W-V1500H Hart Vortex Flow Meter

User's Manual

5.2018

CONTENTS

Part I：Manual

1.Application Scope

(W-V1500)series is suitable for oil,chemical industry,metallurgy,heating power,spinning,papermaking ,etc. Be use of control: over-heating vapor, saturation vapor, compressed air, ordinary air(oxygen, nitrogen, hydrogen, natural gas, coal gas ,etc),water and liquid (water, petrol , alcohol, benzene ,etc.)

2.Working Principle

Non-streamline vortex-maker be set in fluid（anti-flow part）,then two regular vortex would be come out ,from two sides of the vortex-maker in turn，so this kind of vortex be called as Karman vortex street，Chart I as follow。

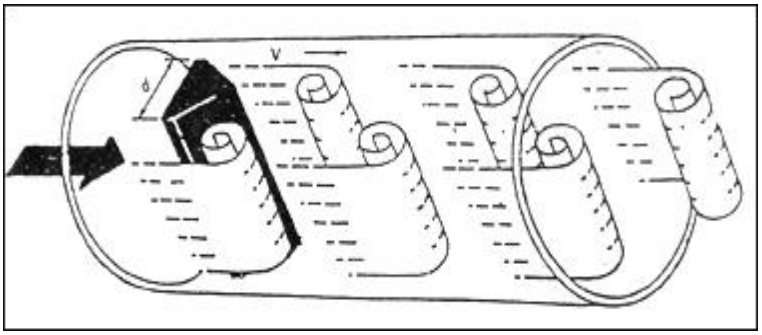


Chart I

Vortex is not flowing symmetrically under vortex-maker set .As if, set frequency of vortex is f,the speed of test medium is V,inlet face width of vortex-maker is d,Past part diameter is D， as the principle of Karman vortex street ,as follow:

$$f=StV/d \qquad (1)$$

Factor：

f—The Karman vortex street frequency which one side of vortex-maker

St—Strouhal number（dimensionless number）

V—mean flow rate

d—the width of vortex-maker

So, check the separate frequency of Karman vortex street to know the instant capacity(flow) .among, Strouhal number（St）is dimensionless number，

Chart II　Show the relation of, Strouhal number（St） & Reynolds number (Re)

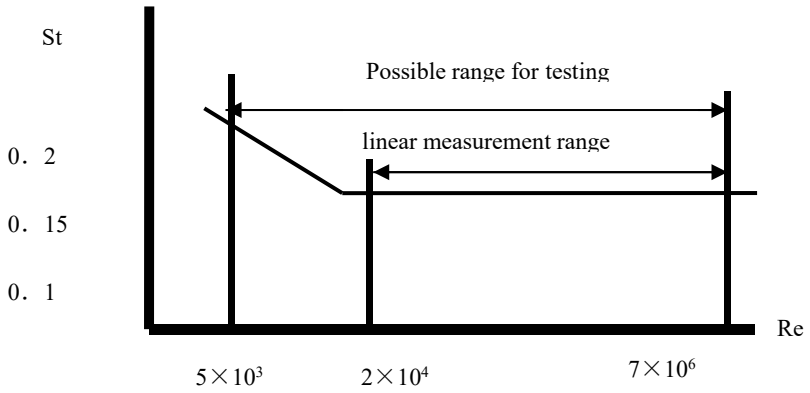


Chart II

Straightness part in curve(St=0.17),free frequency & flow rate of vortex is direct ratio, it means flow sensor range. so just check out frequency (f),we can get the flow rate inside pipe， then as the flow rate(V) to take volume flow, the ratio record of impulse & volume, called as（K），as follow（2）

$$K=N/Q\ (1/m^3) \qquad (2)$$

Model：K＝instrument constant（$1/m^3$）.

N＝impulse number

Q＝volume flow（m^3）

3. Main Specification

Inside nominal diameter (mm)	25，40，50，65，80，100，125，150，200，250，300，(300～1000 plug-in)
Nominal pressure (MPa)	DN25-DN200 4.0(>4.0 order by agreement)，DN250-DN300 1.6(>1.6 order by agreement)
Medium temperature (℃)	Piezoelectric type：-40～250，-40～320；Capacitance： -40～300, -40～400，-40～450（Order by agreement）
Body	SS304,(Order by agreement if need other material)
Range	±1%R，±1.5%R，±1FS；Plug-in：±2.5%R，±2.5%FS
Range degree	1：6～1：30
Configuration	Flow mode, Flow unit, Range (Qmax), Density, Display, etc.
Power supply	+12V DC~+32V DC；
Output signal	4～20mA output with HART
Alarm	Low alarm will output 3.8mA, high alarm will output 22.0mA.
K-Factor Linearity	Provides 2 to 5 points k-Factor correction
Local adjust functions	Setting range and PV unit, Density, Flow mode, damping, high alarm percent, low alarm percent and data recovery etc.
Two-line LCD display	Instant flow rate and totalized flow value can be displayed simultaneously with high-brightness backlight.
Perfect compensation	Supports real-time temperature and pressure compensation for gas, and supports the international standard of steam density table, temperature and pressure compensation for over heat steam, pressure compensation or temperature compensation for saturated steam.
Special feature	has a power-down protection and flow accumulation function.
Anti-explosion	Ben-an type：ExdIIia CT2-T5 anti-explosion type：ExdIICT2-T5
Protection level	Ordinary type IP65 Dive type IP68
Environment condition	Tem-20℃～55℃,Relative humidity 5%～90%,Atm press 86～106kPa
Medium	Gas、Liquid、Vapor
Transmission range	Three-wire system flow sensor：≤300m， electric sign of two-wire system transmitter (4～20mA)：load resistance≤750Ω

Part II : Model selection & Installation of meter

It is important for selecting model, the key to use, so client must read this chapter carefully, and if find question, you can contact us.

1. Ensure the diameter of meter

According to the flow range to choose diameter. Different diameter hold different test range. Even if the same diameter, the test range is different if medium is not same. Practical test range must be confirmed by figure.

1.1 Flow range of air and water under reference condition， as chart II， reference condition as follow:

1)．Air：Normal Temp & press，t=20℃，P=0.1MPa（absolute pressure）,ρ=1.205 kg/m3，υ=15×10-6 m2/s.

2).Liquid ： Normal temperature water,t=20℃ ，ρ=998.2kg/m3，υ=1.006×10-6m2/s.

1.2 Basic step to ensure diameter of meter and flow range：

1)．Working parameter clearly.

