with the flow rate unit setting and therfore does not need to be set seperately.
	> signal indicates that this field is adjustable. To switch between lower span and upper span by pressing Shift Key. Press enter to set span limits, the first digit will blink if it in editing model.
	Set the upper alarm and lower alarm. The alarm setpoints are always expressed in percentage of instrument full scale . For instance, setting the Lower alarm setpoint to 10% means: The lower alarm setpoint =(upper span - lower span)*10%. At the example left, both upper anf lower hysteresises are set to 0.5. That means,: the switch back point of upper alarm = upper alarm setpoint - upper hysteresis(i.e. 8-0.5) the lower alarm switch back point = lower alarm setpoint + lower hysteresis(i.e. 2+0.5)
	

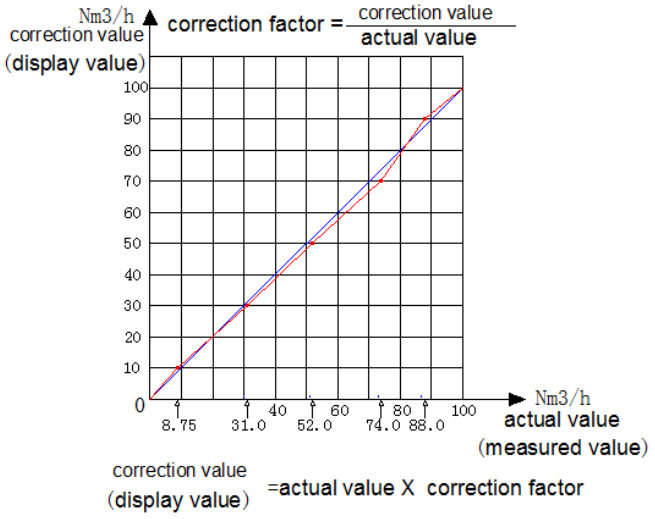
Damping Factor > 2 Signal CutOff<%> 0.05	Damping factor: default value is 2 while it could be adjusted bwtween 0 and 50. Decreasing the damping factor results in a quicker response of flow rate changes but may counts the unwanted interferences in. Increasing the damping factor results in a smoother curve but may be dull for quick flow rate changes. Signal cut-off: Set as a percentage of full scale. Any signal less than this value will be cut-off and considered as ZERO.
Medium Type[00] 00. Air<1.2048> Convers ionFactor	Since the laboratory can not calibrate the flow rate of the medium according to the gas actually used by the customer, the Conversion Coefficient of the medium is usually calibrated according to the flow rate of the gas actually used by the customer converted into the air, when in use, the conversion Coefficient of measuring medium relative to air should be set to ensure the measuring accuracy. Instrument with Conversion Coefficient for the reference value, if necessary to modify the re-input. Instrument internal with 59 Gas Conversion Coefficient, when the medium is mixed gas, need to calculate the conversion coefficient. The conversion factor table and the calculation of the conversion factor of the gas mixture are shown in Appendix 2
GasDichte<kg/m3> > 1.2904 ConversionFactor 1.0	Gas density: unit Kg/m3 When the actual medium density is differnt from calibration gas density, this could be used for density correction. Always, this is used for unit conversion of volume and weight. Conversion rate: The rate of calibration gas desity and actual gas density.
Pulse Width <ms> > 50.0 Pulse Equivalent 1.0	Output pulse width （50-1000ms） Pulse equivalent: Defines how many volum per pulse. There 4 pulse equivalents: 1.0、10.0、100.0 and 1000.0. Setting pulse equivalent to 10.0 means: for every 10 units cummulative flow, the instrument outputs a pulse.
MeterFactor > 1.0 I.Diameter mm 100.0	Instrument factor: The instrument factor is used to compensate the interference of cross section velocity distribution and the influence of the specific application environment。 The instrument factor is a coefficient of linear flow and results in: Display flow rate = instrument factor * actual measured flow rate.

