Vortex flow meter

User's manual

KAWAKI MEASURING INSTRUMENT CO.,LTD.

Contents

Precautions

1. Receiving inspection

When you get this product, please confirm whether there is any bumps or scratches during transportation.

According to the label on the product nameplate, please confirm whether it matches the model you want to buy.

2. During transportation and storage

- Use our company's packaging as much as possible to transport the flow meter directly to the installation site.
- Don't make strong collision during transportation, and don't let rainwater get wet.
- When storing, try to use the company's original packaging for storage. The storage place should meet the following requirements:

  There will be no rain

  Places with as little vibration or collision as possible

  Temperature: -40℃—+55℃

  Humidity: 5%—90%
- When storing the used flow meter, it is necessary to completely clean the residual liquid and adherends inside. In addition, pay attention to seal the power interface to prevent moisture.

3. Check before installation

It should be used under the conditions specified by the flow meter during use. It is not feasible to use the flow meter beyond this specification. If the flow meter is damaged due to this, the maintenance cost will be borne by you.

After the flow meter has a problem, contact us or the repairer as much as possible to solve the problem as soon as possible.

Read the manual carefully before installation. If the flow meter is damaged due to failure to follow the manual, the maintenance cost shall be borne by yourself.

Product use and working principle

1. Purpose

Vortex flow meter is widely used in industrial pipeline measurement in petroleum, chemical, electric power, light industry and other sectors.

The flow of liquid or gas. Since the sensor material is 1cr18ni9ti, it can also be used for flow measurement of urban water supply, heating, boiler water supply, and fluid pipelines in the medical industry.

The explosion-proof vortex flow sensor uses intrinsically safe explosion-proof technology. The explosion-proof mark of the battery-powered vortex flow meter is "Ex ia□C T6 Ga", which is suitable for use in hazardous locations containing T1~T4 groups in zone 0, zone 1, and zone 2 that are not higher than class ii b; vortex street powered by safety barriers the explosion-proof mark of the flow meter is "Ex ia□C T6 Ga", which is suitable for use in hazardous locations containing T1~T5 groups in zone 0, zone 1, and zone 2 of class ii b.

2. Working principle

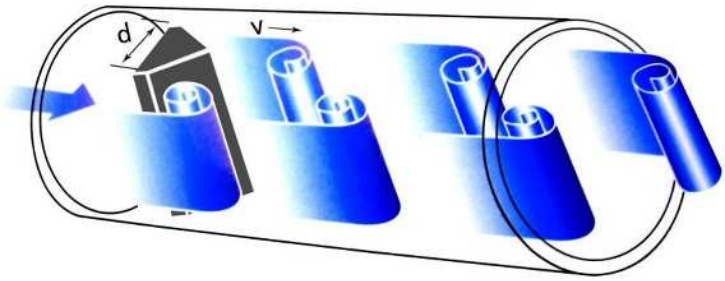


Figure 1: Working principle diagram of Karman vortex street

Setting a triangular prism vortex generator in the flow meter, regular vortex will be generated at both the sides of triangular prism, which is called Karman swirl. As showed on the drawing 1.1,vortex are arranged regularly at the downstream of vortex generator. Suppose the vortex generation frequency is f, the average flow velocity of medium is v, d is the width of the surface of triangular prism incident flow, and d for the nominal diameter of flow meter. Then we get the computation formula:

$$f=Sr\frac{\bar{V}}{(1\sim1.25d/D)\,d}$$

3.The characteristics of the product

The vortex flow meter produced by our company is a product launched after years of research and development based on the product design concept of the Japanese oval company combined with the use characteristics of domestic enterprises. This product is produced in accordance with the Japanese national standard JIS z8766: 2002 "Vortex flow meter—flow measurement method". Therefore, the vortex flow meter of our company has the accuracy and stability that this domestic similar product does not have, except for ordinary in addition to the characteristics of the vortex flow meter, it also has the following outstanding features:

(1) this product uses the design principle of japan oval company, the generator adopts the triangular column design with the top angle facing forward, instead of the ladder column design adopted by most domestic manufacturers. Although it increases the production cost, it greatly increases the product range. . In addition, the cross-sectional area, width, slope of the triangular column and the position of the triangular column in the meter body are all proportional to the pipe diameter, so that the accuracy and stability of the product are guaranteed.

(2) the above specifications starting from dn20: The meter body and triangular column are used for one-time casting, which reduces the deformation of the measuring hole due to welding of the triangular column and improves the stability of the vortex signal.

(3) since dn40, all specifications above adopt built-in structure, that is, the measuring probe is inserted into the triangular column. Only a small amount of domestic large-caliber adopts this structure, although it increases the process difficulty, it greatly improves the anti-interference ability of the product.

(4) the conversion of vortex signals adopts digital signal processing technology (dsp) to break through the limitations of traditional analog methods for processing vortex signals, improve the detection sensitivity of vortex signals, and strengthen the seismic performance of vortex flow meters.

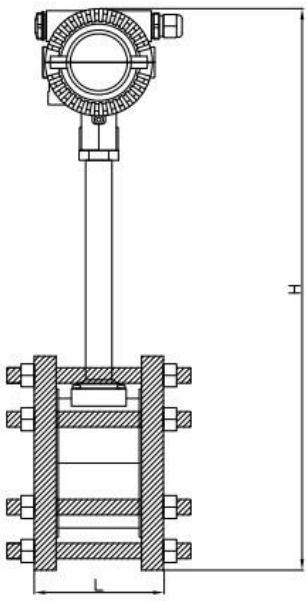
(5) due to the adoption of the above structure and digital signal processing technology, the range of the flow meter is greatly expanded. Under normal

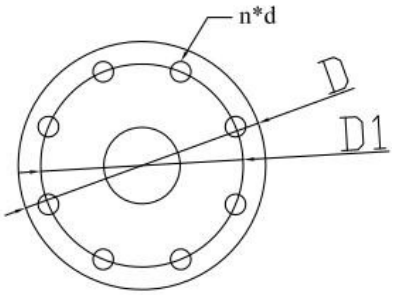
circumstances, it can reach 1:10 ~ 1:20, which is mainly manifested in the obvious reduction of the lower limit flow rate, which is usually 1/4-1/2 of the ordinary vortex flow meter.

(6) under the specified conditions, the technical performance and quality of the product have reached or approached the level of advanced foreign vortex flow meters.

4.The structure, function and dimensions of the vortex flow meter

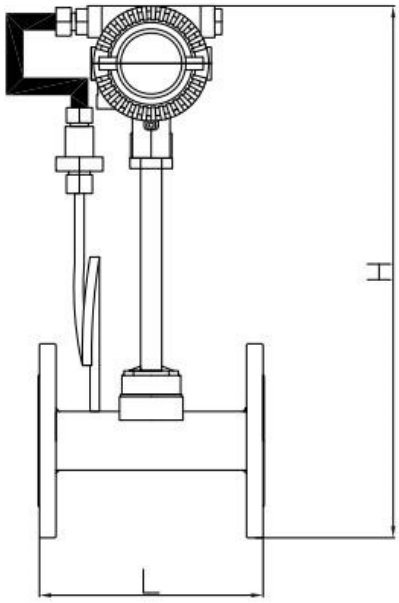
Dimensions of flange clamped vortex flow meter

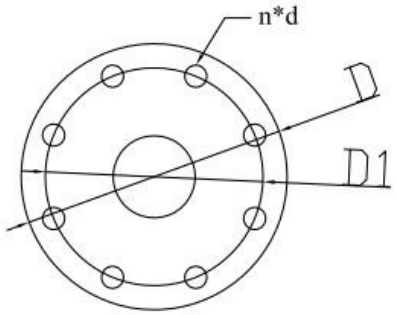




Size（mm）	15	20	25	32	40	50	65	80	100	125	150	200	250	300
L（mm）	95	95	95	114	114	117	117	117	136	151	170	190	205	220
H（mm）	460	460	460	480	490	500	515	530	550	570	600	650	710	760
D（mm）	125	125	125	145	145	160	180	195	215	245	280	335	405	460
D1（mm）	100	100	100	120	120	125	145	160	180	210	240	295	355	410
N（pce）	4	4	4	4	4	4	4	8	8	8	8	12	12	12
D（mm）	14	14	14	14	14	18	18	18	18	18	22	22	26	26

Flange connection type vortex flow meter size





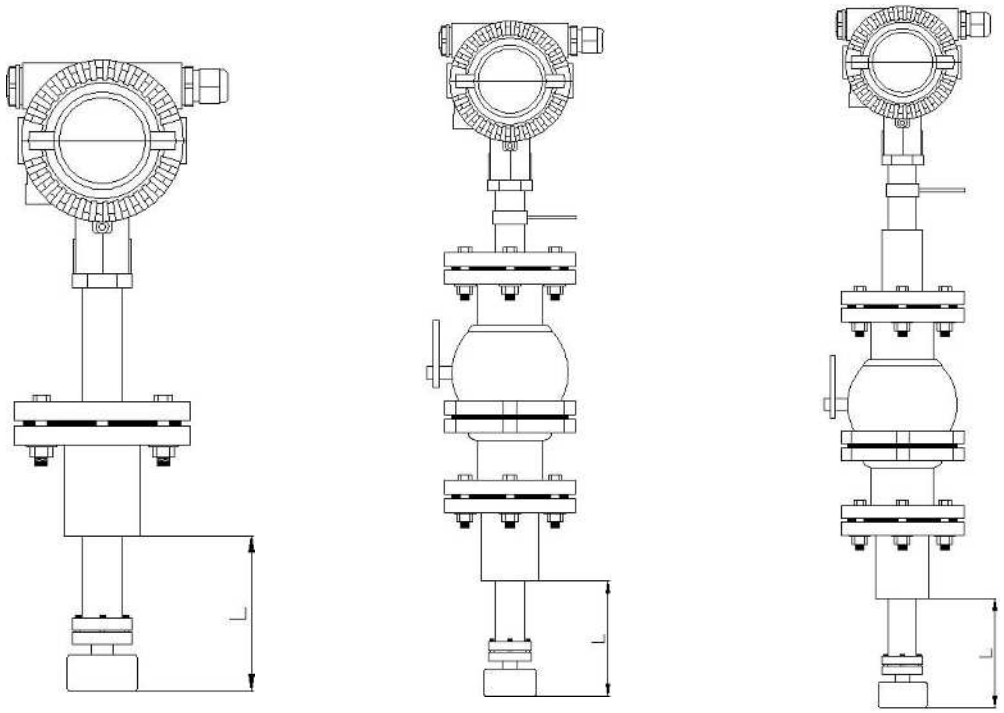
Size（mm）	15	20	25	32	40	50	65	80	100	125	150	200	250	300
L（mm）	180	180	180	180	180	180	200	200	200	220	220	220	350	300
H（mm）	416	423	431	448	456	470	488	501	525	552	584	636	696	749
D（mm）	95	105	115	140	150	165	185	200	220	250	285	340	405	460
D1（mm）	65	75	85	100	110	125	145	160	180	210	240	295	355	410
N（mm）	4	4	4	4	4	4	8	8	8	8	8	12	12	12
D（mm）	14	14	14	18	18	18	18	18	18	18	22	22	26	26

Note:

1. the above parameters are only applicable to flange-connected vortex flow meters with pressure specifications below 1.6mpa.

2. the flange connection type vortex flow meter is not equipped with pipe flanges and bolts when leaving the factory, and needs to be purchased the standard of the connection flange is GB/T9119-2000 raised panel flat welding control flange.

Insertion type vortex flow meter insertion depth table



DN	DN250	DN300	DN400	DN500	DN600	DN800	DN1000	DN1200
L	125	150	200	250	300	400	500	600

5.Technical parameter

Nominal diameter (mm)	25,40,50,65,80,100,125,150,200,250,300，（300~1000plug-in）
Nominal pressure (mpa)	Dn25-dn200 4.0（＞4.0agreement supply），dn250-dn300 1.6（＞1.6agreement supply）
Medium temperature (℃)	Piezoelectric: -40~260, -40~320; capacitive: -40~300, -40~400, -40~450 (order agreement)
Body material	1cr18ni9ti，（other material agreement supply）
Allow vibration acceleration	Piezoelectric: 0.2g capacitive: 1.0~2.0g

Accuracy	±1%r, ±1.5%r, ±1fs;Insertion type : ±2.5%r, ±2.5%fs
Extent	1:6~1:30
Supply voltage	Sensor: +12v dc, +24v dc; transmitter: +12v dc, +24v dc; battery-powered type: 3.6v battery
Output signal	Square wave pulse (excluding battery-powered type): High level ≥5v, low level ≤1v; current: 4~20ma
Pressure loss coefficient	Comply with jb/t9249 standard cd≤2.4
Explosion-proof mark	Intrinsically safe type: Exd ii ia ct2-t5 flameproof type: Exd ii ct2-t5
Protection class	Common type ip65 diving ip68
Environmental conditions	Temperature -20℃~55℃, relative humidity 5%~90%, atmospheric pressure 86~106kpa
Applicable medium	Gas, liquid, steam
Transmission distance	Three-wire pulse output type: ≤300m, two-wire standard current output type (4~20ma): Load resistance ≤750ω

6.Flow range table

Caliber (mm)	Liquid		Gas	
	Range(m3/h)	Output frequency range (hz)	Measurement range (m3/h)	Output frequency range (hz)
25	1.6～16	25～336	8.5～70	190～1140
40	2.5～25	10～200	22～220	140～1040
50	3.5～35	8～160	36～320	94～1020
80	10～100	4.1～82	70～640	55～690

100	15～150	4.7～69	130～1100	42～536
150	40～400	2.8～43	280～2240	33～380
200	80～800	2～31	580～4960	22～315
250	120～1200	1.5～25	970～8000	18～221
300	180～1800	1.2～24	1380～11000	16～213
(300)	100～1500	5.5～87	1560～15600	85～880
(400)	180～3000	5.6～87	2750～27000	85～880
(500)	300～4500	5.6～88	4300～43000	85～880
(600)	450～6500	5.7～89	6100～61000	85～880
(800)	750～10000	5.7～88	11000～110000	85～880
(1000)	1200～17000	5.8～88	17000～170000	85～880
>(1000)	Agreement		Agreement	

Note: The normal flow range is the minimum and maximum flow, and the alternative flow is the maximum flow provided by the customer during model selection

Note: The gas flow in the table is the volume flow under working conditions

The flow rates of the above-mentioned liquids and ordinary gases are volumetric flow rates. To measure their mass flow rates, the density of the liquid or gas needs to be known. Calculate by the following formula qm=qv*p:

Qm: The mass flow rate of the measured fluid (kg/h)

Qv: The volume flow of the measured fluid (m3/h)

P: Density of the measured fluid (kg/m3)

Steam generally measures its mass flow. The prerequisite is that the pressure and temperature of the steam must be known so that the density of the steam can be known. Thus, the mass flow rate of steam can be calculated using the above formula through the volume flow rate.