(a) Name & component of testing medium

(b) Min, Nor and Max capacity under working condition

(c) Min, Nor & Max Press & Temp of medium

(d) Viscosity of medium under working condition

2)． Meter test the flow capacity of medium under working condition, so as the technological parameter to know the flow capacity of medium under working condition, as follows：

(a) If know air capacity under standard condition, we can get the capacity which under working condition, as follow;

$$Q_v = Q_O \times \frac{0.101325}{0.101325 + P} \times \frac{273.15 + t}{293.15}$$ formula（3）

(b) If know air density under standard condition ρ， as follow;

$$\rho = \rho_o \times \frac{0.1'01325 + P}{0.101325} \times \frac{293.15}{273.15 + t}$$ formula（4）

(c) Mass flow rate Qm charge to volume flow Qv

$$Qv = Q_m \times 10^3 / \rho$$ formula（5）

Among formula(5)：

Qv: Volume flow of medium under working condition (m3/h)

（Qv=3600f/K K: Coefficient of meter ）

Qo : Volume flow under standard condition(Nm3/h)

Qm: Mass flow rate (t/h)

ρ: Density of medium under working condition(kg/m3)

ρo: Density of medium under normal state(kg/m3)，common air medium density under normal state， as chart III

P: Gage pressure under working state (MPa)

t: Temp under working state(℃)

3)． To ensure lower limit capacity. For the upper limit capacity of flow meter may be not counted under ordinary condition，so that just count its lower limit for choosing caliber. Shall meet two conditions：Minimum Reynolds number shall be not less than limited （Re=2×104）； for vortex street flow meter with stress type set, it take vortex intensity from lower limit capacity shall be more than limited sensor intensity （vortex intensity and lift force, as scaling relation as ρv2）. Relation as follow:

For density to test measurable lower limit flow：

$$Q_\rho = Q_O \times \sqrt{\rho_O / \rho}$$ formula (6)

For kinematic viscosity to test linear lower limit flow：

$$Q_\upsilon = Q_O \times \upsilon / \upsilon_O$$ formula(7)

medium：

Qρ: Meet request of vortex intensity, the minimum volume flow (m³/h)

ρ0: Medium density under reference condition

Qυ: Meet request of Min-Reynolds number, the minimum linear volume flow (m³/h)

ρ: The density of tested medium under working condition（kg/m³）

Q0: Minimum volume flow of meter under reference condition (m³/h)

υ: Kinematic viscosity of medium under working condition (m²/s)

υo: Kinematic viscosity of medium under

reference condition (m^2/s)

by means of formula（6）&（7）to come out Qρ& Qv: Compare with Qρ& Qv，to ensure measurable range of lower limit flow & linear lower limit flow :

Qυ≥Qρ：measurable range= Qρ～Qmax , linear flow range= Qυ～Qmax

Qυ<Qρ：measurable range & linear flow range Qρ～Qmax

Qmax：upper limit volume flow (m^3/h)

4). The standard of upper limit flow ,See(II). gaseous upper limit flow velocity shall be less than 70m/s, liquid shall be less than 7m/s.

5). When tested gas is vapor，often use quality flow as unit of measurement quality flow，as：t/h or Kg/h. because of vapor （ overheating & saturated ） ,density would be changed under different temp & press， so to ensure the flow range, see (8)

$$Q_s = 1.5Qa \times \rho \times 10^3 \times \sqrt{\rho_o / \rho}$$ formula（8）

TIPS：

ρ: Density of vapor（kg/m^3）

ρ_0: 1.205kg/m^3

Q_s : Quality flow of vapor（t/h）

6) . For pressure loss， check the effect of pressure loss to craft pipeline，(Unit：Pa)：

$\Delta p = Cd\rho V^2/2$ formula（9）

Tips：

Δp: Pressure loss（Pa）

Cd: Coefficient of pressure loss

ρ:Density of medium under working condition（kg/m^3）

V：Mean flow rate（m/s）

7). If tested medium is liquid, to avoid gasification and loss, shall make the press of pipeline as follow:

$p \geq 2.7\Delta p + 1.3p_0$ formula（10）

Tips：

Δp: Pressure loss（Pa）

p_0:Saturated vapor pressure of liquid which under working temperature.

（Pa absolute pressure）

Po: Fluidic vapor pressure

(Pa absolute pressure)

8) . Vortex street flow meter is not suitable for testing high viscosity liquid. if counted measurable lower limit flow is not suitable for designing, pls select and use other meter type..

9). If as the counted parameter, the two or more kinds of meter can be used, then use less caliber, cheaper. Tips: as far as possible tested range during upper limit of about 1/2～2/3.

Table(I):Extent table of reference condition under working condition

Caliber (mm)	Liquid		Gas	
	Range(m^3/h)	Output frequency range (Hz)	Measurement range (m^3/h)	Output frequency range (Hz)
15	0.3～5	35～600	2.2～20	260～2000
20	0.6～10	29～420	4～36	210～1900
25	1.2～16	25～336	8.8～55	190～1140
32	1.8～20	18～264	10～150	156～1080
40	2～40	10～200	27～205	140～1040
50	3～60	8～160	35～380	94～1020
65	4～85	6～120	35～800	94～940
80	6.5～130	4.1～82	86～1100	55～690
100	12～220	4.7～69	133～1700	42～536
125	15～350	3.2～57	150～2000	38～475
150	20～450	2.8～43	347～4000	33～380
200	45～800	2～31	560～8000	22～315
250	65～1250	1.5～25	890～11000	18～221
300	95～2000	1.2～24	1360～18000	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)	1200～1700	5.8～88	17000～170000	85～880
>(1000)	agreement		agreement	

Tips：above table the caliber (300)～(1000) is plug-in

Table(II):The density of common gas under normal state（0℃，absolute pressure P=0.1MPa）

Name	Density (kg/m^3)	Name	Density (kg/m^3)
Air(dry)	1.2928	Acetylene	1.1717
Nitrogen	1.2506	Ethylene	1.2604
Oxygen	1.4289	Propylene	1.9140
Argon	1.7840	Methane	0.7167
Ne	0.9000	Ethane	1.3567
Ammonia	0.7710	Propane	2.0050
Nydrogen	0.08988	Butane	2.7030
Carbon monoxide	1.97704	Natural gas	0.8280
Carbon dioxide	1.3401	Coal gas	0.8020

2．Design & installation

It is important to install meter，if not installed well, then would affect precision, use-life and damage.

2.1 Environmental request for installation:

1). To avoid strong current, high frequency and powerful switch set, power supply of meter shall be avoided to near by these equipment.

2). To avoid high-Temp & radiation source. if have to install it, need heat insulation & ventilated measure.

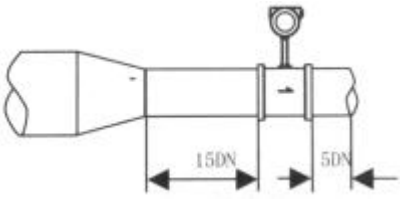
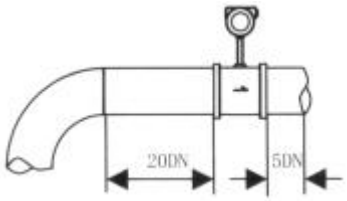
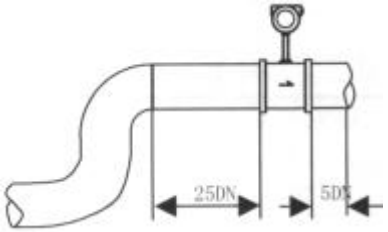
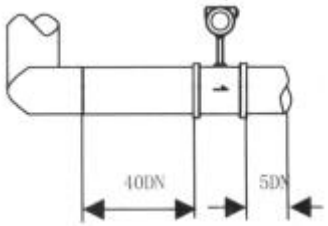
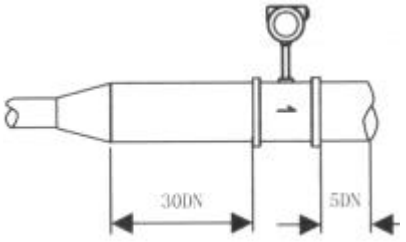
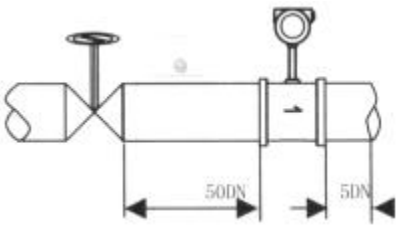
3). To avoid high-Temp & etchant gas, if have to install it, need ventilated measure.