<table>
<tr><td></td><td>Pipe inner diameter: Enter the real pipe inner diameter here in unit of mm.</td></tr>
<tr><td>NoiseValue<0-10>
> 05
SampleTime<1-50>
01</td><td>Noise threshold: Ranged between 0 and 10 and used to suppress the noise signal. The higher the value is, the higher the singal strength wiuld be considered as noise.
Sampling peroid: The instrument averages all the smapled flow rate values within the given period and takes the verage value as the measured value. Sampling period is set as an increamtal of 200ms. For example, if the sampling period is set 5, the actual instrument sampling time is 5*200ms = 1s.</td></tr>
<tr><td>Cal. Flow >>01
> 10.00<10.00>
Cal. Factor >>01
1.143 <8.75>

Cal. Flow >>02
> 30.00<30.00>
Cal. Factor >>02
0.899 <31.00>

Cal. Flow >>03
> 50.00<50.00>
Cal. Factor >>03
0.952 <52.00>

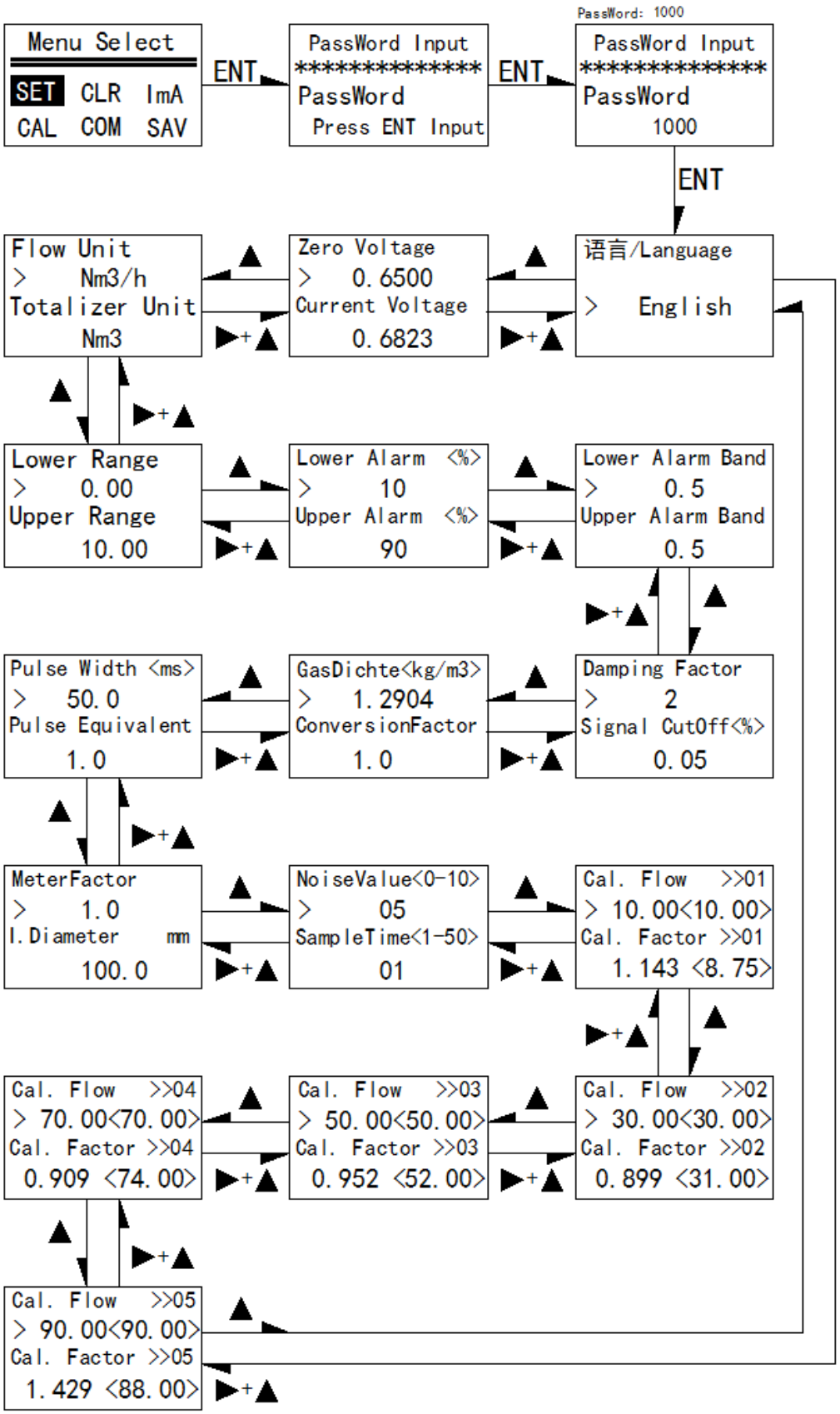
Cal. Flow >>04
> 70.00<70.00>
Cal. Factor >>04
0.909 <74.00>