7.Product model

7.1. Before selecting the model, determine the type and flow value of the measured medium (it can be an estimated value), and then select the corresponding flow range of the vortex flow meter when measuring different media in the table. Specification.

7.2. The flow of the measured medium in the pipeline must be within the flow range of the flow meter, otherwise it cannot be used.
It is better to be at 1/2～2/3 of the flow rate range of the flow meter.

7.3. If the actual pipe diameter is larger or smaller than the selected flow meter diameter, shrink tube or expansion tube should be used to reduce the diameter to ensure the correct use of the flow meter.

7.4. Select the vortex signal output mode according to the purpose of the vortex flow meter:

(1) when the measured medium is a compressible fluid and the temperature and pressure of the medium on the spot change greatly, it is recommended to use a vortex sensor with pulse signal remote transmission and a flow totalizer with temperature and pressure compensation. Pressure transmitter, temperature transmitter or pt100, need to be purchased separately by the user.

(2) the flow meter is installed in a room with a better environment and does not require remote signal transmission. It only needs to read the flow value on the spot, and the installation position of the flow meter is convenient for operation and data reading. It is recommended that users choose battery-powered on-site direct reading type vortex flow meter. However, if the flow meter is installed outdoors and exposed to the atmosphere, battery-powered on-site direct-reading vortex flow meters are generally not selected.

(3) when the installation environment of the flow meter is poor or the installation location is not convenient for on-site reading of flow values or centralized management, it is recommended to use a sensor that outputs pulse signals with a flow totalizer, or with 4-20ma standard current the output vortex transmitter.

(4) when it is necessary to observe the flow rate on site and transmit signals

remotely, it is recommended to use a vortex transmitter with direct reading on site and a 4-20ma output at the same time.

⑸ when there is no need to read on-site, and only standard signals are transmitted remotely, it is recommended to use a vortex transmitter with 4-20ma standard current output.

7.5. According to the temperature of the measured medium, select a high temperature or low temperature vortex flow meter. 250℃—350℃

The high temperature type is usually equipped with a radiator. 6.6. Use explosion-proof vortex flow meter for explosion-proof places.

8. Installation

8.1. Precautions before installation

8.1.1. This installation and operation procedure is only applicable to multi-brand vortex (steam) flow meters

8.1.2. After receiving the meter, please confirm the quantity, type, caliber and whether the meter is in good condition

8.1.3. After opening the instrument packing box, confirm whether the accessories (matching flanges, bolts and nuts, gaskets, instructions, certificates) are complete.

8.1.4. Please read the product manual carefully before installation. If you have any questions, please call the company's after-sales engineer

8.2. Installation procedures

8.2.1. Determine the pipeline to be installed and match the diameter of the flow meter (except for expansion or reduction), and find a suitable installation location according to the installation requirements of the manual. The meter can be installed on horizontal, vertical, and inclined pipelines, but sufficient front and rear straight pipe sections must be reserved according to the requirements of the manual (generally ensure that the first 10 times of the flow meter

The length of the straight pipe section after the pipe diameter flow meter is 5 times the pipe diameter). When the metering medium is steam, please protect the instrument transmitter to prevent the temperature from being too high (ambient

temperature ≤60°c). If necessary, the transmitter (meter head) can be installed upside down.

8.2.2. The installation environment of the instrument should be selected strictly according to the instructions, and isolation and protection measures should be artificially added when necessary.

8.2.3. After completing the above steps and measures, please confirm whether the installer and equipment are complete (including but not limited to pipe cutting tools, pipe welding tools, power supplies, signal lines, power lines, electricians, fitters, welders, etc.) and take safety measures such as on-site protection and fire prevention

8.2.4. Please use a ruler to measure the length of both sides of the flange inner diameter edge of the clamped flow meter during installation. Cut the pipe with this length as an approximate benchmark; after the pipe is cut, weld the two flanges to the pipe respectively (note: Do not carry the welding operation with the instrument, and the flanges should be aligned as horizontally as possible to avoid weak sealing) 7.2.5 , after the flange is welded, clamp the flow meter to the middle of the flange, and then perform the tightening operation. Tightening means that all bolts must be evenly stressed to prevent air and liquid leakage. When installing, pay attention to the gasket must be used, and the metal spiral wound gasket should not be violently bumped to avoid breaking and affecting the installation and use.

8.2.6. For installation pressure and temperature compensator of split compensation type, please refer to section (1) of the manual "Installation method".

8.2.7. After installing the flow meter, you can test water and gas when conditions permit (corrosion, toxic gas, high temperature steam, please pay attention to leakage safety)

8.2.8. Wiring of the instrument: The battery-powered integrated type can directly unscrew the back cover and connect the battery line with the circuit board line. The integrated external power supply requires 24v external dc power supply. Please pay attention to distinguish between 220vac and 24vdc split type.

8.2.9. Under normal circumstances, the instrument has been parameterized before leaving the factory. If the actual parameters have changed, then modify the parameters.

8.3. Precautions after installation

8.3.1. Please keep the manual, certificate, warranty card and other accessories after installation.

8.3.2 clean up the site in time to protect and maintain the instrument.

8.3.3. In the later period, ensure more than three tightening operations to ensure the safe operation of the flow meter

8.3.4. Prevent frequent start and stop of the flow meter during the operation of the instrument, and avoid frequent start and stop of the medium flow (to obtain more accurate accuracy)

8.3.5. When measuring high-pressure and high-temperature media (especially steam), the valve should be slowly opened to sweep the pipeline and equipment.

8.4. Installation requirements:

8.3.2. The ambient temperature of the installation site should meet the technical requirements.

8.3.3. The installation site must not have strong vibration and strong magnetic interference. Vibration reduction measures should be taken when there is strong vibration. Such as the use of vibration-absorbing support or vibration-absorbing soft rubber pads.

8.3.4. The installation site should ensure convenient installation and maintenance operations.

8.3.5. The surroundings of the installation site shall not be filled with corrosive gas or be submerged by water.

8.4.5 the vortex flow meter displayed on site cannot be directly irradiated and exposed to the sun. In this case, necessary shading measures should be taken.

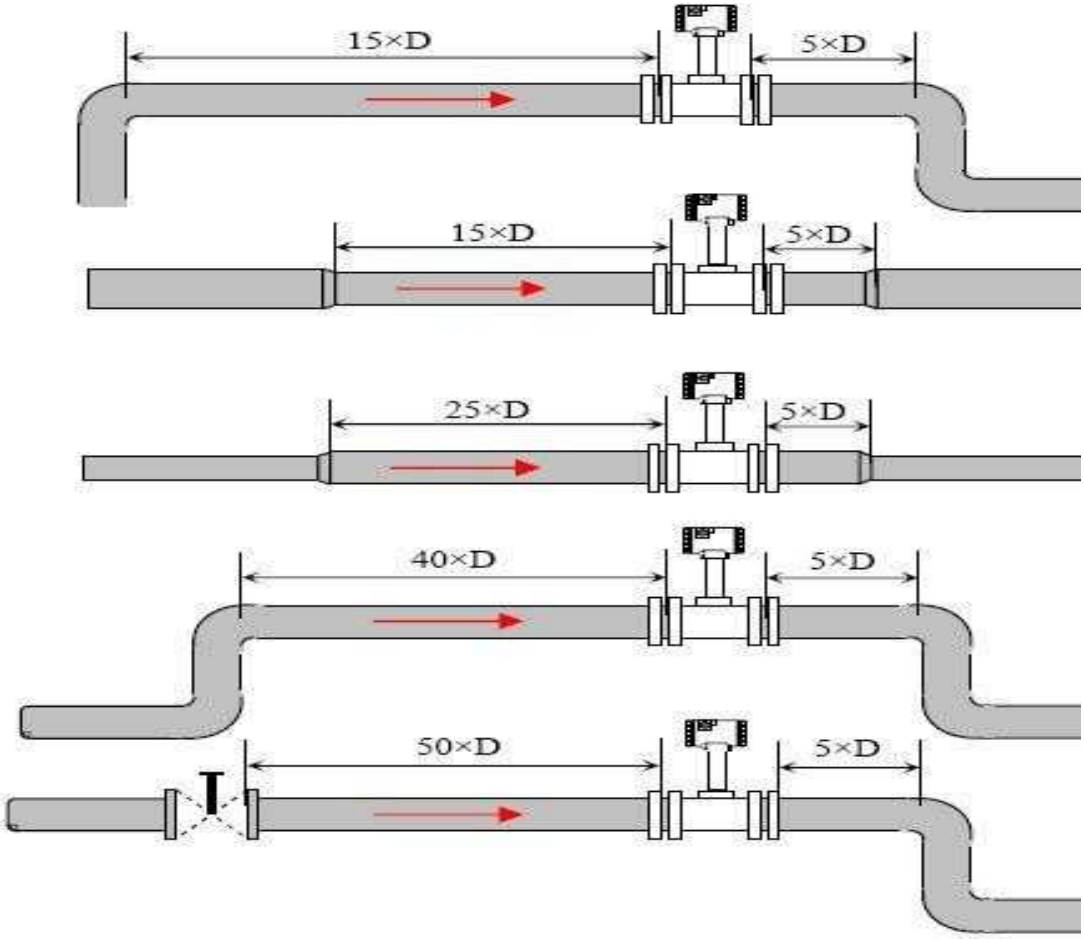
8.4.6. The direction of the flow arrow on the vortex flow meter should be consistent with the direction of fluid flow in the pipeline.

8.4.7. When measuring liquid, make sure that the pipeline is full. When vertical installation is required, the fluid should flow from bottom to top.

8.4.8. The flow regulating valve should not be installed upstream of the flow meter, but the flow regulating valve should be placed downstream of the flow meter.

8.4.9. The upstream and downstream of the vortex flow meter should be equipped

with straight pipe sections of sufficient length according to the site conditions. (see the table below)



Pre-schematic flow diagram of pipe sectio

8.4.10. The inner diameter of the pipe where the vortex flow meter is installed should be the same as that of the vortex flow meter. If it is different, a transition pipe should be added to the upstream and downstream of the vortex flow meter. The length of the transition pipe should conform to the above table. The length of the straight pipe is required.

8.4.11. When installing on site, the length of the upstream and downstream straight pipe sections of the vortex flow meter should meet the requirements of the above

table. Even so, according to the Japanese industrial standard JIS z 8766: 2002, the error ratio of the vortex flow meter used on site is in the laboratory, increase by at least 0.125%. If the upstream and downstream straight pipe sections cannot meet the requirements, increase at least 0.25% or more. If the straight pipe sections differ too much from the requirements, normal measurement may not be possible.

8.4.12. If the site conditions cannot provide the length of the upstream straight pipe section specified in the table, the following measures can be taken:
①. Correct the instrument coefficients made by the laboratory. The Japanese industrial standard JIS z 8766: 2002 has specified the additional uncertainty when the straight pipe section is insufficient. The manufacturer can follow this and according to the specific conditions of the site. Correct the original meter coefficient in the meter. Note: This correction can only be made by the manufacturer of the vortex flow meter.

②. When the length of the upstream straight pipe of the vortex flow meter is insufficient, and there is no effective data for correcting the deviation and accuracy of the meter coefficient due to the insufficient length of the straight pipe, the method of installing a flow regulator upstream of the vortex flow meter can be adopted. , to eliminate the influence of upstream choke. The flow regulator generally adopts a single-plate flow regulator, which must be ordered by the meter user from the manufacturer when purchasing.

8.5. Installation method

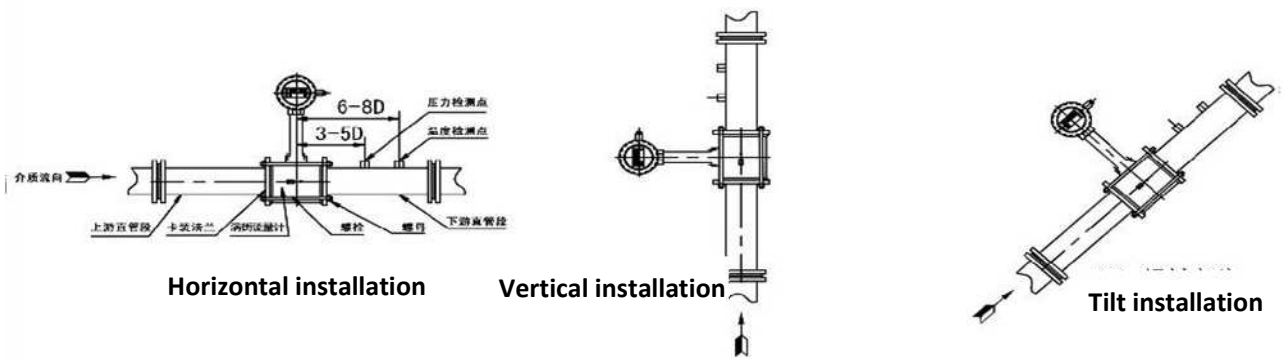
8.5.1. The vortex flow meter should be installed as shown in the figure below. When pressure or temperature compensation is required, a pressure transmitter and a temperature transmitter should be prepared separately. The position of the pressure hole is set at 3～5dn downstream of the sensor, and the diameter of the pressure hole is 6～13mm. The temperature measurement point is set at 6～8dn downstream of the sensor. (as shown in figure 3 above)

8.5.2. When the flange-mounted vortex flow meter is installed on the pipeline, in order to ensure accurate and reliable installation, you can first connect the vortex flow meter and the clamping flange with bolts, and then weld the clamping flange to the on the pipeline. In order to prevent the vortex flow meter from being damaged due to high temperature during welding, spot welding should be performed first, and then the vortex flow meter should be removed before welding.