4). Vortex street flow meter shall be avoided to install on shaking part of pipeline. if have to install on it，shall add clamp device and vibration pad which located on 2D to enhance shake proof . meter has better to installed indoors, pay attention to waterproof when installing meter outdoors， special notice the joint, make cable conductor to U shape to avoid water get into the amplifier body Around installing place shall save enough space， so that install connection line and maintenance routine.

2.2 Request for installation of pipeline meter：

1) .Vortex street-flow meter need a request for about installing point up-down stream pipe，if not flow field of medium will be affected in pipeline，refer to measurement accuracy of meter。up-down stream pipe of meter as chart(III)

DN is nominal caliber of meter　　UNIT: mm

Sensor upstream pipe type	Front and back straight pipe length	Sensor upstream pipe type	Front and back straight pipe length
Concentric contract opening-valve		90 degree elbow	
Two 90 degree Elbow which on a same plane		Two 90 degree Elbow which not on a same plane	
Concentric expanded pipe		Control valve half open the vale (not recommend)	

chart(III)

Tips: control valve shall not install on upstream of meter, it better to the downstream 10D.

2). Up-down internal diameter of pipe shall be same. if not， than internal diameter of pipe Dp and vortex street meter inner diameter Db, shall be as follow

$$0.98Db \leq Dp \leq 1.05Db$$

Up-down internal diameter of pipe shall be concentric with inner diameter of flow meter， The non- axiality shall be less than 0.05Db.

3). Sealing gasket which between meter with flange，can not joint inside pipe when installing，and its inner diameter

shall more than meter `s about 1~2mm.

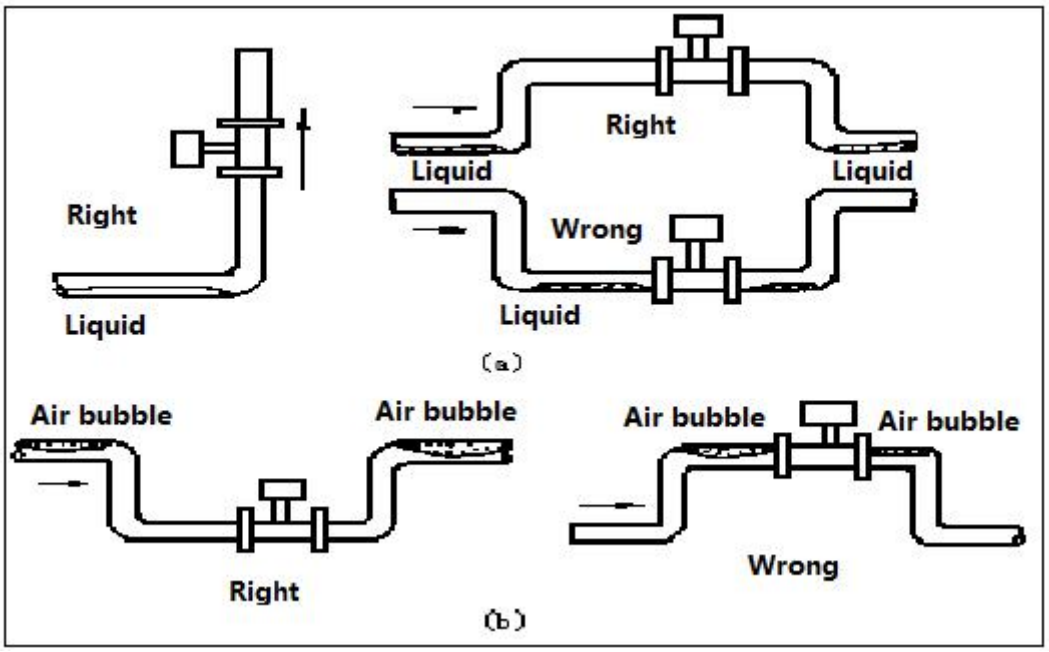
4). Design for temp & press point. When test pipeline need install temp & pressure transmitter，pressure tap may be downstream of 3-5D，thermometer hole may be downstream of 6-8D，see chart（VII）。D is nominal caliber，Unit：mm.

5). Meter can be installed by horizontal, vertical and bias ways on pipeline.

6). When test air, gas can flow anywhere when under uptake pipe to install. if there some air inside pipe ,to prevent liquid into the test pipe，so the air may from below to top, as list（IV）a.

7). When test for liquid，to ensure pipeline filled full，so install meter under vertical or bias working condition，shall ensure liquid flow from below to top。If there are some air inside of pipeline，meter may be installed under pipeline to prevent air into it.

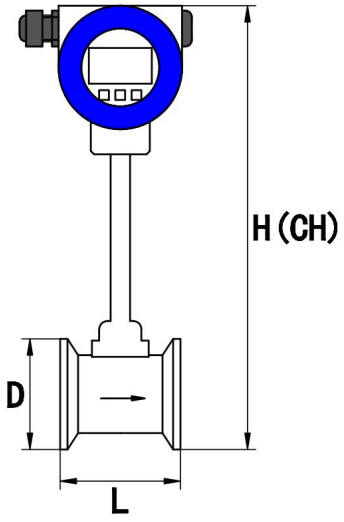
As chart（IV）as follow:



8). when test high& low temp medium，may pay attention to heat preservation. inside changer（inside body of gauge outfit）must be not more than 70℃；if low temp inside will produce water into meter and reducing insulation.

2.3 Overall dimension installation of meter：SEE（V）&（VI）

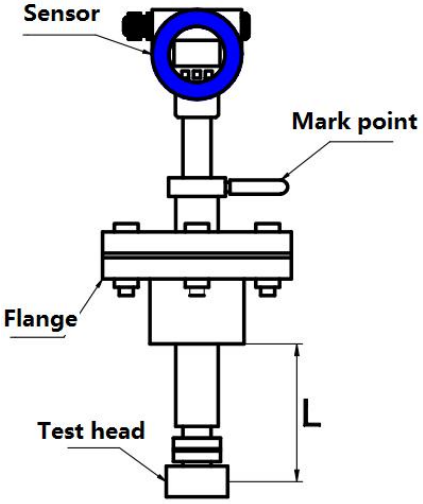
2.3.1 Flange wafer type vortex flowmeter

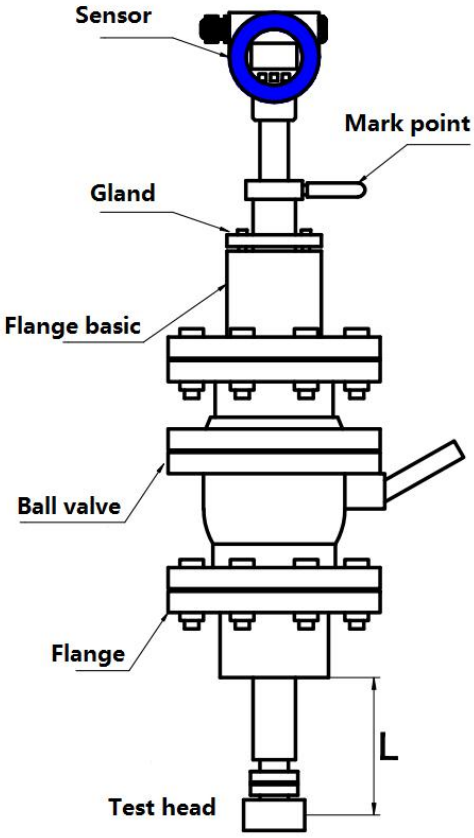


Chart（V）

DN（mm）	L	D	H	CH
15~25	70/90	54	325	385
32	85	69	325	385
40	85	79	325	385
50	85	89	330	390
65	85	104	340	400
80	90	119	360	420
100	90	139	380	440
125	95	168	405	465
150	100	194	430	490
200	102	248	485	545
250	115	300	540	600
300	130	350	590	650

2.3.2 Plug-in vortex flow meter





Chart（VI）

DN(mm)	DN250	DN300	DN400	DN500	DN600	DN800
L（mm）	125	150	200	250	300	400

2.4 The steps of installing plug-in vortex flow meter:

1). Use gas welding to get a near φ100mm circular hole， and clear it so that make the measuring head would be work fine.