Cal. Flow >>05
> 90.00<90.00>
Cal. Factor >>05
1.429 <88.00></td><td>Segmental correction factor. Up to 5 segments could be set to correct the nonlinear errors. The segment number must be ascending. The total number of segments could be less than 5 but the correction takes from the firt segment and in a row.
 

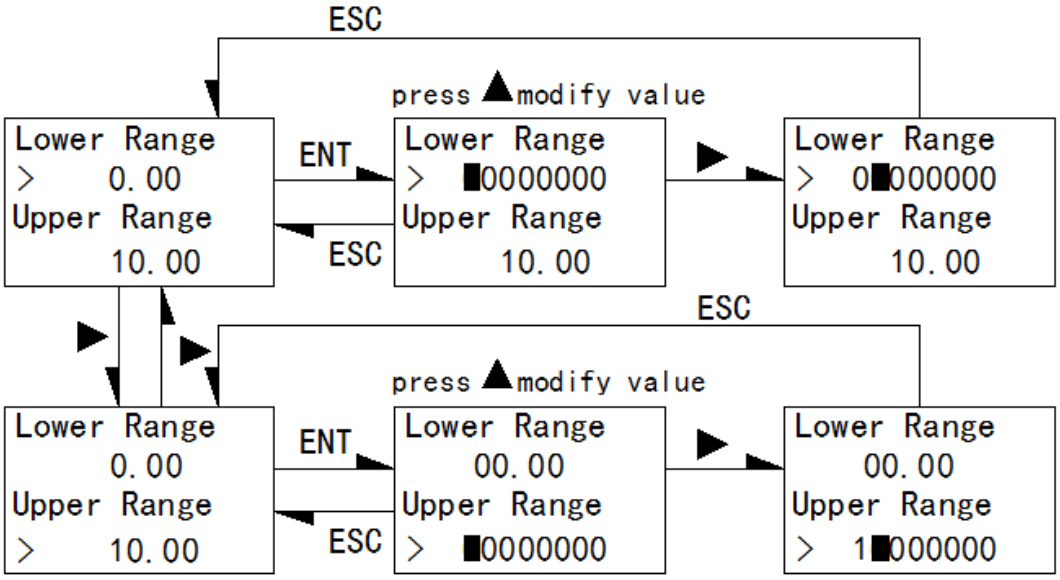
correction value (display value) =actual value X correction factor

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)</td></tr>
</table>

Select menu item in the menu selection screen then enter the password.