8.5.3. In order to facilitate maintenance and inspection, a bypass pipe can be installed. The bypass pipe is installed on the outside of the upstream and downstream straight pipe sections of the vortex flow meter to prevent it from affecting the measurement of the vortex flow meter.

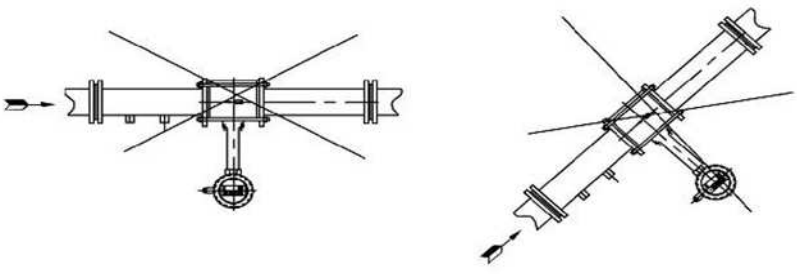
8.5.4. The installation of the waterfall-proof vortex flow meter must be carried out in accordance with the relevant regulations of gb3836.15-2000 "Electrical equipment for explosive gas environments" Part 15: "Electrical installations in hazardous locations (except coal mines)".

8.6. Installation icon



Horizontal installation Vertical installation Tilt installation

Installation diagram



Installation method not allowed

Circuit board operating instructions

Our company's products have three types of circuit boards.

1. E series three-wire system/two-wire system, on-site display type

2.vt2w-xxa two-wire system, temperature and pressure compensation type

3.vt3w-xxa three-wire system, mixed signal processing, temperature and pressure compensation type

According to the product you purchased, check the corresponding operating instructions. The following are introduced separately.

Three-wire /two-wire system on-site display type

1. Wire connection

The terminal blocks is on the amplifier board. The large terminal is the required main terminal and the small terminal is the auxiliary terminal for additional function wiring.

1.1. Wire connection of vt3we

Main power supply and output signal terminal

Gnd	Fout	V +

“gnd”: Is the "-" End of the power supply.

“fout”: Is the pulse output terminal.

“v+” : Is the “+” Terminal of external 12v~24vdc power supply.

Note:

When v+ and gnd are connected to an external power source, the circuit works (the battery-powered model is transferred to an electrician), and the pulse output is drawn from fout.

Auxiliary wiring (small terminal) the double-pin jumper wire between the main terminal and the auxiliary terminal is the battery switch. When it is short connected battery is on; battery is off, when it is disconnected.

Battery and communication terminal

+ 3 v6	3 v6 -	Cmb -	Cma +

1) battery terminal(1,2 bit right of small terminal)

“+3v6”: Connect to the "+" End of 3.6v lithium battery.

“3v6-“ : Connect to the "-" End of 3.6v lithium battery

2) communication terminal (3,4 bit left of small terminals)

“cmb -”: Connect the "-" Or “b” End of rs485 wires.

“cma +”: Connect the "+" Or “a” End of rs485 wires.

1.2. Wire connection of vt2we

1. Main power supply and current output terminal

-	+

"-" : Is the output terminal of 4~20ma current. And also is the “-” End of 15-24v power supply

"+" : Is the "+" End of 15-24v power supply

The ammeter or sampling resistance is between the “-” End and the negative of power.

Auxiliary terminal (3 small terminals)

V +	Fout	Gnd

“v+” : Connect to the positive of the power supply (+12v).

“fout”: Is the pulse output signal terminal.

“gnd”: Connect to the negative of the power supply.

This pulse output must be used in the case of power supply in the main current loop. The output is the uncorrected original pulse with 50hz excised with light isolation, which is usually used in calibration. The output signal is npn open collector output with 2k pull-up resistance.

2. User operation

2.1. Work screen

After the meter is powered on, it will perform self test first, and then enter the main display state of screen-1.

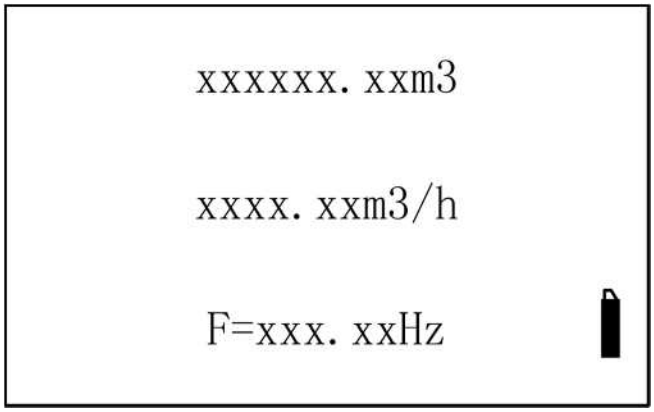


Figure 1 vt3we work screen-1 interface

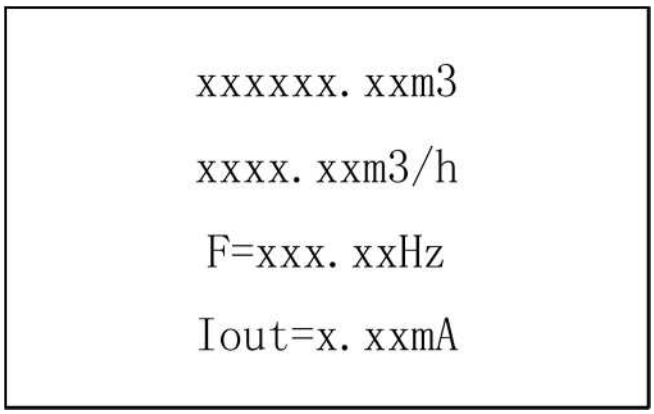


Figure 2 vt2we work screen 1 interface

Line 1: Qt, with max 9-bit integer, 3-bit decimal. The unit as the molecule of qn unit.

Line 2 :Qn, with max 7-bit integer, 2-bit decimal. The unit is set by the menu.

Line 3: F, frequency value of flow signal; with max 7-bit integer, 2-bit decimal

Line 4: Qi, output current value; with max 7-bit integer, 2-bit decimal (vt2we only)

The lower right corner: The battery power indicator, when the meter is powered by the battery.

Press the key '<' or '+' to switch between work screen_1 and work

Screen_2

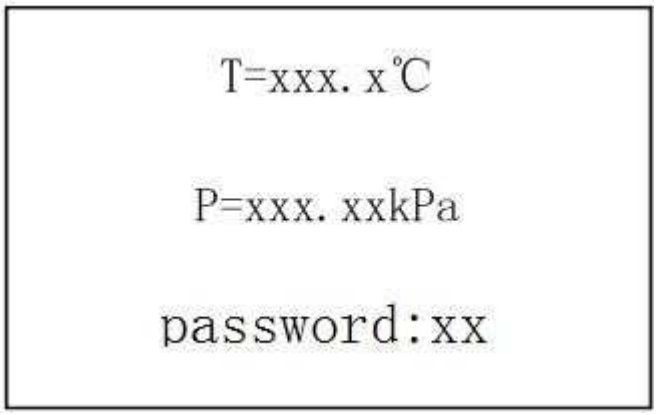


Figure 3 working screen 2 interfaces

Line 1: Temperature value (setting value); used for calculation of temperature compensation.

With 1-bit decimal.

Line 2: Pressure value (setting value); used for calculation of pressure compensation.

With 2-bit

Decimal.

Line 3: Enter 4-bit password to entry different menu states.

Press the key "E" To enter the initial password entry state.

Press the key "S" To cancel the input state and return to the work screen-2.

Press the key "+" In the input state and loop to change the char at the cursor.

Press the key "<" To move the input cursor position;

Press the "E" Key in the input state to submit the content.

When password is correct, system goes to the related menu, incorrect, system goes back to the initial password state.

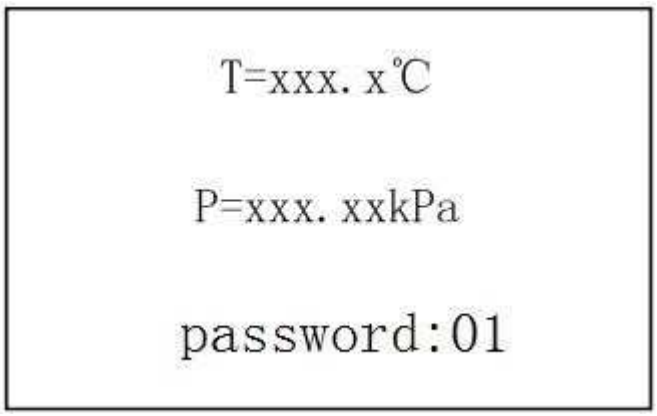


Figure 4 password inputting

Note:

About key, you must note these:

Key “e” Pressed, means “enter”.

Key “s” Pressed, means “esc”.

Key “+” Pressed, switch the char[between 0~9,and symbol] on input cursor position.

Key “<” Pressed, move the input cursor position.

2.2. User menu

Input password string :“2010” On the work screen-2 and hand in to entry user menu.

In user menu: Enter up to 8 bits of data (including symbols, decimal points).

Press the key "S" To exit item edit state or exit menu to work screen-2.

Press the key "E" To entry item edit state or hand in the input .

Press the key “+” To switch the char[between 0~9,and symbol] on input cursor position.

Press the key “<” To move the input cursor position.

Note: When setting parameters, the content can be saved only after pressing "E" To confirm, otherwise the setting parameters will lost!

Table 1 user menu items (password code: 2010)

Number	Caption	Meaning/(default)	Parameter options or range
1	Q unit M3/h	Set the qn flow unit (m3/h)	0: M3/h 1: M3/m 2: L/h 3: L/m 4: T/h 5: T/m 6: Kg/h 7: Kg/m
2	Q mode Qvw actual	Set the algorithm mode (qvw actual)	00_qvw: Regular volume flow algorithm 01_qm[dw]: Regular mass flow 02_qvn[@tnpn]: Conventional gas Volume flow 03_qmg[dn@tnpn]: Conventional gas Mass flow 04_qm steam[t]: Saturation steam Temperature compensation 05_qm steam[p]: Saturation steam Pressure compensation 06_qm steam[t&p]:Temperature and Pressure compensation Of superheated steam
3	K P/m3 3600.0	Set the coefficient (3600)	Set the meter coefficient in p/m3
4	Q20ma M3/h 1000.0	Set the full flow (1000.0)	The qn value with 20ma current output. It must be set as not zero value. The unit is the same as q - unit.
5	Density Kg/m3 1.00	Set the density of the fluid medium (1.0)	The density of the fluid medium

6	Tw ℃ 0.0	Set the temperature In working (0.0)	Set the calculated value of temperature, in degrees celsius. Which must be set when selecting algorithms 02, 03, 04 and 06.
7	Pw-abs Kpa 101.325	Set the absolute pressure of the fluid In working (101.325)	Set the calculation value of gas or steam absolute pressure, which must be set when selecting algorithms 02, 03, 05 and 06.
8	Q cut-zero % 1.0	Set the percent of full to be cut off (1.0)	Percent of full to be cut off, flow=0.0 Values range from 0 to 50%
9	Damp 2-32[s] 6.0	Set the damp time Of current output (4)	Set the damping time of current output, which is used to avoid the fluctuation of current output. The range is 2~32
10 Vt3we only	485 address 0	Set the meter sub-address in 485 (0)	Set the meter sub-address in modbus-485 for vt3we, ranging from 0 to 99
11	Clear q	Reset qt=0.0	“yes” And hand in to clear the qt=0.0

3. Amplifying board parameter table

Parameters setting of vortex flow meter amplifier refer to the table (liquid)

Dn	K1								K2								K3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
20	↑		↑		↑		↑						↑				↑	↑	↑					
25	↑		↑		↑		↑						↑							↑				
40	↑			↑	↑			↑							↑		↑	↑	↑	↑				

50	↑			↑	↑			↑							↑						↑			
80	↑			↑	↑			↑						↑	↑					↑	↑			
100	↑			↑	↑			↑						↑	↑							↑		
125	↑			↑	↑			↑						↑	↑								↑	
150	↑			↑	↑			↑					↑	↑	↑								↑	
200				↑				↑					↑	↑	↑						↑		↑	
250			↑	↑			↑	↑					↑	↑	↑							↑	↑	
300			↑	↑			↑	↑								↑								↑
350			↑	↑			↑	↑							↑	↑							↑	↑
400			↑	↑			↑	↑					↑	↑	↑	↑					↑	↑	↑	↑

Parameters setting of vortex flow meter amplifier refer to the table (gas)

DN	K1								K2								K3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
20	↑	↑			↑	↑			↑								↑							
25	↑	↑			↑	↑			↑								↑							
40	↑		↑		↑		↑			↑								↑						
50	↑		↑		↑		↑			↑									↑					
80	↑		↑		↑		↑				↑						↑		↑					
100	↑		↑		↑		↑				↑						↑	↑	↑					
125	↑		↑		↑		↑					↑					↑	↑	↑					
150	↑		↑		↑		↑					↑								↑				
200	↑			↑	↑			↑					↑							↑				
250	↑			↑	↑			↑						↑			↑	↑	↑	↑				
300	↑			↑	↑			↑							↑						↑			
350	↑			↑	↑			↑						↑	↑						↑			
400	↑		↑	↑	↑		↑	↑								↑				↑	↑			

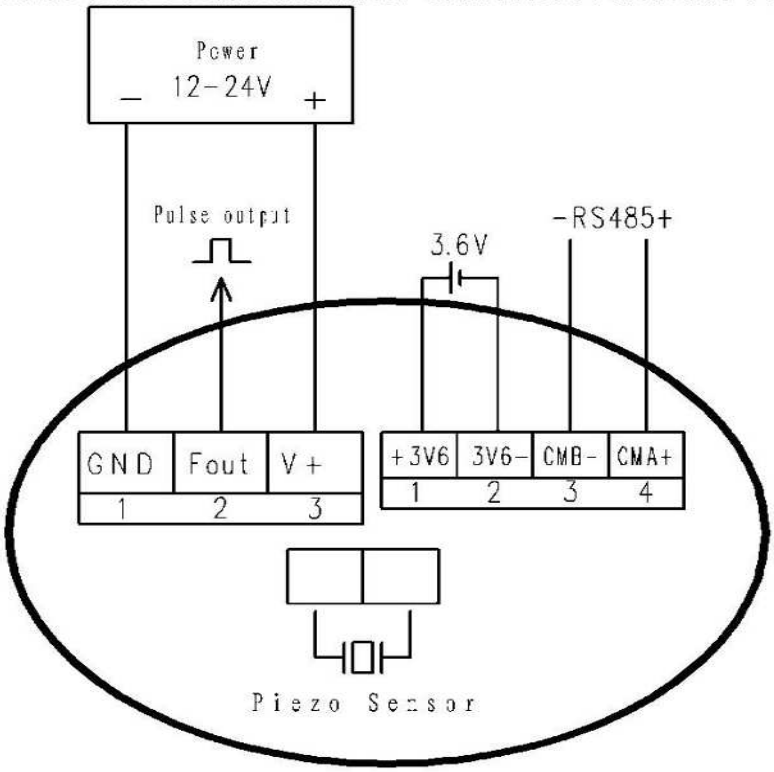
Parameters setting of vortex flow meter amplifier refer to the table (steam)