2). The flange which from manufacturer would be burned-on round hole of pipeline.

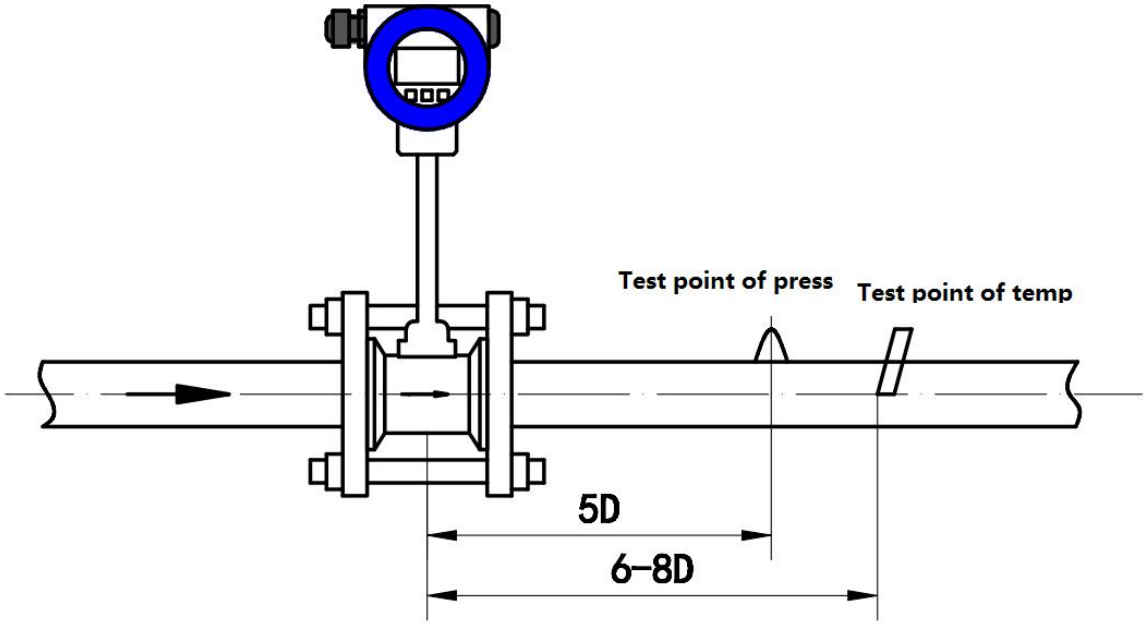
3). Take ball valve and sensor install on the flange.

4). Balance screw, so that insertion depth is pass muster(ensure central axis dead in line between test head with pipeline), fluid flow direction must be stay the same with arrows.

5). Balance gland screw.(Notice: lead screw swirl and seal degree is decided to gland screw elasticity)

6). Check every steps, opening valve slowly to ensure leakage (take care of body), if find leakage, do step 5,6 once more.

2.5 Pt100 installing sketch map of PT100 and pressure transmitter

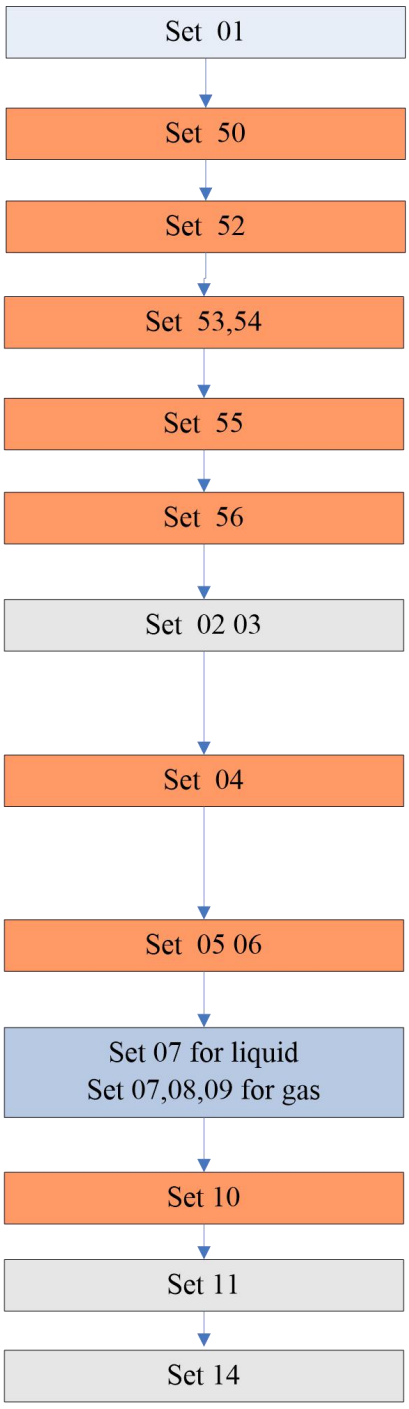


Chart（VII）

Part III: Parameter set

1. Production Process via Local Adjustment

We recommend the following steps to set parameters.



Please make sure the current write protection is 'OFF', which allows you to change the settings.

Please input the opcode'00050'to set 51~57 menu.

Select the meter size and media type.

According to the meter size and measuring media, set the corresponding maximum and minimum frequency.

Setting maximum gain, which corresponds to the minimum measurement frequency (signal minimum). The gain should between 200 to 1000 suggested. Typically about 500.

Set average calibration k-Factor

Set low alarm limit and high alarm limit.

Set flow mode:
LIq_0: Liquid volume LIq_1: Liquid mass
GAS_0: Gas volume: GAS_1: Gas mass:
ST_0: Steam volume ST_1: Steam mass
ST_2: Saturated steam mass (temperature compensation)
ST_3: Saturated steam mass(pressure compensation)

Set flow unit and upper range value.
The lower range value is fixed to 0. The total flow unit is depends on the flow unit.

If flow mode is liquid, then set liquid density.
If flow mode is gas, then set the gas density, pressure and temperature.
If flow mode is steam, you may need set the default pressure and temperature depends on the flow mode.

Set low flow cutoff value.

Set damping.

Totalizer reset.

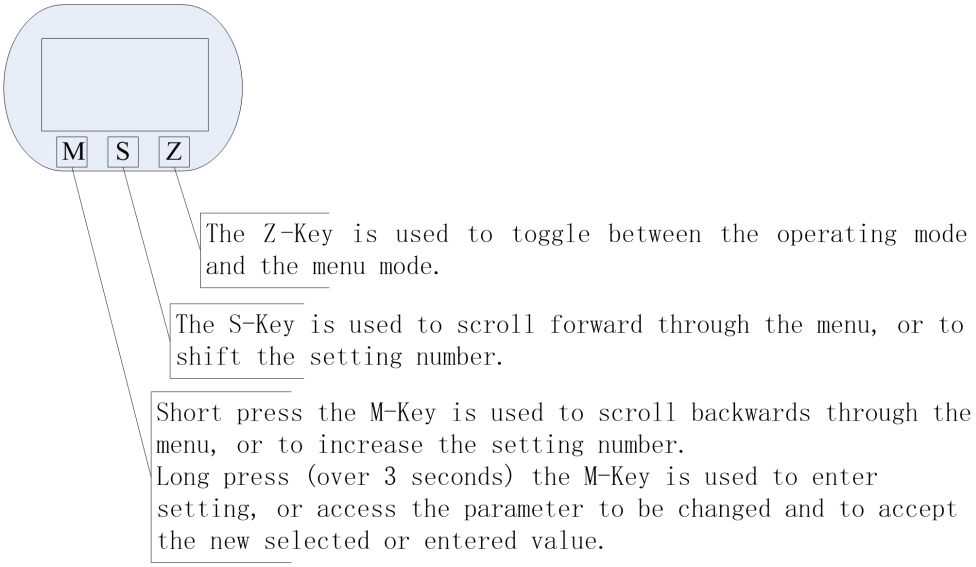
Note:

This color means that these items must be done. This color means that these items must be done, and easily forgotten or incorrectly set.