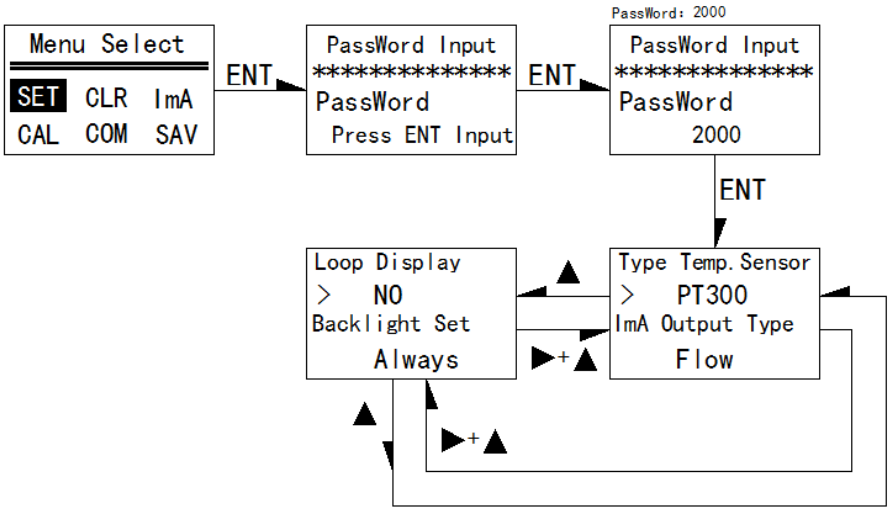

Menu Select
SET CLR ImA
CAL COM SAV
ENT
PassWord Input
****
PassWord
Press ENT Input
ENT
PassWord: 1000
PassWord Input
****
PassWord
1000
ENT
Flow Unit
> Nm3/h
Totalizer Unit
Nm3
Zero Voltage
> 0.6500
Current Voltage
0.6823
语言/Language
> English
Lower Range
> 0.00
Upper Range
10.00
Lower Alarm <%>
> 10
Upper Alarm <%>
90
Lower Alarm Band
> 0.5
Upper Alarm Band
0.5
Pulse Width <ms>
> 50.0
Pulse Equivalent
1.0
GasDichte<kg/m3>
> 1.2904
ConversionFactor
1.0
Damping Factor
> 2
Signal CutOff<%>
0.05
MeterFactor
> 1.0
I.Diameter mm
100.0
NoiseValue<0-10>
> 05
SampleTime<1-50>
01
Cal. Flow >>01
> 10.00<10.00>
Cal. Factor >>01
1.143 <8.75>
Cal. Flow >>04
> 70.00<70.00>
Cal. Factor >>04
0.909 <74.00>
Cal. Flow >>03
> 50.00<50.00>
Cal. Factor >>03
0.952 <52.00>
Cal. Flow >>02
> 30.00<30.00>
Cal. Factor >>02
0.899 <31.00>
Cal. Flow >>05
> 90.00<90.00>
Cal. Factor >>05
1.429 <88.00>

After entered the menu item , press the "ESC" Key to return to the menu selection creen, press the "ENT" key to enter the value set



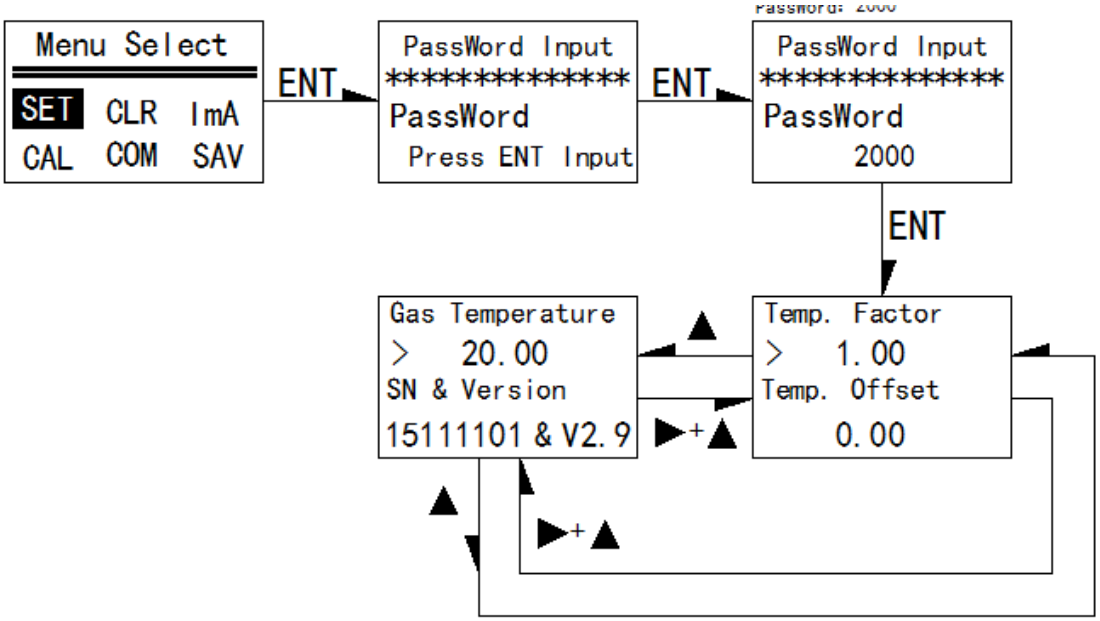
Select SET in the menu selection screen then enter the password. 2000