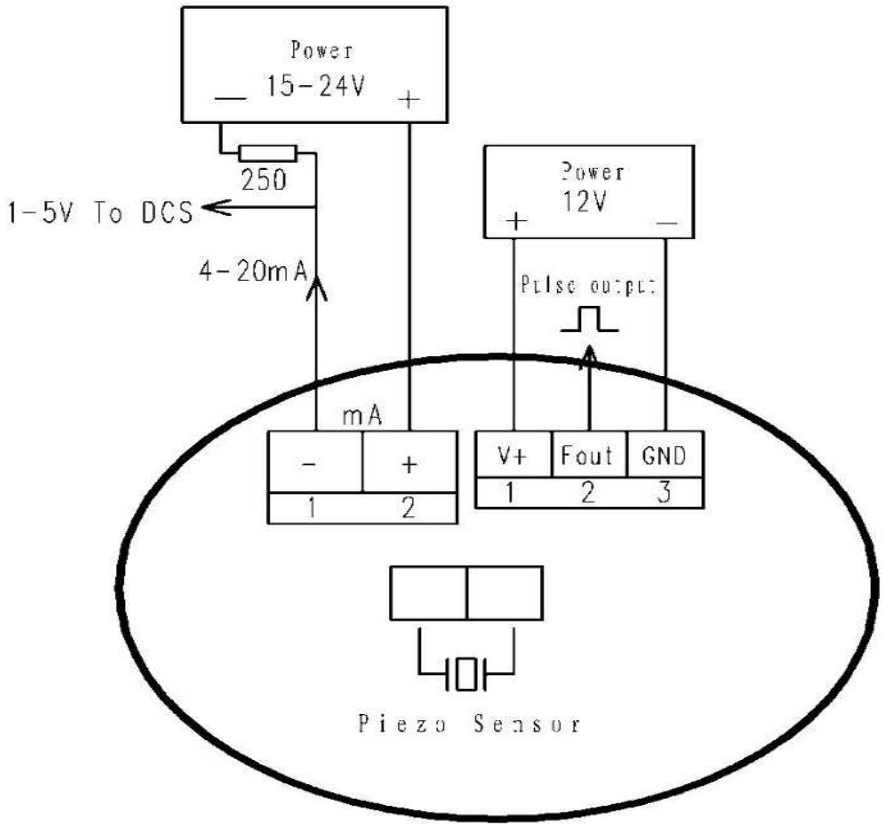
DN	K1								K2								K3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
20	↑	↑			↑	↑			↑								↑							
25	↑	↑			↑	↑			↑								↑							
40	↑		↑		↑		↑			↑							↑							
50	↑		↑		↑		↑			↑								↑						
80	↑		↑		↑		↑				↑						↑	↑						
100	↑		↑		↑		↑				↑						↑	↑						
125	↑		↑		↑		↑					↑					↑		↑					
150	↑		↑		↑		↑					↑					↑	↑	↑					
200	↑			↑	↑			↑					↑				↑	↑	↑					
250	↑			↑	↑			↑						↑			↑	↑	↑					
300	↑			↑	↑			↑							↑		↑	↑	↑	↑				
350	↑			↑	↑			↑						↑	↑		↑	↑	↑	↑				
400	↑			↑	↑			↑								↑					↑			

The arrow pointing up indicates that the switch position is on; other off.

The above table values are for reference only. In practice, due to the difference in liquid viscosity and gas density, it should be adjusted near this value. When the frequency is low, k3 can be adjusted to one to three levels in the direction of large diameter. When the frequency is high, k2 can be adjusted to one to three levels in the direction of small diameter.

VT3WE Three-wire Vortex flowmeter connection reference Figure





VT2WE Two-wire Vortex flowmeter connection reference Figure

Two-wire system temperature and pressure compensation type

3.1. Flow meter working interface

The working interface of the flow meter includes two interfaces, one is the main interface and the other is the auxiliary interface. As shown in figure:

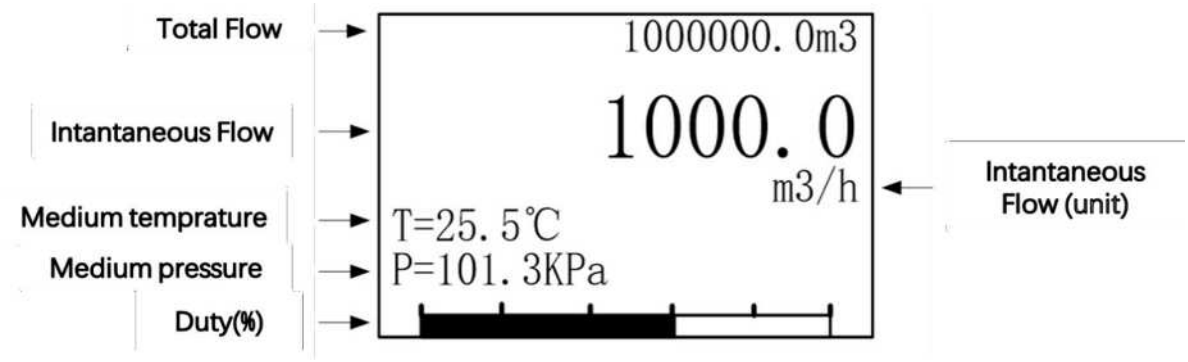


Figure 1 main working interface

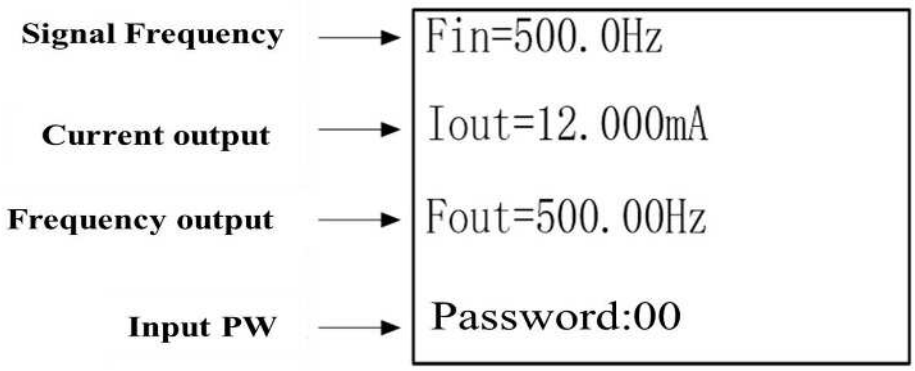


Figure 2 auxiliary working interface

Switch between the main interface and the auxiliary interface by pressing
The '+/s' left button and the '</e' right button.
Left key is + and next page, long press +/s one second to exit.
Right key < and page up, long press </e one second to enter and confirm.

In the auxiliary interface, long press the '</e' right key to enter the password input state. The user can press the '+/s' key to select the password number needed for the current input position, and press the '</e' key to move the input cursor position.after typing 2 passwords, long press '</e' to enter the function setting menu corresponding to the password;in the password input state, long press the '+/s' key to return to the auxiliary interface and the display metering value.

About the refresh rate of the main work interface and the auxiliary interface. In the engineer menu, there is the setting item of "Ambient temperature". If -10℃ is selected, it will be refreshed once every cycle (about 2 seconds).if -20℃ is selected, the main interface will be refreshed every four computing cycles (about 8 seconds), and the auxiliary interface will be refreshed every two computing cycles (about 4 seconds).

3.2. Flow meter parameter setting menu:

The flow meter menu includes user menu, engineer menu and manufacturing menu. Among them, the engineer menu must have professional knowledge of the operator to set the menu content.the production and manufacturing menu is set and calibrated by the factory when the flow meter goes out. Only when there is corresponding equipment can this kind of parameter setting be modified after leaving the factory, otherwise the flow meter will be wrong or invalid!
In the menu, long press the '< /e' key to enter the state of parameter modification of

the selected item. If it is a parameter of numeric input type, enter the number through the '+/s' key, and '< /e' key to move the input cursor position.if the parameter is a selector type, then '+/s' or '< /e' can be used to scroll down the selection item. After selecting the content, long press the '< /e' key to confirm, and the transmitter will automatically update the setting parameter and store it.

3.2.1.The user menu:

Under the password input state of the auxiliary interface, enter "22" Password to enter the user menu. The structure of the user menu is as shown in the figure below. The functions and parameter meanings of each menu are shown in the following table:

Number	Menu display	Meaning	Selection or numeric range
1	Q unit **M3/h**	Flow unit selection (default 0)	0: **M^3/h** algorithm 2 1: **M^3/m** automatically add n 2: **L/h** 3: **L/m** 4: **T/h** 5: **T/m** 6: **Kg/h** 7: **Kg/m**
2	Q mode **Qvw actual**	Algorithm to choose (default 0)	0: **Qvw actual** actual volume flow (non-gas or liquid) 1: **Qm[dw]** mass flow (working condition density) 2: **Qvn[@tnpn]** Standard gas volume flow 3: **Qmg[dn@tnpn]** mass flow Of gas (standard density) 4:**Qm steam[t]** steam Temperature compensation 5: **Qm steam[p]** steam Pressure compensation 6: **Qm steam[t&p]** temperature And pressure compensation Of superheated steam **7: Special mode (for user customization)**
3	Q factor K [p/m3]	Flow factor (default 3600)	Set the flow coefficient of the instrument, not to be 0

	Xxx. Xxxxxxx		
4	Density [kg/m3] **Xxxx. Xxxx**	Density is set (default 1000)	This must be set for algorithms 1 and 3 The unit is kg/m3, not 0
5	Q20ma M3/h **Xxxxx. Xx**	Full output flow (default 1000)	The value must be set And must not be 0, Units are the same as flow units
6	Q cut-zero [%] **Xx. X**	Set the percent of cut flow and full flow	The value is between 0 and 20, And the default is 1.0 %
7	Q up al M3/h **Xxxxx. Xx**	Upper limit alarm flow (default 990.0)	You don't have to set it, It's usually not 0, Units are the same as flow units
8	Q dn al M3/h **Xxxxx. Xx**	Lower limit alarm flow (default 10.0)	You don't have to set it, It's usually not 0, Units are the same as flow units
9	Damp s [s] **Xx**	Output current Damping time (default is 4s)	The damping time is to avoid large fluctuation of output current and frequency shown The range of 2 ~ 32
10	Hart address (0-15) **0**	Set the hart Communication, Address	Range from 0 to 15 (default 0)
11	Clear q **Enter** Password xx	Zero clearing cumulative quantity	To clear the cumulative value, Enter, password 70, And press the "E" Key

Table 1 user menu parameter description

3.2.2.Engineer menu:

In the password input mode of the auxiliary interface, enter "**33**" Password into the engineer menu.

The functions of each menu are as follows:

Number	Function	Instructions
1	Language **English**	Set menu display language (default 0) English 1: Engilish
2	Pulse type **F_bas**	According to the requirements, select the output type as **F_bas/f_adj/f_out/pulse/h-al/l-al** Signal frequency/calibration frequency/line frequency output/ Equivalent pulse/upper limit alarm/lower limit alarm

		Initial calibration should be selected signal frequency, correction output: Calibration frequency/ line frequency output.
3	Pulse factor **0. 01**	Valid for pulse output only, the meaning is how many units Of cumulative flow per pulse represent
4	P_display **Measure**	Set the display fluid pressure mode: **Measure/default/calculate/off** If set to **off**, The fluid pressure term is not displayed in the main interface
5	Set pc Pc ≡ [kpa] **0. 00**	When selected as default or when the pressure measurement is greater than 2 times the range Use this default pressure to display the identity and calculate
6	P0-ref P0 = [kpa] **101. 325**	The reference pressure of the absolute pressure sensor is **0** When the gauge pressure sensor, the reference pressure is the local atmospheric pressure, unit kpa
7	T_display **Measure**	Set the display fluid temperature mode: **Measure/default/calculate/off** if set to **off**, The fluid temperature term is not displayed in the main interface
8	Set tc Tc ≡ [℃] **20. 00**	When the default is selected or platinum resistance off Use this default temperature to display the identity and calculate
9	T-type **Pt = 100**	Pt100 and pt1000 platinum resistance type selection And to change the temperature of the board jumper, Pt100 **double jumper** are short
10	Tn [℃] **0.0 ℃**	Choose different system with a scale temperature value of 0/20, In degrees celsiusgenerally, The natural gas industry uses 20℃ and the others use 0℃
11	Environ-t	Set "-10℃" For normal display ;when the low temperature Environment set "-20℃", the displayed in 4cycles (about 8 seconds), and the refresh will be slow

	-10℃	
12 12 a - 12 j	Q-adj Ci qi (%) *Q-percent* *q-fac* *Q0[%]-(c0=1.00)* *c0-(q0=15.00%0)* ***15.00*** ***1.00***	Flow percentage qi range 0~120%; flow coefficient Ci range 0.8~1.2 (ci= standard flow/measured flow) Note: 5 point correction, when making the traffic correction Each percentage point increases, and can only occur once, Ci default to 1.0

Form 2 function description of engineer menu

4.The hart communication

The transmitter supports two-wire 4~20ma instrument to communicate with hart general commands listed in the following table.