2 Data Entry

2.1 Basic Function of Keys

Data is entered using the 3 keys M, S and Z on the display.



2.1.1 Enter or Exit Menu Mode

2.1.1.1 Enter Menu Mode

In the operating mode, press the "Z" key to enter the menu mode (data entry).

2.1.1.2 Exit Menu Mode

In the menu mode, press the "Z" key to enter the operating mode.

2.1.2 Data Entry Method

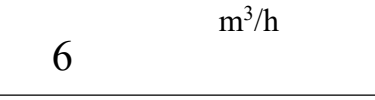
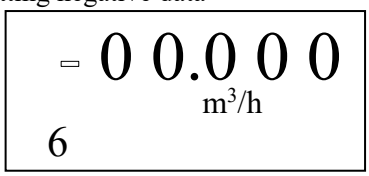
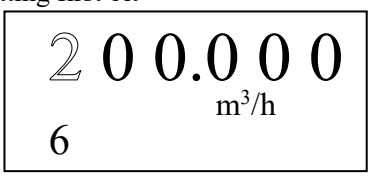
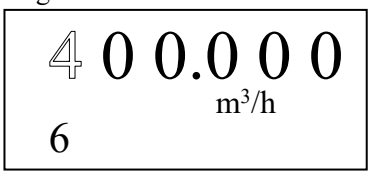
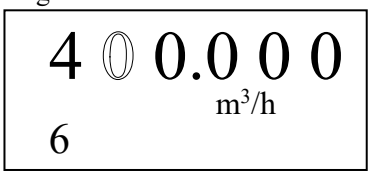
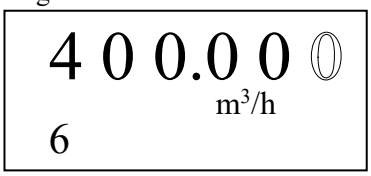
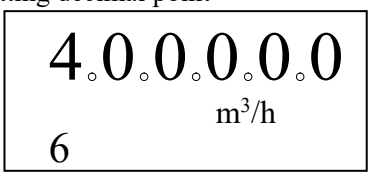
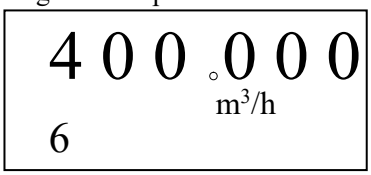
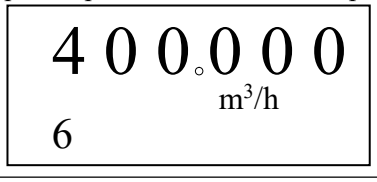
There are two ways to set parameters, one is numeric, and the other is from table .

2.1.2.1 'Numeric' Method

- Long press the M-Key to enter setting, and the sign flag will start flashing.
- Short press the M-Key to select the sign.
- Press the S-Key to shift the setting number. The number bit will start flashing, which means that you can set. Press M-Key to increase the setting number.
- Press the S-Key to shift the setting number again. All bits can be set according to the same operation.
- After setting all 6-bits, press S-Key to set decimal point position. And five decimal points will flash simultaneously, which means that you can set. Short press M-Key to change the decimal point position.
- After completion of data entry, you can long press M-Key to save (access) the parameter. Or Press Z-Key to give up.

For example, the original range limit is 200, the new input range limit is 400.

➢ Press the Z-key to enter the menu mode. ➢ Press M-Key or S-Key to scroll backwards or forwards the menu until display 6 in the bottom-left. Then you can set the range limit.	Setting the range limit 200.000 m^3/h 6
➢ Long press M-Key to enter setting, and the sign flag will start	Enter setting the range limit +00.000

flashing.	
➢ Short press the M-Key to select the sign between "+" and "-". "-"means input is negative (less than 0, vortex flowmeter range limit must be a positive number).	Setting negative data 
➢ Press the S-Key, the first bit "2" will start flashing, which means you can change this bit.	Setting first bit 
➢ Press the M-Key until display "4".	Setting first bit 
➢ Press S-Key, the second bit "0" will start flashing, which means you can change this bit. ➢ Press M-Key to set new data.	Setting the second bit 
➢ Press the S-Key to shift the setting number again. All bits can be set according to the same operation.	Setting the last bit 
➢ After setting all 6-bits, press S-Key to set decimal point position. And five decimal points will start flashing simultaneously, which means that you can set.	Setting decimal point 
➢ Short press M-Key to change the decimal point position.	Setting decimal point  Expected position of the decimal point 

➢ After completion of data entry, you can long press M-Key to save (access) the parameter. Or Press Z-Key to give up.	

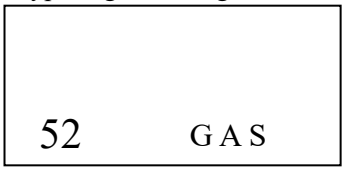
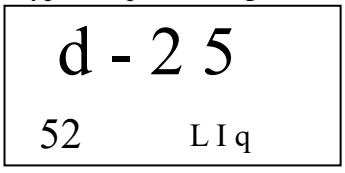
2.1.2.2 From Table Method

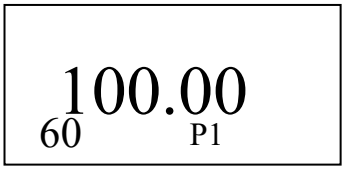
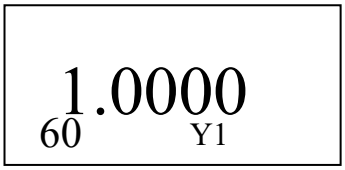
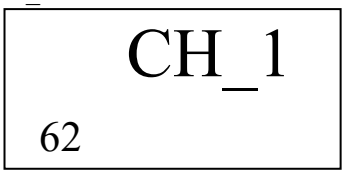
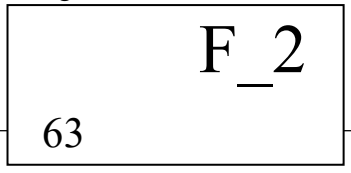
- Long press M-Key to enter setting, and the menu options will start flashing.
- Short press M-Key or S-Key to scroll backwards or forwards the menu.
- Long press M-Key to save (access) the parameter.