Type Temp.Sensor > PT300 ImA Output Type Flow	Sensor Type: PT100、PT200、PT300、PT1000 This function is reserved for manufacturer. The user should not set this value as it affects the temperature value. Output Type: flow rate or velocity To set the 4~20mA outpout reprsents which parameter. If it is set to velocity, the span setting is the scop of velocity.
Loop Display > NO Backlight Set Always	Loop display: Loop or NOT If it is set to loop, then the screens switch in a loop style with 10s interval. Backlit Setting: Temporary / Always on Temporary: the backlit lights up when a key is pressed down and turns off if no key is pressed within 30s. Always On: The backlit is always on.

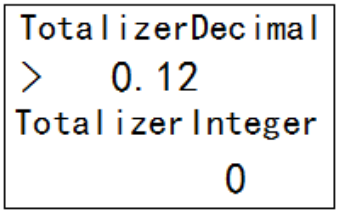


Select SET in the menu selection screen then enter the password.3000

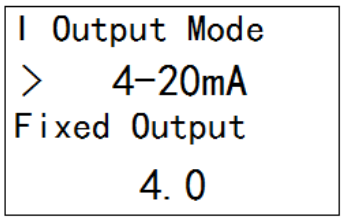
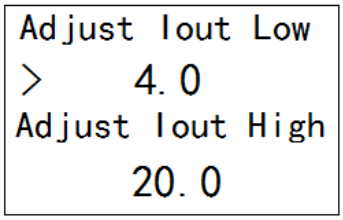
Temp. Factor > 1.00 Temp. Offset 0.00	Gas tmeperature correction. T=at+b Where, a is the coefficient, b is the offest
Gas Temperature > 20.00 SN & Version 15111101 & V2.9	Present value of temperature The serial number and version of instrument



7．2．4 Cummulative Settings

	Clear or set the cumulative flow decimal and integer

7．2．5 Current settings

	Current output model: 4~20mA and fixed current. When the "Fixed current" is selected, the output currrent is fixed in a given value.
	For example: the current output model is set to "4~20mA" When there is no flow, if the output is measured as 3.89mA with a multimeter, then set the " Adjust Iout Zero " to 3.89mA At the maximum flow rate, if the outpout is measured as 19.75mA with a multimeter, then set the " Adjust Iout Zero " to 19.75mA

Calibrate the cuurent output with "Fixed current" model:

Setp 1: Connect a multimeter to the current output circuit

Setp 2: Set the current output model to "Fixed current"

Step 3: Move the ">" cursor to next row, enter the setting model by pressing Ent key. Select the output current value by pressing Page Down Key. Select the value to 4mA.

Step 4: Check the multimeter reading, if it's not 4mA (for example, 3.90mA), press Page Down Key to enter the calibration menu. Move the ">" cursor to " Adjust Iout Zero " and then press Ent Key to edit the value. Enter 3.90mA(in this example) and then press Ent Key angain to save.

Step 5: Hold down the Shift Key and Page Down Key at same time to return to previous menu. Select the 20mA and press Ent Key.

Step 6: Check the multimeter reading, if it's not 20mA (for example, 19.90mA), press Page Down Key to enter the calibration menu. Move the ">" cursor to " Adjust Iout Span " and then press Ent Key to edit the value. Enter 19.90mA(in this example) and then press Ent Key angain to save.