The command	Action object	Parameter meaning	Instructions
0	Read transmitter information	Transmitter information	There is no
1	Read transmitter master variable	Flow unit + flow value	There is no
2	Read output current and percentage	Output current + flow percentage	There is no
3	Read output current and dynamic variables	Current + instantaneous flow + frequency + low cumulant + high cumulant	The last four dimensions have units
11	Read transmitter	Transmitter information	There is no

	information		
12	Read transmitter information	Transmitter message	Custom content can be written from command no. 17
13	Read transmitter information	Transmitter information (tag+description +date)	Custom content can be written by command no. 18
14	Read sensor information	Sensor information	There is no
15	Read the limit and the damping	Unit of flow + full flow + removal flow + damping	There is no
16	Read transmitter information	Transmitter information (fan)	Custom content can be written by command no. 19
17	Write transmitter information	Transmitter message	After writing, the validation can be read through command 12
18	Write transmitter information	Transmitter information (tag+description +date)	After writing, the validation can be read through command 13
19	Write transmitter information	Transmitter information (fan)	After writing, the validation can be read through command 16
34	Modify the damping	Damping	There is no
35	Modify the limits and units	Unit + full discharge + removal discharge	There is no
40	The output current	Output current value (4~20ma range)	Execution of this command immediately outputs the specified current value
44	Modify the unit	Flow unit	There is no
45	Calibrate 4ma current	The current value of the transmitter output as measured by a precision ammeter	First, command no. 40 is used to output 4ma current. Then, the actual output value is measured

46	Calibrate the current output from the transmitter measured on the 20ma ammeter	First take command 40, output 20ma current,	Then measure the actual output value and use this command for calibration
110	Read the extension dynamic variable	Transmitter expansion dynamic variable (temperature + pressure)	The first variable is temperature; the second variable is pressure

Table 2 transmitter hart command

See hart spec v5 above for details and definitions of the hart command.

5.Setting of analog amplifying filter circuit:

Reference table for parameter setting of vortex flow meter amplifier (liquid)

Dn	Charge amplification k1								The upper limit k2								The lower limit k3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
15	↑		↑		↑		↑						↑						↑					
20	↑		↑		↑		↑							↑			↑	↑	↑					
25	↑		↑		↑		↑							↑						↑				
40	↑	↑	↑		↑	↑	↑								↑		↑	↑	↑	↑				
50	↑	↑	↑		↑	↑	↑								↑						↑			
80	↑	↑	↑		↑	↑	↑								↑					↑	↑			
100	↑	↑	↑		↑	↑	↑								↑							↑		
125	↑	↑	↑		↑	↑	↑							↑	↑								↑	
150	↑	↑	↑		↑	↑	↑							↑	↑							↑	↑	
200				↑				↑					↑	↑	↑						↑	↑	↑	
250				↑				↑					↑	↑	↑						↑	↑	↑	
300				↑				↑								↑								↑
350			↑	↑			↑	↑							↑	↑						↑	↑	↑

10m /180p/390p/680p//10m /180p/390p/680p 1539/723/328.4/153/72.4/32.8/15.9/7.2hz **159/72.4/33.8/15.9/7.24/3.39/1.6/0.7**hz

Parameters setting of vortex flow meter amplifier refer to table (gas)

Dn	Charge amplification k1								The upper limit k2								The lower limit k3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
15	↑	↑			↑	↑			↑								↑							
20	↑	↑			↑	↑			↑								↑							
25	↑	↑			↑	↑				↑								↑						
40	↑		↑		↑		↑			↑	↑						↑	↑						
50	↑		↑		↑		↑			↑	↑								↑					
80	↑		↑		↑		↑				↑	↑						↑	↑					
100	↑		↑		↑		↑				↑	↑					↑	↑	↑					
125	↑		↑		↑		↑						↑				↑	↑	↑					
150	↑		↑		↑		↑						↑							↑				
200	↑	↑	↑		↑	↑	↑							↑						↑				
250	↑	↑	↑		↑	↑	↑						↑	↑			↑	↑	↑	↑				
300				↑				↑							↑						↑			
350				↑				↑						↑	↑						↑			

10m /180p/390p/680p//10m /180p/390p/680p 1539/723/328.4/153/72.4/32.8/15.9/7.2hz **159/72.4/33.8/15.9/7.24/3.39/1.6/0.7**hz

The arrow up indicates that the switch position is on, and the switch without the arrow is off.**usually the lower frequency is first determined by the switch 2*k3 value**

Normally the gain gb=6(adjusted between 2-14); trigger sensitivity sb=4 (adjusted between 2 and 8).

The above table values are for reference only. In actual use, due to the difference in liquid viscosity and gas density, it should be adjusted around this value. When the frequency is low, k2/k3 can be increased synchronously or adjusted to one to three levels in the direction of large diameter.**when the frequency is high, the k2/k3 can be synchronously reduced or to the direction of small diameter to adjust one to three.**

K2 is in the same place as k3, scale over 1/10. K2 is one bit higher than k3, and the range is 1/5. The band can only be moved and compressed, and cannot be widened.

Attachment: Troubleshooting

1） Conventional volume flow rate and conventional gas mass flow rate in algorithm selection:

In the algorithm, the conventional volume flow rate refers to the uncompensated flow rate, which is used for liquid or uncompensated gas. The volume flow rate of standard gas is calculated by gaseous equation, while the mass flow rate of conventional gas is calculated by standard volume multiplied by standard density.

2） Flow correction coefficient:

In the flow calculation according to the basic formula to calculate the flow condition of the first times the flow correction coefficient to calculate the correction. The correction coefficient is usually set as the percentage of the target relative to the full-degree flow. Correction coefficient c= standard flow/measured flow value without correction. The points are interpolated linearly. Without correction, c=1, and the value of correction is limited to the range of 0.8-1.2.

3） Pulse output type and usage:

The signal pulse in the pulse output type is to track the output of the original signal pulse and is usually used for initial calibration. Calibration frequency is used for frequency output after multi - segment polyline correction. The frequency output is the instantaneous linear output of 0-1000hz, and the output frequency is 1000hz at full discharge. The correction coefficient c value linear correction and compensation calculation are effective for the frequency output, which is usually used for the corrected output. The pulse output is calculated according to the cumulative flow, and there are maximum and minimum limits on the output value of each calculation period.

4） Pulse equivalent:

The pulse equivalent is the output factor and its value is the flow unit/pulse. That is, how many units of flow does each pulse represent? Its value must be kept within 1000 pulses per measurement period.

5） Temperature and pressure calibration during production and maintenance:

For temperature calibration, there should be a standard resistance box or a standard resistance corresponding to the calibration value. After the resistance is connected to the corresponding menu, press "E" Key to confirm. If the value is normal, confirm again to save it. For modification, press "+" To change the confirmation prompt to "E" To save after modification. Pt100 temperature double jumper should be short-circuited. Pt1000 temperature double jumper should be disconnected.

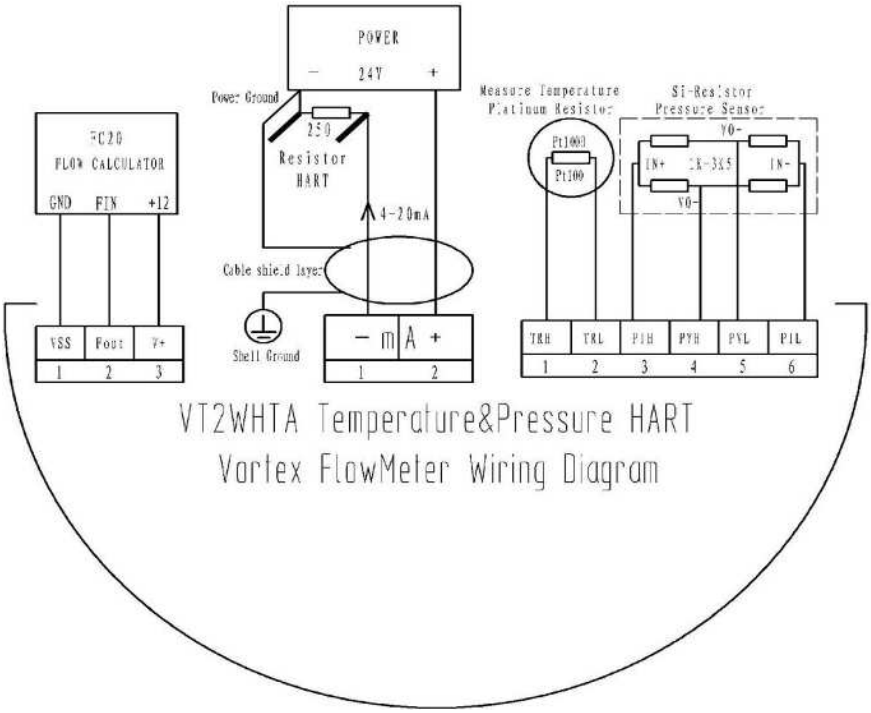
6） Calibration of output current:

For the calibration of output current, the standard ammeter shall be connected in series to the current loop. After the corresponding 4/12/20ma item is confirmed by pressing the "E" Key, the

current output of approximate value shall be obtained. At this time, the calibration will be completed after the actual display value of ammeter is input and confirmed. Usually three calibration points should be carried out each time.

7） Usage of hart:

Hart should be used to connect the manual operator to the 250 ohm sampling resistance in the current loop, the resistance value deviation of more than 20% or the zero current lower than 3.9ma may cause hart communication failure. In particular, the zero current should not be lower than 3.9ma when adjusting the current.



2-wire wire circuit wiring diagram

Three-wire system temperature and pressure compensation type

1. Circuit wiring

（1） Main power supply and output signal terminal (middle 4-bit large hanging frame terminal)

Iout	Gnd	Fout	V +

"Iout" : Is 4~20ma current output + terminal.flow from the output current iout flowed to the computer or display table of 10-250 ω sampling resistor, after sampling resistance and negative class, flow back to the power supply "-" Side.

"Gnd" : Connect 12-24v power "-"End.

"Fout" : Is the output end of the pulse signal.the output of the flow-related pulse signal is an npn open collector output containing 2k pull-up resistance.the high level is the power supply voltage of -1v, and the low level is less than 0.5v.namely the vh = vi-1; vl < 0.5 v.

"V+" : Connect the "+" End of 12-24v power supply.

（2） Left communication line (2-bit low-end sub)

B -	A +

"B-" : Connect to the "B-" End of 485 communication."A+" : Connect the "A+" End of 485 communication.

（3） Right temperature-voltage connection (6-bit low-end sub)

Trh	Trl	Pih	Pvh	Pvl	Pil

Trh and trl are connected to the ends of pt100 or pt1000 platinum resistance.

Select pt100 or pt1000 from the engineer menu in "33" For internal software.

Pressure transmitter can be connected when both jumper wires are on the left "Ma" :

At this time, the main terminal "V+" Leads the line to the "+" End of the pressure transmitter, and the "-" End of the pressure transmitter is connected to pvh.

Pressure sensor can be connected when both jumper wires are on the right "R-b" :

Pih and pil's 200ua constant current source is divided into in + and in - of the pressure sensor; mv outputs vo+ and vo- of pvh and pvl splitter pressure sensing. Normally, a silicon piezoresistive sensor is used, which requires the equivalent resistance of the bridge to be less than 3k5 and the sensitivity to be greater than 25mv/ma.

Lower battery connection (2-bit low-end sub)

- 3 v6	3 v6 +

"-3v6: Connect the 3.6v lithium battery" - "End".

"3v6+" : Connect 3.6v lithium battery "+" Terminal.

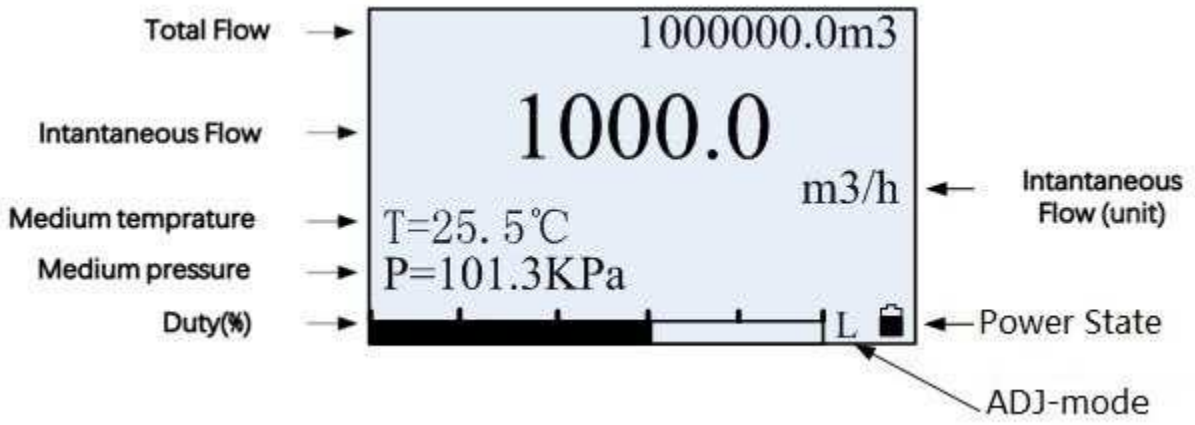
Generally, 3.6v 2# lithium battery is used, and the power consumption of the battery is less than 0.7ma (no 485); at 485, the power consumption is increased by 0.2-0.5ma. A 7ah # 2 lithium battery can last more than a year.the nearby switch only controls whether the 3.6v lithium battery supplies power to the circuit. When "On" Is connected to the circuit, "Off" Cuts off the passage between the battery and the circuit. The external power supply connected to the battery and v+ can be automatically converted by double power supply.automatically cut off the current and pulse output signal when the battery is supplied, and automatically resume output when there is external electricity.

485 communication is allowed when the battery is powered, but it is recommended to increase the communication interval in order to save power.

2. Flow meter working interface

The working interface of the flow meter includes two interfaces, one is the main interface and the other is the auxiliary interface.as shown in figure:

Figure 1 main working interface



Signal comparison mode:

L= low region 0-1/4; 1/4-1/2 h = high area

S= narrow = 5%; m= medium = 10% of filter noise; w= width = 15% of filter noise; n: N = closed.

The "Plug" Pattern in the power supply mode indicates that the current power supply is provided;display the "Battery" Pattern to indicate the current battery power supply

When t temperature and p pressure are shown as "=", it means that the current temperature and pressure are measured values.

When t temperature and p pressure are shown as "≡" After means that the current temperature and pressure are exceeded when measured, the default is used

Set the value, pay attention to the need to troubleshoot whether the sensor is abnormal!