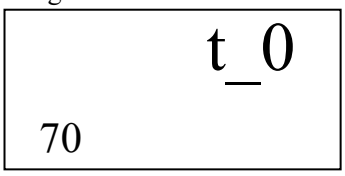
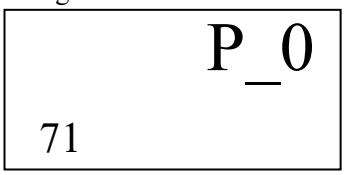
2.2 Local Configuration Function

The character "88" on the bottom-left of LCD corresponding menu item:

character	Menu	Setting method	Notes
01	Write Protect	from table	ON / OFF
02	Low Alarm Limit	numeric	Unit: %
03	High Alarm Limit	numeric	Unit: %
04	Flow mode	from table	LIq_0：Liquid volume LIq_1：Liquid mass GAS_0：Gas volume GAS_1：Gas mass ST_0：Steam volume ST_1：Steam mass ST_2 ： Saturated steam mass (temperature compensation) ST_3 ： Saturated steam mass(pressure compensation)
05	Flow unit	from table	Nm^3/h，Nm^3/m，Nm^3/s，m^3/d，m^3/h，m^3/m，m^3/s，l/h，l/m，l/s，t/d，t/h，t/m，kg/d，kg/h，kg/m，kg/s，g/h，g/m，g/s， Note: Totalizer flow's unit based on the flow unit.
06	Range (Qmax)	numeric	Qmax value for selected flow mode (= 20 mA)
07	Density	numeric	Gas density (unit: Kg/m3) Liquid density (unit: g/cm3)
08	Gas pressure (Gauge)	numeric	Unit: kpa.
09	Gas temperature (Degrees C)	numeric	Unit: ℃.
10	Low flow cutoff value	numeric	Range: 0% ~ 20%
11	Damping	numeric	Range: 0 ~ 64S
14	Totalizer reset	from table	When Lcd display ACC_y, press M-Key to reset the totalizer and overflow counter.
15	Number of totalizer overflows	read only	Display of the number of totalizer overflows; max. 99,999 1 overflow = 10,000,000
40	Trim 4mA		Steps： 1. Long press M-Key, enter trim; 2. Short press M-key to decrease current. Press
41	Trim 20mA		

			S-Key to increase current. Stepping is 12 microamperes. 3. Long press M-Key to save new trim value. Or press Z-Key to exit without saving.
50	Opcode	numeric	**Input ****50, set 51~ 57 menu。** **Input ****40, set 40~ 41 menu。** **Input ****60, set 60 menu。** **Input ****62, set 62 menu。** **Input ****63, set 63 menu。** **Input ****70, set 70~77 menu。**
51	Signal status	read only	LCD display： 450.00 51 2 - 10 status：450.00 is the gain, 51 is indicator, 2 is channel, 10 is signal amplitude, it must be greater than 9.
52	Meter size and media type	from table	Options： 15mm，20mm，25mm，32mm，40mm，50mm，65mm，80mm，100mm，125mm，150mm，200mm，250mm，300mm，350mm，400mm，450mm，500mm，600mm; Note: Maximum frequency, minimum frequency, maximum gain and average calibration K- Factor should be reset， if meter size or media type changed. Media type is gas, setting interface:  Media type is liquid, setting interface:  If you change the meter size and media type, you must re-set from 53 to 56.
53	Maximum frequency	numeric	According to the meter size and measuring media, set the corresponding maximum frequency.
54	Minimum frequency	numeric	According to the meter size and measuring

			media, set the corresponding minimum frequency.
55	Maximum gain	numeric	Between 200 and 1000 suggested. Typically about 500.
56	k-Factor	numeric	Set average calibration k-Factor
57	Pulse factor	numeric	Set the output pulse number corresponding 1m3.
60	Five-point linearity correction	numeric	**Where P is the reference frequency, Y is the correction coefficient K.** When input frequency value, the lower right corner shows Pi, i=1,2,3,4,5. When i = 1, LCD show as follows：  When input coefficient value, the lower right corner shows Yi, i=1,2,3,4,5. When i = 1, LCD show as follows： 
62	Channel settings	from table	There are CH_1, CH_2, CH_3 three options。 CH_3 gain maximum CH_1 gain minimum Set CH_1 show as follows:  Note： CH1 generally used for liquid measurement, which corresponds to the configuration software, select X0 and X1. CH_3 generally used for gas measurement, which corresponds to the configuration software, select X1, X2 and X3.
63	Work mode settings	from table	There are F_1, F_2, F_3, F_4 four options. F_2 setting show as follows: 

			Note： Generally choose F_2.
70	Temperature acquisition mode setting	from table	There are t_0 and t_1 two options. t_0: Temperature uses the input reference value. See Section 9: gas temperature. t_1: Temperature is automatic acquisition, should be use external pt1000. t_0 setting show as follows: 
71	Pressure acquisition mode setting	from table	There are P_0 and P _1 two options. P_0: Pressure uses the input reference value. See Section 8: gas pressure. P_1: Pressure is automatic acquisition, should be use external silicon pressure sensor. P_0 setting show as follows: 
72	Temperature low trim	numeric	Enter the calibration resistor value , unit: ohm.
73	Temperature high trim	numeric	Enter the calibration resistor value , unit: ohm.
74	Pressure low trim	numeric	Enter the calibration reference pressure value, unit kpa
75	Pressure high trim	numeric	Enter the calibration reference pressure value, unit kpa
76	Low pressure cutoff value	numeric	If the measured pressure value is less than " Low pressure cutoff value", set to 0kpa. Unit kpa.
77	Pressure bias settings	numeric	Enter the current actual pressure value, to achieve bias. Unit kpa.

Special Note：

Maximum frequency, minimum frequency, maximum gain and average calibration K- Factor should be reset，if meter size or media type changed. These parameters are very important for vortex flowmeter good working, please carefully set according to the actual application.

1.1 Totalizer Flow Unit Table

Totalizer flow‘s unit is determined according to the flow unit.

Flow Unit	Totalizer Flow Unit
Nm^3/h，Nm^3/m，Nm^3/s，	Nm^3
m^3/d，m^3/h，m^3/m，m^3/s	m^3
l/h，l/m，l/s	l
t/d，t/h，t/m	t
kg/d，kg/h，kg/m，kg/s	kg
g/h，g/m，g/s	g

3 Parameter Description

3.1 K- Factor

The average k-Factor value shown in the display must be the same as the value on the primary tag on the flowmeter primary.

3.2 Five-point Linearity Correction

The actual k-Factor of vortex flowmeter is different in low flowrates and high flowrates. In order to improve the accuracy of vortex flowmeter, it provides 2 to 5 points k-Factor correction.

For example, for D = 80mm, measuring medium is liquid, the real k-Factor in different flowrates as follows:

<20 Hz	40	80	> 100
2200	2100	2100	2000

Then we can choose 4-points calibrated, set k-Factor 2100. Enter the calibration data as follows:

Frequency	k-Factor coefficient	formula
20	0.954545	2100/2200=0.954545
40	1	2100/2100=1
80	1	2100/2100=1
100	1.05	2100/2000=1.05

3.3 Pulse Factor Description

There are two ways to set the pulse factor via HART-CONFIG Tool.

1. Set the number of pulses output every 1m3.
2. Set a pulse corresponds to how many m3.

The output pulses are based on the flow value after five-point K-Factor correction. That will get higher accuracy than using the original pulses.

The local adjustment menu 57 is used to set the output pulse number corresponding 1m3.

3.4 Output Original Pulses Description

If you need the flowmeter outputs original pulses, follow the following steps:

1. Set the K- Factor and the Pulse Factor equal. That is the value of local adjustment menu 56 and 57 equal.
2. Cancel the Five-point linearity correction via HART-CONFIG Tool. Or enter the local adjustment menu 60 to set all of correction coefficient K equal 1.0.

Then the flowmeter output pulse frequency equals to the original pulse frequency.

3.5 Temperature and Pressure Compensation

3.5.1 Precondition

The pressure sensor should be bridge type sensors and the temperature sensor should be PT1000.