7．2．6　Communication Settings

Device ID > 1	Modbus Device ID, ranged from 0 to 255
Comm. Parameter > BaudRate 9600 Parity None StopBit 1	Set the RS485 port baud rate and parity bit. The stop bit is fixed as i bit. The default parameters of RS485 are : Baud Rate:9600 Parity bit: NONE Stop Bit: 1 Data Bits:8

7．2．7 Save and restore paramters

Save Parameters > save Restore Factory Restore Save Parameters	Save Parameters > save... Restore Factory Restore Saving....	Save Parameters > save OK Restore Factory Restore Saved successfully	Save Parameters > save Err Restore Factory Restore Failed when saving
Save Parameters save Restore Factory > Restore Restore parameters		Save Parameters save Restore Factory > Restore OK Restored successfully	Save Parameters save Restore Factory > Restore Err Failed wen restoring

8. Quality asurrance and after-sale service

According to the ISO9001:2000 quality management and control system, this product is made of new raw materials and components, and has been tested strictly in factory. However, due to the uncertainties that may arise in transportation or use, we undertake to ensure that:

- Whithin 2 weeks from the date of delivery, if a quality defects can be recognized, the instrument will be changed free of charge
- Whithin 1 year from the date of delivery, if the instrument is damaged but not caused by improper using or users, it will be repaired free of charge.
- Damages caused by following resons are not considered as the free service conditions

  ↗ In violation of the relevant provisions of the manual requirements and installation or use conditions

  ↗ Incorrect or violate the local related instrument installation, wiring or the use regulations

  ↗ Wroks with the equipmets which are not electrically compatable with the instrument or not certified or not assured with quality ensurance

  ↗ Unauthorized disassemble or repair

  ↗ Out of one year warrenty

  ↗ Force majeure as defined by applicable laws
- For thos fault instruments within warranty, users should pay for the freight for sending instrument to us, the fees for exchange or repair and the freight for sending back are taken by us
- If there is not faulty found in the istrument sent back to us, users should take all the freights.
- Once the faulties found in the instrument send to us, unless under the special circumstances, the new or repaired instrumnent will be send back out within 48 hours or 2 working days.
- If a faulty appears, contact us or your local agent

Appendix 1 Modbus register address table

Floating point data arrangement is F2-F1-F4-F3 (F4-F3-F2-F1 High to low)

register address	Register name	Register number	data type	data format
4x0001-4x0002	Flow	2	float	IEEE754
	TXD	01 03 00 00 00 02 C4 0B		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0003-4x0004	velocity	2	float	IEEE754
	TXD	01 03 00 02 00 02 65 CB		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0005-4x0006	current	2	float	IEEE754
	TXD	01 03 00 04 00 02 85 CA		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0007-4x0008	Cumulative decimal	2	Unsigned long	F4-F3-F2-F1
	TXD	01 03 00 06 00 02 24 0A		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0009-4x0010	Cumulative decimal	2	float	IEEE754
	TXD	01 03 00 08 00 02 45 C9		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0011-4x0012	Cumulative float	2	float	IEEE754
	TXD	01 03 00 0A 00 02 E4 09		
	RXD	01 03 04 00 00 00 00 FA 33		
4x0013-4x0014	Gas temperature	2	float	IEEE754
	TXD	01 03 00 0C 00 02 04 08		
	RXD	01 03 04 BA 4A 41 F8 CF 2F		
4x0015-4x0016	Current acquisition signal value	2	float	IEEE754
	TXD	01 03 00 0E 00 02 A5 C8		
	RXD	01 03 04 82 1F 40 36 52 5B		
4x0017-4x0018	Lower Range	2	float	IEEE754
4x0019-4x0020	Upper Range	2	float	IEEE754
4x0021	Lower relay status	1	Unsigned int	0- open 1- close
4x0022	Upper relay status	1	Unsigned int	0- open 1- close
4x0051-4x0052	ID number	2	Unsigned long	F4-F3-F2-F1
4x0053	Device ID	1	Unsigned int	0-255
4x0054	BaudRate	1	Unsigned int	
4x0055	Parity	1	Unsigned int	
4x0056	StopBit	1	Unsigned int	

Appendix 2 Conversion Coefficient of Common Gas

According to different gas on site, the calibration in lab translates the flow rate of actual gas on site into flow rate of air, and then begins to calibrate the flow rate at present. Therefore, when using the meter on site, the meter displays mass flow or volume flow of actual gas.

When translating the flow rate of gas into flow rate of air, there is a conversion coefficient table of different gas.