When the t temperature identity is "Tu≡", it means the upper limit of the measurement temperature exceeding 500 degrees. At this time, the temperature is fixed to the setting value of "Default temperature" In the engineer menu.when t

temperature's identity scale is "Td≡", it indicates the lower limit of the measurement temperature exceeding -200 degrees, and then the temperature is fixed to the setting value of "Default temperature" In the engineer's menu.

When the pressure identity of p is "Pd≡", the measured pressure is lower than -101.3kpa. At this point, the pressure is fixed to the "Default pressure" Setting in the engineer menu.when the pressure identity scale of p is "Pu≡", it means that the measuring pressure exceeds the upper limit by one times the measuring range (the range is the difference between the upper limit of pressure and the lower limit of pressure), then the pressure is fixed to the setting value of "Default pressure" In the engineer menu.

When t temperature or p pressure is "≈", it is the calculated value of reverse-extrapolation showing that the temperature or pressure is steam.

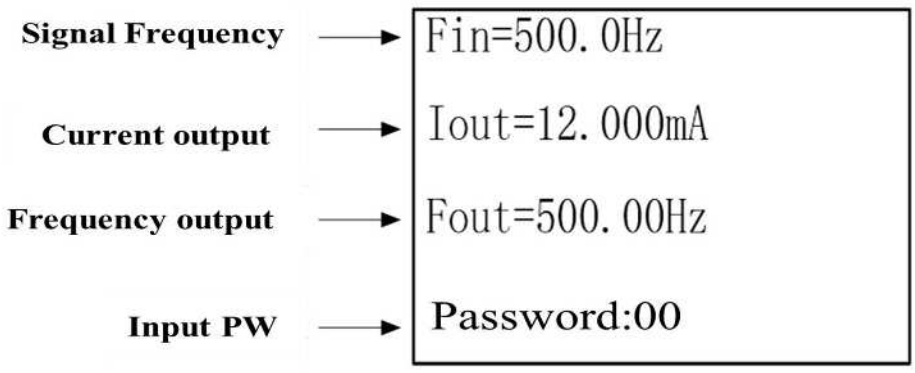


Figure 2 auxiliary working interface

In the auxiliary interface, different names of signal frequency lines represent different running states

- ✧ Fin - normal signal frequency
- ✧ Fincv - the signal amplitude is weak, the output is cut, and the flow is not calculated
- ✧ Finc5 - the signal belongs to 50hz noise, the output is cut out, and the flow is not calculated
- ✧ Finfl - the signal is below the band range and the output is cut out
- ✧ Finfh - the signal is higher than the band range and the output is cut off
- ✧ Finsl - the signal wave number is too low, the output is cut, the flow is

not calculated

- ✧ Finsm - the signal waves through the clutter, the output is cut off, the flow is not calculated
- ✧ Fincs - the signal feature belongs to the noise, the output is cut off, and the flow is not calculated

In the auxiliary interface, different names of output frequency lines represent different output states

- ✧ F_bas - basic signal output, according to the measured signal frequency output
- ✧ F_adj - calibration output, calibration output by multi-point k value detailed algorithm see the following section
- ✧ F_out - frequency output. According to the measured signal, calculate the output signal of a certain frequency.
- ✧ Signal frequency = (instantaneous flow/full flow) * 1000 (hz)
- ✧ Pulse - pulse output, the number of output pulses calculated according to the "Pulse factor" In the menu
- ✧ H-al=0 -high alarm is not generated; h-al=1 - high alarm is generated
- ✧ L-al =0 - low alarm has not been generated; l-al=1 - low alarm is generated
- ✧ No - the current output is invalid

In the auxiliary interface, the value after the output current, in the power supply mode, is the actual output current value; fixed display 0.0 in battery power mode (because there is no current output)

Switch between the main interface and the auxiliary interface by pressing the '+/s' left button and the '</e' right button.

Left key is + and next page, long press s to exit. Right-click < and pageup, long press e to enter and confirm.

In the auxiliary interface, long press the '</e' left key to enter the password input state.the user can continue to press the '+/s' key to select the password number needed for the current input position, and press the '</e' key to move the input cursor position.after typing 2 passwords, long press '</e' to enter the function setting menu corresponding to the password;in the password input state, long press the '+/s' key to return to the auxiliary interface and continue to update the display metering value.

About the refresh rate of the main work interface and the auxiliary work interface. In the engineer menu, there is the setting item of "Ambient temperature". In the power-supply mode, if selected"**-10℃"**, it will refresh once every 1.2 seconds. If selected"**-20℃"**, refresh every 8 seconds; **in battery mode, refresh every 4 seconds.**

3.Flow meter parameter setting menu

The flow meter menu includes user menu, engineer menu, manufacture menu and setup menu.among them, the engineer menu must have professional knowledge of the operator to set the menu content.

The setting menu and the manufacturing menu are set and calibrated by the factory when the flow meter goes out. Only when there is the Corresponding equipment can the parameter setting be modified, Otherwise the flow meter will be wrong or invalid!

In the menu, long press the '< /e' key to enter the state of parameter modification of the selected item. If it is a parameter of numeric input type, enter the number through the '+/s' key, and '< /e' key to move the input cursor position.if the parameter is a selector type, then '+/s' or '< /e' can be used to scroll down the selection item. After selecting the content, long press the '< /e' key to confirm, and the transmitter will automatically update the setting parameter and store it.

Enter the password "61" To check the version number.

3.1.The user menu

Enter the password "22" To enter the user menu.

The functions and parameters of each menu are as follows

Serial number	The name of the menu	Functional specifications
1	Q unit **M3/h**	Set the instantaneous flow unit and select it according to the type of flow algorithm Optional: Volume: M3/h; m3/m; l/h; l/m Quality: T/h; t/m; kg/h; kg/m
2	Q mode **Qvw actual**	0: **Qvw actual** actual volume flow (non-gas or liquid) 1: **Qm[dw]** mass flow(working condition density) 2: **Qvn[@tnpn]** standard gas volume flow 3: **Qmg[dn@tnpn]** mass flow Of gas (standard density) 4:**Qm steam[t]** steam temperature compensation 5: **Qm steam[p]** steam pressure compensation 6: **Qm steam[t&p]** temperature and pressure Compensation of superheated steam **7: Special mode (for user customization)**
3	Q factor K [p/m3] **Xxx. Xxxxxxxx**	The flow meter coefficient required to calculate the flow. **The default is:3600.0, not to be 0;** The unit is p/m3, (pulse / m3)
4	Density [kg/m3] **Xxxx. Xxxx**	Suppose the density value of the fluid, **The default is: 1000.0** unit kg/m3 (0 is not allowed)
5	Q20ma M3/h **Xxxxxx. Xx**	Set the instantaneous flow corresponding to the 20ma current output (not allowed to be set to 0). **The default is: 1000.0** The units are the same as those selected in the unit selection
6	Q cut-zero [%] **Xx. X**	The percentage of the cutting flow in the full-degree flow is set. When the measured flow is lower than this percentage value, the calculated flow is 0 and the 4ma current is output. **Default is: 0%**
7	Q up al M3/h **Xxxxxx. Xx**	Set the upper limit of alarm flow threshold, when the flow is higher than this value, the output alarm.the unit is the same as The selected unit. **The default value is: 990.0**
8	Q dn al M3/h **Xxxxxx. Xx**	Set the lower limit of alarm flow threshold, when the flow is lower than this value, the output alarm.the unit is the same as The selected unit. **The default value is: 10.0**
9	Damp s [s]	Value of 2~32 seconds for display and current output smoothing. **The default value is: 4 seconds**

	Xx	
10	Comm address **0**	Set the device address of the 485modbus. The default value of range 0-254 is: **0**
11	Clear q **Enter** Password xx	Clear the accumulative amount to 0 value, And the zeroing password is: "70"

3.2.Engineer menu: Enter "33" Password to enter the engineer menu.

The functions and parameter meanings of each menu are as follows:

Serial number	The name of the menu	Functional specifications
1	Language English	Set the instrument language type. Optional: Chinese; english **default: Chinese**
2	Pulse type **F_bas**	Select the output type according to the requirements, each output detail key main interface explanation. Optional: **F_bas:** The signal frequency of the measuring sensor (unmodified) **F_adj:** Frequency output after correction by 5 point coefficient **F_out:** Output linear frequency of 0-1000hz according to flow range **Pulse:** Accumulates the pulse with output flow of selected pulse factor **H-al:** Press the upper limit of alarm to output the signal of alarm switch **L-al:** Press lower limit to output alarm switch signal
3	Pulse factor **0.01**	Valid only for equivalent pulse outputs, meaning how many cumulative flow units per pulse represents. Optional: **0.00001; 0.0001; 0.001; 0.01; 0.1; 1.0; 10.0; 100.0**
4	Comm param **9600,no**	Set 485 modbus communication baud rate. Optional: 4800odd; 4800even; 4800no; 9600odd; 9600even; **9600no**;
5	Comm switch **On**	Set whether modbus communication function is enabled. Optional: **Off;** on
6	P_display **Measure**	Sets whether the fluid pressure is displayed. Optional: **Measure:** Shows the pressure value by the measured pressure

		signal **Deft:** "P≡" Displays the value of the default pressure item set in the following menu and is used for calculation **Calculate:** "P≈" Shows the pressure of the calculated value, when the temperature of saturated steam is compensated **Off:** No pressure item is displayed
7	Set pc Pc≡[kpa] **0.00**	Set the default calculated value of gas pressure in kpa. When the sensor fault is selected as the default or when the pressure is measured (when the pressure is over 2 times the range), the equivalent after the home screen p is calculated with this pressure.
8	P0-ref P0=[kpa] **101.32**	Set the pressure value at the reference end, which is used for the high-altitude correction when the gauge pressure sensor calculates the absolute pressure. The absolute pressure sensor should be set to 0.0kpa
9	T_display **Measure**	Sets whether the fluid temperature is displayed. Optional: **Measure:** Shows the temperature value calculated from the measured platinum resistance signal **Def:** "T ≡" Displays the value of the default temperature item set in the following menu and is used for calculation **Calculate:** "P≈" Shows the temperature of the calculated value of the backward calculation when the saturated steam pressure is compensated **Off:** No temperature is displayed
10	**Set tc** **Tc≡[℃]** **20℃**	Select to set or measure platinum resistance fault (greater than) with this temperature calculation, the main screen t changed to the identity number display 500℃.the unit is ℃
11	**T-type** **Pt=1000**	Choose the type of resistance to measure the temperature. Optional: Pt=100**;** **pt = 1000**
12	**Tn** **[℃]** **0.0 ℃**	Set the calculation value of the standard temperature. Optional: **0℃;** 20℃
13	**Environ-t** **-10℃**	For different environments to select the lcd refresh rate. Optional: **-10℃:** When"**-10℃**"Is selected in normal environment, the working interface will refresh every 1.2 seconds **-20℃:** When the low temperature environment is set"**-20℃**", the working interface will refresh every 6 seconds
14 14a	Q-adj Ci qi (%)	Flow percentage qi range 0~120%; flow coefficient Ci range 0.8~1.2 (ci= standard flow/measured flow)

- 14 j	*Q-percent q-fac* *Q0[%]-(c0=x)c0-(q0=x)* ***15.00 1.00***	Note: 5 point correction, when making the traffic correction Each percentage point increases, and can only occur once, Ci default to 1.0

Form 2 function description of engineer menu

4.Modbus communication

According to modbus-rtu communication protocol, the three-wire transmitter can quickly read the operation parameters in the maintenance register.the modbus command, which only reads and maintains register values, is command no.3.only 4800 and 9600 baud rates are supported, and the response time is within 50ms.

Modbus continuous command interval minimum 100ms;

Table 5 is the offset address and data format of each value in the modbus command

Address offset	Action object	The data format	Number of data bytes
0	The instantaneous flow	Floating point types	4
4	Flow at working condition	Floating point types	4
8	Accumulator low	Integer types	4
12	Accumulative high	Integer types	4
16	The fluid temperature	Floating point types	4
20	Fluid pressure	Floating point types	4
24	Measure the frequency	Floating point types	4
28	The output current	Floating point types	4
32	Instantaneous flow unit sequence code	Short integer type	2

Table 5 transmitter modbus read hold register command resolution

On cumulant: The cumulant consists of high and low parts. The low part of the cumulant is a fixed-point integer. After the data is converted to base 10, the high part of the cumulant is the integer value of the cumulant divided by the quotient of 1000,000.the calculation formula is: Cumulant (floating-64bit) = high cumulant (integer) * 1000000.0 + low cumulant (integer) / 1000.0

The accumulative flow unit is the instantaneous flow unit.

As for the flow unit code, the flow unit is the physical unit obtained by matching the sequence code value of the flow unit with the following table.

Code	0	1	2	3	4	5	6	7
Units	M3 / h	M3 / m	L/h	L/m	T/h	T/m	Kg/h.	Kg/m

Table 6 instantaneous flow unit code table

For details of modbus command and message format, please refer to protocol specification such as modbus white paper.

Test point tp0-tp3:

Tp3	Tp2	Tp1	Tp0
After hard to trigger	After filtering	Signal amplifed	Gnd

Oscilloscope can be used to observe the signal between tp3-tp1 and tp0=gnd or on the circuit board.

The pre-stage amplification waveform was observed at the test point tp1, the waveform after the hardware filtering was observed at tp2, and the square wave output from the hardware was observed at tp3. Each measurement point was only for observation and testing, and the important one was the tp2 waveform.note that the final output produced by the software will be different from tp3.the final output can be affected by changing the settings in "33"And"44".