User input reference pressure should be gauge pressure, and the unit must be kpa. Absolute pressure and gauge

pressure relationship: Absolute pressure = gauge pressure + 101.325kPa.

User should input the reference resistor when trim the temperature sensor.

3.5.2 Pressure Sensor Trim

If you want trim the pressure sensor, please check the flow mode and pressure acquisition mode setting.

character	Menu	Setting
04	Flow mode	Set one of the following：(The other modes do not collect pressure) GAS_0：Gas volume： GAS_1：Gas mass： ST_0：Steam volume ST_1：Steam mass ST_3 ： Saturated steam mass(pressure compensation)
71	Pressure acquisition mode setting	P_1: Pressure is automatic acquisition, should be use external silicon pressure sensor.

It provides two points calibration for the pressure sensor. If use HART-CONFIG Tool, please enter into 'Advanced Features' -> 'Temperature and Pressure Sensors' to trim the sensor.

You can also trim the sensor via local adjustment menu 74 and 75:

1. Set menu 04 and 71.
2. Apply zero pressure to the sensor, enter into menu 74, input the reference pressure(gauge pressure, unit kpa) to trim zero.
3. Apply full pressure to the sensor, enter into menu 75, input the reference pressure(gauge pressure, unit kpa) to trim full.

3.5.3 Low pressure cutoff value

If the pressure value is close to 0 is not stable, for example, varied between -0.01 and 0.01 kPa, may cause the output fluctuation. You can set 'Low pressure cutoff value' to remove this fluctuation.

If the measured pressure value is less than 'Low pressure cutoff value', it will set to be 0kpa.

3.5.4 Pressure bias settings

If there is a fixed pressure deviation, for example, the actual pressure value is 10kPa and the measured pressure value is 9.8kPa. You can perform '7.5.4 Pressure bias settings' to remove this error.

Enter the current actual pressure value, to achieve bias.

3.5.5 Temperature Sensor Trim

If you want trim the temperature sensor, please check the flow mode and temperature acquisition mode setting.

character	Menu	Setting
04	Flow mode	Set one of the following：(The other modes do not collect temperature) GAS_0：Gas volume： GAS_1：Gas mass： ST_0：Steam volume ST_1：Steam mass ST_2 ： Saturated steam mass (temperature compensation)
70	Temperature acquisition mode setting	t_1: Temperature is automatic acquisition, should be use external pt1000.

It provides two points calibration for the temperature sensor. We recommend use 1000ohm and 2500ohm resistors for calibration. If use HART-CONFIG Tool, please enter into 'Advanced Features' -> 'Temperature and

Pressure Sensors' to trim the sensor.

You can also trim the sensor via local adjustment menu 72 and 73:

1. Set menu 04 and 70.
2. Apply lower resistor, such as 1000ohm, enter into menu 72, input the reference resistor value(1000) to trim..
3. Apply higher resistor, such as 2500ohm, enter into menu 73, input the reference resistor value(2500) to trim..

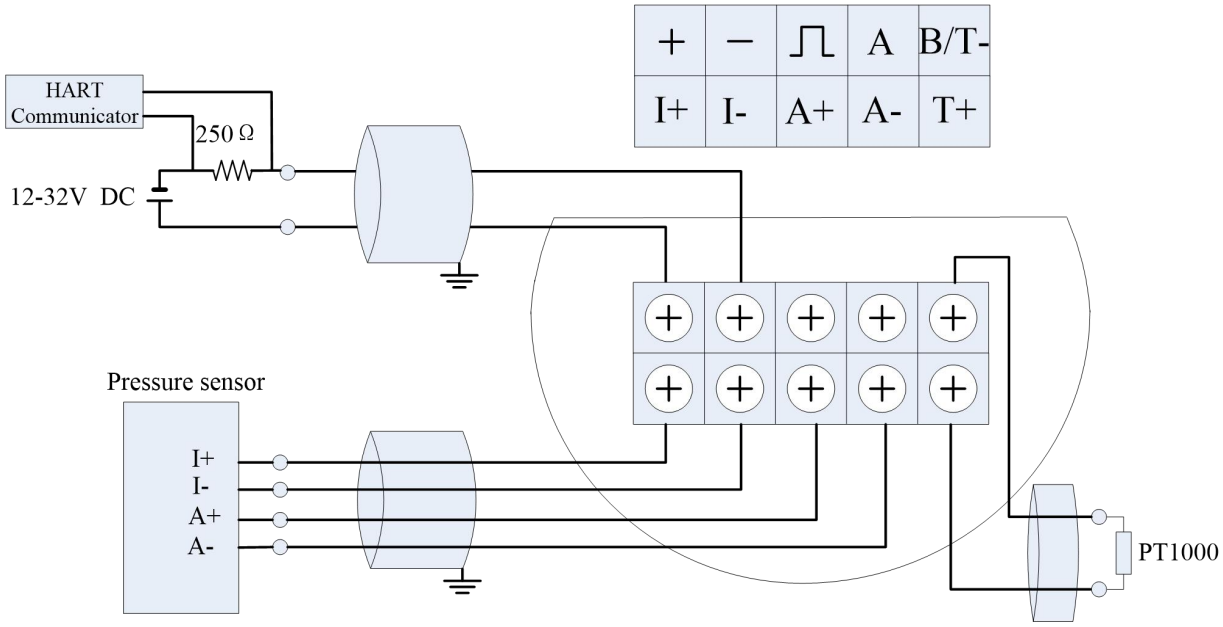
Part IV: Wiring connection

1 Terminal Board Wiring

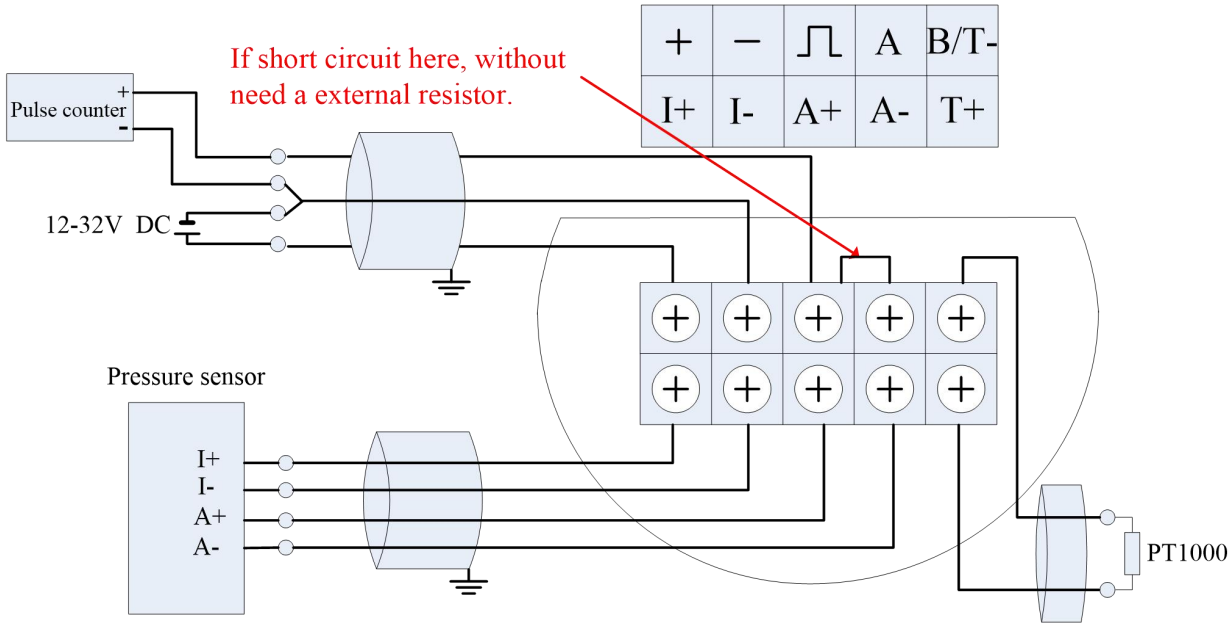
The terminal board is used for connects the external power supply, output pulse, the external pressure sensor and temperature sensor.