Table 1 The Density and Conversion Coefficient of Common Gas

	Gas	Specific heat (Kal/g*℃)	Density (g/l, 0℃)	Conversion Coefficient
0	Air	0.24	1.2048	1.0000
1	Argon (Ar)	0.125	1.6605	1.4066
2	Arsine (AsH^3)	0.1168	3.478	0.6690
3	Boron Tribromide (BBr^3)	0.0647	11.18	0.3758
4	Boron Trichloride (BCl^3)	0.1217	5.227	0.4274
5	Boron Trifluoride (BF^3)	0.1779	3.025	0.5050
6	Borane (B^2H^6)	0.502	1.235	0.4384
7	Carbon Tetrachloride (CCl^4)	0.1297	6.86	0.3052
8	Carbon Tetrafluoride (CF^4)	0.1659	3.9636	0.4255
9	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	Allylene (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	Carbinol (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 (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	Fluoride (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 (H_2)	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 (He)	1.2418	0.1786	1.4066
38	Krypton (Kr)	0..0593	3.739	1.4066
39	nitrogen (N_2)	0.2486	1.25	0.9940
40	Neon (Ne)	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	Phosphorane (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 Fluoride (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 (Xe)	0.0379	5.858	1.4066

Appendix 3 Trouble Shooting

Before any hardware repair, please ensure all following points are correct as these affect the performance

1. Check if the instrument is correctly supplied power
2. Check if the instrument wiring is correct against Charpter 2
3. Check the straightway lengths are properly set as discribed in Chapter 6.2
4. Check if the actual flow direction is same as the indicator on instrument is
5. Check if there are pipe leaks

Cut off the power supply before removing instrument

Make sure the pipe is decompressed before repair

Troubles	Possible causes	Solutions
Velocity is anomaly or fluctuation	Abnormal or irregular fluid	Refer to chapter6.2
	The flow regulator is not installed in front of instrument	Correct the installation
	Sensor faulty	Send to manufacturer
	Electronic component anomaly	Send to manufacturer
	Incorrect or unstable grounding	Check the wiring
Measured velocity is too high or too low	The direction of sensor is not correct	The flow direction indicator arrow points to the downstream
	The flow regulator is not installed in front of instrument	Correct the installation
No response for the flow	No power	Turn the power supply on
	Gas contains water	Install a dryer of filter at upstream
	The signal cut-off is set too high	Set a correct value by using keyboard of software
	The actual flow rate is less than the instruction minimum flow	Set instrument span or contact manufacturer for re-calibrating
	Sensor faulty	Send to manufacturer
	PCB faulty	Send to manufacturer

Appendix 4 Upper Range Value of Common Gas

(Unit: Nm^3/h. The follow table can be extended)

Nominal Diameter (mm)	Air	Nitrogen（N_2）	Oxygen（O_2）	Hydrogen(H_2)
15	65	65	32	10
25	175	175	89	28
32	290	290	144	45
40	450	450	226	70
50	700	700	352	110
65	1200	1200	600	185
80	1800	1800	900	280
100	2800	2800	1420	470
125	4400	4400	2210	700
150	6300	6300	3200	940
200	10000	10000	5650	1880
250	17000	17000	8830	2820
300	25000	25000	12720	4060
400	45000	45000	22608	7200
500	70000	70000	35325	11280
600	100000	100000	50638	16300
700	135000	135000	69240	22100
800	180000	180000	90432	29000
900	220000	220000	114500	77807
1000	280000	280000	141300	81120
1200	400000	400000	203480	91972
1500	600000	600000	318000	101520
2000	700000	700000	565200	180480

The flow rate in standard condition: The flow rate is in the condition of 20℃ temperature and 101.325kPa pressure.

The unit of flow rate is optional: Nm3/h, Nm3/min, L/h, L/min, t/h, t/min, kg/h or kg/min.

The reduction formula of flow rate in working condition and flow rate in standard condition:

$$Qs = \frac{0.101325+p}{0.10325} * \frac{273.15+20}{273.15+t} * Qn$$

Qs: The flow rate in standard condition (Nm3/h).

Qn: The flow rate in working condition (m3/h).

t: The medium temperature in working condition (℃).

p: The medium pressure in working condition (Gauge pressure, kPa).