5.Setting of vt3w analog amplifier filter circuit

Reference table for parameter setting of vortex flow meter amplifier (liquid)

Dn	Charge amplification k1								The upper limit k2								The lower limit k3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
15	↑		↑		↑		↑						↑						↑					
20	↑		↑		↑		↑							↑			↑	↑	↑					
25	↑		↑		↑		↑							↑						↑				
40	↑	↑	↑		↑	↑	↑								↑		↑	↑	↑	↑				
50	↑	↑	↑		↑	↑	↑								↑						↑			
80	↑	↑	↑		↑	↑	↑								↑					↑	↑			
100	↑	↑	↑		↑	↑	↑								↑							↑		
125	↑	↑	↑		↑	↑	↑							↑	↑								↑	
150	↑	↑	↑		↑	↑	↑							↑	↑							↑	↑	
200				↑				↑					↑	↑	↑						↑	↑	↑	
250				↑				↑					↑	↑	↑						↑	↑	↑	
300				↑				↑								↑								↑
350			↑	↑			↑	↑							↑	↑						↑	↑	↑

10m /180p/390p/680p//10m /180p/390p/680p 1539/723/328.4/153/72.4/32.8/15.9/7.2hz **159/72.4/33.8/15.9/7.24/3.39/1.6/0.7**hz

Parameters setting of vortex flow meter amplifier refer to table (gas)

Dn	Charge amplification k1								The upper limit k2								The lower limit k3							
Mm	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
15	↑	↑			↑	↑			↑								↑							
20	↑	↑			↑	↑			↑								↑							
25	↑	↑			↑	↑				↑								↑						
40	↑		↑		↑		↑			↑	↑						↑	↑						
50	↑		↑		↑		↑			↑	↑								↑					
80	↑		↑		↑		↑				↑	↑						↑	↑					
100	↑		↑		↑		↑				↑	↑					↑	↑	↑					
125	↑		↑		↑		↑						↑				↑	↑	↑					
150	↑		↑		↑		↑						↑							↑				
200	↑	↑	↑		↑	↑	↑							↑						↑				
250	↑	↑	↑		↑	↑	↑						↑	↑			↑	↑	↑	↑				
300				↑				↑							↑						↑			
350				↑				↑						↑	↑						↑			

10m /180p/390p/680p//10m /180p/390p/680p 1539/723/328.4/153/72.4/32.8/15.9/7.2hz **159/72.4/33.8/15.9/7.24/3.39/1.6/0.7**hz

The arrow up indicates that the switch position is on, and the switch without the arrow is off.

Usually the lower frequency is first determined by the switch k3 value

Normally the gain gb=7(adjusted between 1-14);trigger sensitivity sb=4 (adjusted between 2 and 8).

The above table values are for reference only. In actual use, due to the difference in liquid viscosity and gas density, it should be adjusted around this value. When the frequency is low, k2/k3 can be increased synchronously or adjusted to one to three levels in the direction of large diameter.

When the frequency is high, the k2/k3 can be synchronously reduced or to the direction of small diameter to adjust one to three.

K2 is in the same place as k3, scale over 1/10. K2 is one bit higher than k3, and the range is 1/5. The band can only be moved and compressed, and cannot be widened.

Common settings in the "44" Menu:

1） Common settings in the "44" Settings menu

Project:	**Work type**	**An-noise type**	**Signal -adj-set**	**50 hz cut**	**K-line adj**
Usually	**Manual**	**Na-standard**	**Off**	**On**	**Off**
Optional	Ds-digital	Ans-antinoise		Off	On

When the signal is normal, the manual mode has better real-time performance. When the signal is bad, the gain can be adjusted to increase the k2k3 filter and the digital mode can be tried.

The lower limit of the standard mode is low, and the anti-noise can be tried in ds-digital mode when the interference and vibration are large.

Usually cut 50hz power frequency interference.

Only in the case of normal flow error can be set to cut 50hz as off, not cut 50hz.

2） In the "44" Setting menu, gas application settings for each caliber：
(steam usually increases the frequency band of 1-2 stages)

Dn Mm	Instrument Coefficient K(p/m3)	Signal and gain selection		Vpp limit	Fre-range	
		Signal -type	**Gain**	(mv)	**No.**	**Signal frequency (hz)**
15	340000	Hf	**10**	50	**15**	**96-2400.**
20	150000	Hf	**10**	50	**15**	**96-2400.**
25	76000	Hf	**10**	50	**15**	**96-2400.**
32	31000	Hf	**10**	50	**14**	**64-1600.**
40	18000	Hf	**6**	50	**13**	**52-1300.**

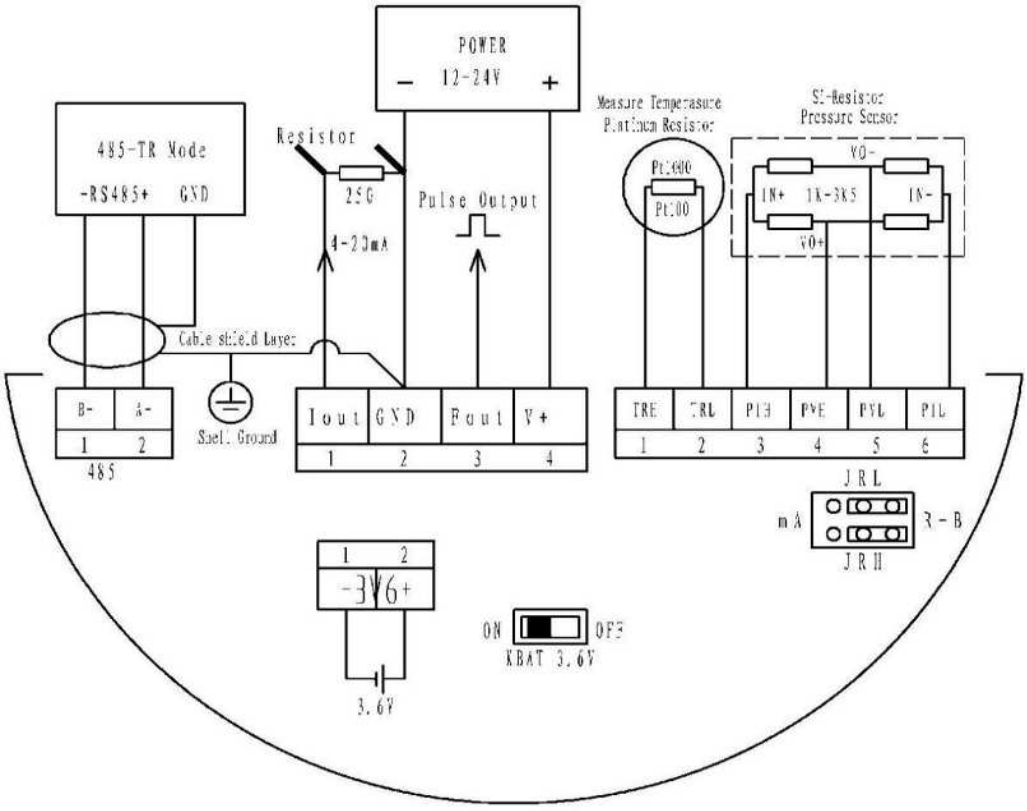
50	9400	Mf	**6**	70	**11**	**34-850.**
65	4300	Mf	**6**	70	**10**	**28-700.**
80	2280	Mf	**6**	100	**9**	**22-550.**
100	1160	Mf	**6**	100	**8**	**18-450.**
125	605	Mf	**8**	100	**8**	**18-450.**
150	340	Mf	**8**	70	**7**	**14-350.**
200	143	Mf	**8**	70	**6**	**11-275.**
250	77.6	Lf	**10**	70	**5**	**8.8-220.**
300	42.8	Lf	**10**	70	**4**	**6.4-160.**
350	26.7	Lf	**13**	70	**3**	**4.8-120.**
400	17.7	Lf	**13**	70	**3**	**4.8-120.**

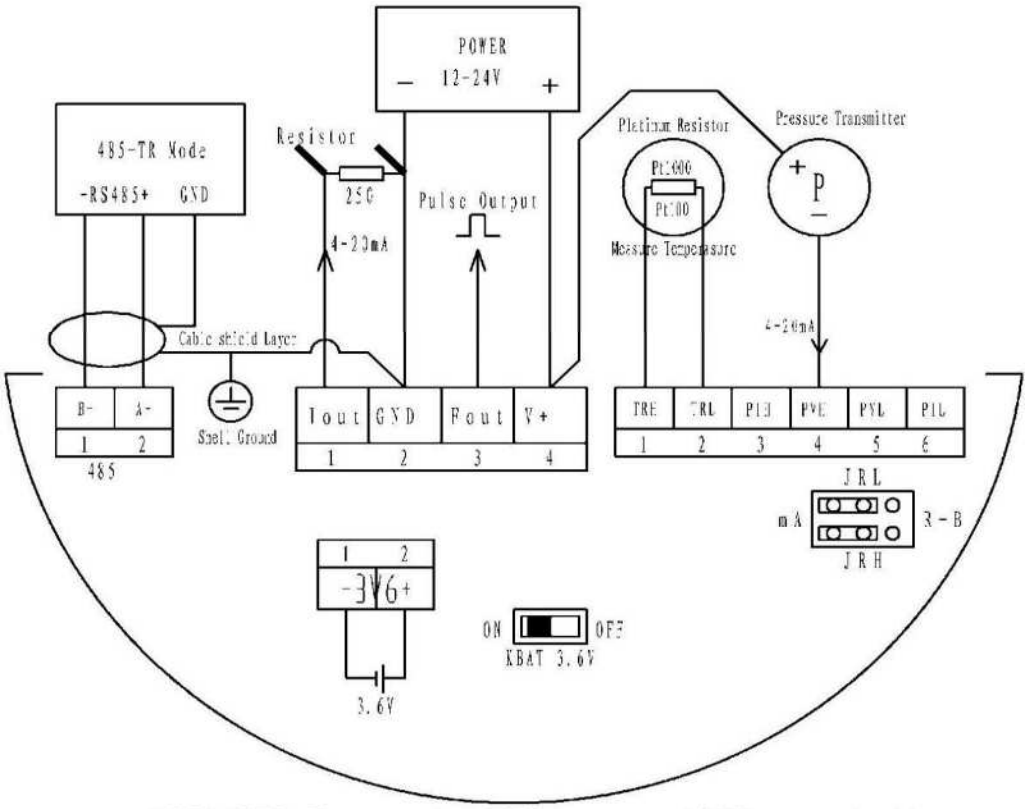
3） In the "44" Setting menu, the application settings of each liquid caliber are as follows:

Dn Mm	Instrument Coefficient K(p/m3)	Signal and gain selection		Vpp limit (mv)	Fre-range	
		Signal -type	**Gain**		**No.**	**Signal frequency (hz)**
15	340000	Mf	**8**	70	**12**	**42-1050.**
20	150000	Mf	**8**	70	**9**	**22-550.**
25	76000	Mf	**8**	70	**7**	**14-350.**
32	31000	Mf	**8**	70	**5**	**8.8-220.**
40	18000	Mf	**6**	70	**5**	**8.8-220.**
50	9400	Lf	**6**	100	**4**	**6.4-160.**
65	4300	Lf	**6**	100	**4**	**6.4-160.**
80	2280	Lf	**6**	100	**3**	**4.8-120.**
100	1160	Lf	**8**	100	**2**	**3.6-90.**
125	605	Lf	**8**	100	**2**	**3.6-90.**
150	340	Lf	**8**	100	**1**	**2.4-65.**
200	143	Lf	**10**	100	**1**	**2.4-65.**
250	77.6	Lf	**10**	70	**0**	**1.6-45**
300	42.8	Lf	**10**	70	**0**	**1.6-45**
350	26.7	Lf	**14**	70	**0**	**1.6-45**
400	17.7	Lf	**14**	70	**0**	**1.6-45**

Qvw actual: F=k*qv/3600, f: Hz; qv: M3 / h; k: P/m3; calculate the working frequency.

Mass flow: F=k*qm/(3.6*d), f: Hz; qm: T/h; d: Kg/m3; k: P/m3; calculate the working frequency.





VT3WCTB Temperature&Pressure 485Communication
Vortex FlowMeter Wiring Diagram

Appendix: Steam density table

Appendix

Appendix I A

Table of comparisons for saturation water-vapor density & platinum resistor-temp

indexing NO.: Pt100 R0=100.00Ω absolute pressure

Tem ℃	Pre bar	Density kg/m^3	Platinum resistor Ω	Tem ℃	Pre bar	Density kg/m^3	Platinum resistor Ω	Tem ℃	Pre bar	Density kg/m^3	Platinum resistor Ω
100	1.1033	0.5997	138.50	138	3.414	1.864	152.83	176	9.137	4.723	166.98
101	1.0500	0.6108	138.88	139	3.513	1.915	153.20	177	9.353	4.829	167.35
102	1.0878	0.6388	139.26	140	3.614	1.967	153.58	178	9.574	4.937	167.72
103	1.1267	0.6601	139.64	141	3.717	2.019	153.95	179	9.798	5.048	168.09
104	1.1668	0.6321	140.02	142	3.823	2.073	154.32	180	10.027	5.160	168.46
105	1.2080	0.7046	140.39	143	3.931	2.129	154.70	181	10.259	5.274	168.83
106	1.2504	0.7277	140.77	144	4.042	2.185	155.07	182	10.496	5.391	169.20
107	1.2941	0.7515	141.15	145	4.155	2.242	155.45	183	10.738	5.509	169.57
108	1.3390	0.7758	141.53	146	4.271	2.301	155.82	184	10.983	5.629	169.94
109	1.3852	0.8008	141.91	147	4.398	2.361	156.19	185	11.233	5.752	170.31
110	1.4327	0.8265	142.29	148	4.510	2.422	156.57	186	11.488	5.877	170.68
111	1.4815	0.8528	142.66	149	4.634	2.484	156.94	187	11.747	6.003	171.05
112	1.5316	0.8798	143.04	150	4.760	2.584	157.31	188	12.010	6.132	171.42
113	1.5832	0.9075	143.42	151	4.889	2.613	157.69	189	12.278	6.264	171.79
114	1.6362	0.9359	143.80	152	5.021	2.679	158.06	190	12.551	6.397	172.16
115	1.6906	0.9650	144.17	153	5.155	2.747	158.43	191	12.829	6.533	172.53
116	1.7465	0.9948	144.55	154	5.293	2.816	158.81	192	13.111	6.671	172.90
117	1.8039	1.025	144.93	155	5.433	2.886	159.18	193	13.398	6.812	173.26
118	1.8628	1.057	145.31	156	5.577	2.958	159.55	194	13.690	6.955	173.63
119	1.9233	1.089	145.68	157	5.732	3.032	159.93	195	13.987	7.100	174.00
120	1.9854	1.122	146.06	158	5.872	3.106	160.30	196	14.298	7.248	174.37
121	2.0492	1.155	146.44	159	6.025	3.182	160.67	197	14.596	7.398	174.74
122	2.1145	1.190	146.81	160	6.181	3.260	161.04	198	14.909	7.551	175.10
123	2.1816	1.225	147.19	161	6.339	3.339	161.42	199	15.226	7.706	175.47
124	2.2504	1.261	147.57	162	6.502	3.420	161.79	200	15.549	7.864	175.84
125	2.3210	1.298	147.94	163	6.667	3.502	162.16	201	15.877	8.025	176.21
126	2.3933	1.336	148.32	164	6.836	3.586	162.53	202	16.210	8.188	176.57
127	2.4675	1.375	148.70	165	7.008	3.671	162.90	203	16.549	8.354	176.94
128	2.5435	1.415	149.07	166	7.183	3.758	163.27	204	16.893	8.522	177.31
129	2.6215	1.455	149.45	167	7.362	3.847	163.65	205	17.243	8.694	177.68
130	2.7013	1.497	149.82	168	7.545	3.937	164.02	206	17.598	8.868	178.04
131	2.7831	1.539	150.20	169	7.731	4.029	164.39	207	17.959	9.045	178.41
132	2.8670	1.583	150.57	170	7.920	4.123	164.76	208	18.326	9.225	178.78
133	2.9528	1.627	150.95	171	8.114	4.218	165.13	209	18.699	9.408	179.14
134	3.0410	1.672	151.33	172	8.311	4.316	165.50	210	19.077	9.593	179.51
135	3.1310	1.719	151.70	173	8.511	4.415	165.87	211	19.462	9.782	179.88
136	3.2230	1.766	152.08	174	8.716	4.515	166.24	212	19.852	9.974	180.24
137	3.3170	1.815	152.45	175	8.924	4.618	166.61	213	20.249	10.17	180.61

Appendix

Appendix I B

Table of comparisons for saturation water-vapor density & platinum resistor-temp

indexing NO.: Pt100 R0=100.00Ω absolute pressure

Tem	Pre	Density	Platinum resistor	Tem	Pre	Density	Platinum resistor	Tem	Pre	Density	Platinum resistor
℃	bar	kg/m^3	Ω	℃	bar	kg/m^3	Ω	℃	bar	kg/m^3	Ω
214	20.651	10.37	180.97	252	41.138	20.69	194.80	290	74.46	39.16	208.45
215	21.060	10.57	181.34	253	41.831	21.05	195.16	291	75.55	39.81	208.81
216	21.475	10.77	181.71	254	42.534	21.42	195.52	292	76.65	40.48	209.17
217	21.869	10.98	182.07	255	43.246	21.79	195.88	293	77.77	41.15	209.52
218	22.324	11.19	182.44	256	43.967	22.17	196.24	294	78.90	41.83	209.88
219	22.758	11.41	182.80	257	44.697	22.55	196.60	295	80.04	42.53	210.24
220	23.198	11.62	183.17	258	45.437	22.94	196.96	296	81.19	43.24	210.59
221	23.645	11.84	183.53	259	46.185	23.33	197.33	297	82.36	43.96	210.95
222	24.099	12.07	183.90	260	46.943	23.73	197.69	298	83.53	44.69	211.31
223	24.560	12.30	184.26	261	47.711	24.14	198.05	299	84.72	45.43	211.66
224	25.027	12.53	184.63	262	48.488	24.55	198.41	300	85.93	46.19	212.02
225	25.501	12.76	184.99	263	49.275	24.97	198.77	301	87.12	46.96	212.37
226	25.982	13.00	185.36	264	50.071	25.40	199.13	302	88.37	47.75	212.73
227	26.470	13.24	185.72	265	50.877	25.83	199.49	303	89.62	48.54	213.09
228	26.965	13.49	186.09	266	51.693	26.27	199.85	304	90.87	49.36	213.44
229	27.467	13.74	186.45	267	52.519	26.72	200.21	305	92.14	50.18	213.80
230	27.976	14.00	186.82	268	53.356	27.17	200.57	306	93.43	51.02	214.15
231	28.493	14.25	187.18	269	54.202	27.63	200.93	307	94.73	51.88	214.51
232	29.016	14.52	187.54	270	55.058	28.10	201.29	308	96.04	52.75	214.86
233	29.547	14.78	187.91	271	55.925	28.57	201.65	309	97.36	53.64	215.22
234	30.086	15.05	188.27	272	56.802	29.06	202.01	310	98.70	54.54	215.57
235	30.632	15.33	188.63	273	57.689	29.55	202.36	311	100.01	55.47	215.93
236	31.186	15.61	189.00	274	58.587	30.04	202.72	312	100.14	56.40	216.28
237	31.747	15.89	189.36	275	59.496	30.55	203.08	313	100.28	57.36	216.64
238	32.317	16.18	189.72	276	60.415	31.06	203.44	314	100.42	58.33	216.99
239	32.893	16.47	190.09	277	61.346	31.58	203.80	315	100.56	59.33	217.35
240	33.478	16.76	190.45	278	62.287	32.11	204.16	316	100.70	60.34	217.70
241	34.071	17.06	190.81	279	63.239	32.65	204.52	317	100.85	61.37	218.05
242	34.672	17.37	191.18	280	64.202	33.19	204.88	318	100.99	62.43	218.41
243	35.281	17.68	191.54	281	65.176	33.75	205.23	319	101.14	63.50	218.76
244	35.898	17.99	191.90	282	66.162	34.31	205.59	320	101.29	64.60	219.12
245	36.523	18.31	192.26	283	67.158	34.88	205.95	325	102.06	70.45	220.88
246	37.157	18.64	192.63	284	68.167	35.47	206.31	330	102.86	76.99	222.65
247	37.799	18.97	192.99	285	69.186	36.06	206.67	335	103.71	84.36	224.41
248	38.449	19.30	193.35	286	70.218	36.66	207.02	340	104.61	92.76	226.17
249	39.108	19.64	193.71	287	71.261	37.27	207.38	345	105.55	102.4	227.92
250	39.776	19.99	194.07	288	72.315	37.89	207.74	350	106.54	113.6	229.67
251	40.452	20.36	194.44	289	73.382	38.52	208.10	355	107.58	127.2	231.42

Appendix II A

Appendix II A

Overheating- vapor density chart（Kg/m^3）

absolute pressure p/MPa	Tem t(℃)										
	140	150	160	170	180	190	200	210	220	230	240
0.20	1.070	1.042	1.016	0.992	0.969	0.947	0.926	0.906	0.887	0.868	0.851
0.30	1.622	1.578	1.537	1.499	1.463	1.428	1.396	1.365	1.336	1.308	1.281
0.40	-	2.127	2.067	2.014	1.964	1.916	1.872	1.829	1.789	1.751	1.715
0.50	-	-	2.608	2.538	2.472	2.411	2.353	2.299	2.247	2.198	2.152
0.55	-	-	2.882	2.803	2.729	2.661	2.596	2.535	2.478	2.424	2.372
0.60	-	-	3.159	3.071	2.989	2.912	2.841	2.773	2.710	2.650	2.593
0.65	-	-	-	3.341	3.250	3.165	3.087	3.013	2.943	2.877	2.815
0.70	-	-	-	3.614	3.514	3.421	3.334	3.253	3.117	3.105	3.037
0.75	-	-	-	3.889	3.779	3.678	3.584	3.495	3.413	3.335	3.261
0.80	-	-	-	-	4.048	3.937	3.835	3.739	3.649	3.565	3.486
0.85	-	-	-	-	4.318	4.198	4.087	3.984	3.887	3.797	3.711
0.90	-	-	-	-	4.591	4.461	4.342	4.231	4.127	4.030	3.938
1.00	-	-	-	-	5.145	4.995	4.856	4.729	4.610	4.499	4.395
1.10	-	-	-	-	-	5.537	5.379	5.233	5.098	4.973	4.855
1.20	-	-	-	-	-	6.089	5.909	5.744	5.593	5.452	5.321
1.30	-	-	-	-	-	-	6.448	6.263	6.093	5.936	5.790
1.40	-	-	-	-	-	-	6.996	6.789	6.600	6.426	6.265
1.50	-	-	-	-	-	-	7.554	7.324	7.114	6.922	6.744
1.60	-	-	-	-	-	-	-	7.867	7.635	7.424	7.229
1.70	-	-	-	-	-	-	-	8.418	8.163	7.931	7.719
1.80	-	-	-	-	-	-	-	8.978	8.699	8.446	8.214
1.90	-	-	-	-	-	-	-	9.548	9.243	8.967	8.715
2.00	-	-	-	-	-	-	-	-	9.795	9.495	9.222
2.10	-	-	-	-	-	-	-	-	10.36	10.03	9.735
2.20	-	-	-	-	-	-	-	-	10.93	10.57	10.25
2.30	-	-	-	-	-	-	-	-	11.51	11.12	10.78
2.40	-	-	-	-	-	-	-	-	-	11.68	11.31
2.50	-	-	-	-	-	-	-	-	-	12.25	11.85
2.60	-	-	-	-	-	-	-	-	-	12.83	12.40
2.70	-	-	-	-	-	-	-	-	-	13.41	12.96
2.80	-	-	-	-	-	-	-	-	-	-	13.52
2.90	-	-	-	-	-	-	-	-	-	-	14.09
3.00	-	-	-	-	-	-	-	-	-	-	14.67
3.10	-	-	-	-	-	-	-	-	-	-	15.26
3.20	-	-	-	-	-	-	-	-	-	-	15.86
3.30	-	-	-	-	-	-	-	-	-	-	16.47
3.40	-	-	-	-	-	-	-	-	-	-	-
3.50	-	-	-	-	-	-	-	-	-	-	-
4.00	-	-	-	-	-	-	-	-	-	-	-

Appendix II B

Appendix

Overheating- vapor density chart（Kg/m^3）

absolute pressure	Tem t(℃)										
p/MPa	250	260	270	280	290	300	310	320	330	340	350
0.20	0.834	0.818	0.803	0.788	0.774	0.760	0.747	0.734	0.721	0.709	0.698
0.30	1.256	1.230	1.208	1.185	1.163	1.142	1.122	1.103	1.084	1.066	1.049
0.40	1.680	1.647	1.615	1.585	1.555	1.527	1.500	1.474	1.449	1.424	1.401
0.50	2.108	2.066	2.025	1.986	1.949	1.914	1.879	1.846	1.814	1.784	1.754
0.55	2.323	2.276	2.231	2.188	2.147	2.108	2.070	2.033	1.998	1.964	1.931
0.60	2.539	2.487	2.438	2.391	2.345	2.302	2.260	2.220	2.182	2.145	2.109
0.65	2.755	2.699	2.696	2.594	2.544	2.497	2.452	2.408	2.366	2.326	2.287
0.70	2.973	2.912	2.853	2.797	2.744	2.693	2.643	2.596	2.551	2.507	2.465
0.75	3.191	3.125	3.062	3.001	2.994	2.889	2.836	2.785	2.736	2.689	2.643
0.80	3.411	3.339	3.271	3.206	3.144	3.085	3.028	2.974	2.921	2.871	2.822
0.85	3.631	3.554	3.481	3.412	3.345	3.282	3.221	3.163	3.107	3.053	3.001
0.90	3.852	3.770	3.692	3.618	3.547	3.480	3.415	3.353	3.293	3.236	3.181
1.00	4.296	4.204	4.116	4.032	3.952	3.876	3.804	3.734	3.667	3.603	3.541
1.10	4.745	4.641	4.542	4.449	4.360	4.275	4.194	4.116	4.042	3.971	3.902
1.20	5.198	5.082	4.972	4.869	4.770	4.676	4.587	4.501	4.419	4.340	4.265
1.30	5.654	5.526	5.405	5.291	5.182	5.079	4.981	4.887	4.798	4.711	4.629
1.40	6.114	5.974	5.841	5.716	5.598	5.485	5.378	5.275	5.178	5.084	4.994
1.50	6.579	6.425	6.280	6.144	6.015	5.893	5.776	5.665	5.560	5.458	5.361
1.60	7.049	6.880	6.723	6.575	6.435	6.303	6.177	6.057	5.943	5.834	5.729
1.70	7.522	7.340	7.169	7.009	6.858	6.715	6.580	6.451	6.329	6.211	6.099
1.80	8.001	7.803	7.619	7.446	7.284	7.131	6.985	6.847	6.716	6.590	6.470
1.90	8.484	8.271	8.072	7.886	7.712	7.584	7.393	7.245	7.105	6.971	6.843
2.00	8.973	8.743	8.529	8.330	8.144	7.968	7.802	7.645	7.496	7.353	7.217
2.10	9.466	9.219	8.990	8.777	8.578	8.391	8.214	8.047	7.888	7.737	7.593
2.20	9.965	9.700	9.455	9.228	9.015	9.965	8.628	8.451	8.283	8.123	7.970
2.30	10.47	10.19	9.924	9.682	9.456	9.244	9.045	8.857	8.679	8.510	8.349
2.40	10.98	10.68	10.40	10.14	9.899	9.675	9.464	9.266	9.078	8.899	8.730
2.50	11.50	11.17	10.87	10.60	10.35	10.11	9.886	9.676	9.478	9.290	9.112
2.60	12.02	11.67	11.36	11.07	10.80	10.55	10.31	10.09	9.880	9.683	9.495
2.70	12.55	12.18	11.84	11.53	11.25	10.98	10.74	10.50	10.28	10.08	9.880
2.80	13.08	12.69	12.33	12.01	11.71	11.43	11.17	10.92	10.69	10.47	10.27
2.90	13.62	13.21	12.83	12.48	12.17	11.87	11.60	11.34	11.10	10.87	10.66
3.00	14.17	13.73	13.33	12.97	12.63	12.32	12.03	11.76	11.51	11.27	11.05
3.10	14.73	14.26	13.84	13.45	13.10	12.77	12.47	12.19	11.92	11.67	11.44
3.20	15.30	14.80	14.35	13.94	13.57	13.23	12.91	12.62	12.34	12.08	11.83
3.30	15.87	15.34	14.86	14.44	14.05	13.69	13.36	13.05	12.76	12.48	12.23
3.40	16.45	15.89	15.39	14.94	14.53	14.15	13.80	13.48	13.18	12.89	12.63
3.50	17.04	16.44	15.91	15.44	15.01	14.61	14.25	13.91	13.60	13.30	13.02
4.00	-	19.34	18.65	18.04	17.49	17.00	16.55	16.13	15.74	15.39	15.05