The following are common wiring.

1.1 4~20mA output+ HART+ External Pressure and Temperature sensors



1.2 Pulse Output+ External Pressure and Temperature sensors



2 Sensor Interface

2.1 Vortex Sensor

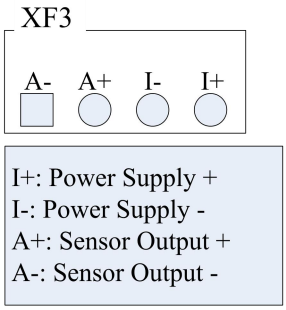
The 2-Pin green terminal XT is used for connecting the vortex sensor.

2.2 Pressure Sensor

Users can use XF3 socket to connect pressure sensor, and the pressure sensor should be bridge type sensors. I+ and I- are power supply, A + and A- are the sensor signal outputs.

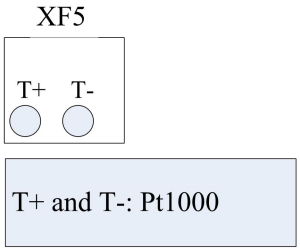
Required the bridge impedance of pressure sensor should from 3 to 6000 ohms. The circuit supply current for the pressure sensor is about 0.3mA, as long as the sensor output does not exceed 50mV@0.3mA, you can use.

Socket XF3 defined as follows:



2.2.3 Temperature Sensor

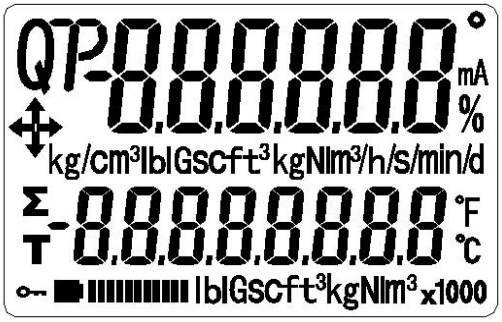
Socket XF5 supports PT1000, two-wire connection.



Installation Notes: The main circuit board must be reliably connected to housing (purpose is grounded) !

Part V: LCD Display

LCD Full display as Chart (VIII) :



Chart（VIII） LCD Screen

Two-line LCD display. Instant flow rate and totalized flow value can be displayed simultaneously with high-brightness backlight, as Chart(IX).

Chart（IX） Instant flow rate and totalized flow value

Short press M to set the second line shows the frequency, pressure, temperature, density, current, or percentages.

Use indicator to distinguish between different display variables shows in the second line

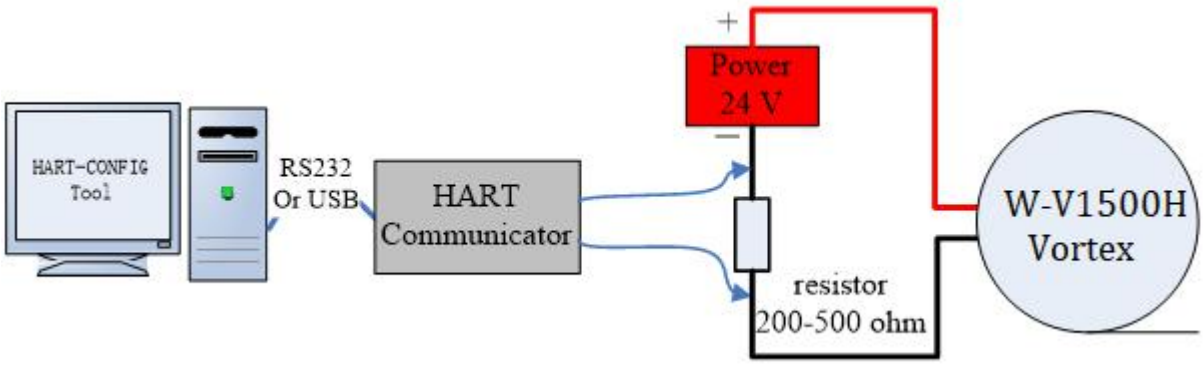
Indicator	Σ	F	d	P	t	I	r
variable	totalized flow	frequency	density	pressure	temperature	current	percentage

Notes:

- In write protection mode, display 。
- Measured value is lower than the lower limit alarm, flashing the "down arrow".
- Measured value is higher than the upper limit alarm, flashing the "up arrow".
- If enable automatic measure pressure, and the pressure signal abnormality (sensor fault), flashing the "left arrow"
- If enable automatic measure temperature, and the temperature signal abnormality (sensor fault), flashing the "right arrow"

Part VI: Production Process Using HART-Config Tool

Connect the flow meter as shown in Chart(X).



Chart(X) HART communication connection diagram

Run HART-CONFIG TOOL, follow these steps to complete the production process of vortex flowmeters.

Run HART–CONFIG TOOL.exe	Set COM, then click the "Connect" -> "Search Address 0".
Analog Output Trim	Click on 'Transmitter adjustment' -> 'Analog Output Trim' to enter into operation interface. Note: This operation is factory calibrated done!
Set Vortex Parameters	Click on 'Vortex Feature ' -> 'Vortex Parameters' to enter the interface. You can set meter size, media type, maximum frequency, minimum frequency, maximum gain, k-Factor and pulse factor.
Vortex Feature	Click on 'Vortex Feature ' -> 'Vortex Feature' to enter the interface. You can set flow mode, media status such as density, pressure, temperature, etc. And You can also reset the total flow.
Set Range	Click on the 'Transmitter Configuration' -> 'Range' to enter into transmitter range configuration interface.
Output Setting	Click on the 'Transmitter Configuration' -> 'Output Setting' to set the damping value. Click on the 'Transmitter Configuration' -> 'Fail Setting' to enter into the interface. The write protect mode and alarm percent can be set.
User Trim	Five-point linearity correction.
Low flow cutoff and Data Backup	Enter 'Advanced Features' -> 'Additional Features'. You can set the low flow cutoff percent. And you can perform 'Data Backup' here. If the damping value entered is '05678', it will automatically perform 'restore factory settings'.

Note： This color means that these items must be done. This color means that these items must be done, and easily forgotten or incorrectly set.

Part VII: Troubleshooting

Fault	Cause	Solution
No output signal after power on	1. No fluid flowing or the flow rate is under starting flow. 2. The connections of power supply and output are incorrect. 3. The pre-amplifier is damaged (The calculator can't count, and the flow rate is 0). 4. The circuit of driving amplifier is damaged (The display of calculator is normal).	1. Increase the flow rate or replace a flow meter with smaller nominal diameter to meet the requirement of flow range. 2. Make the connection correct. 3. Replace the pre-amplifier. 4. Replace the damaged components in the circuit of driving amplifier.
The meter outputs signal when no flow	1. The interference of bad grounding of meter, strong electricity and interference of other grounding. 2. The higher sensitivity of amplifier or it may produce self excitation. 3. Unstable power supply, bad filtering or other electrical disturbance.	1. Make the grounding well 2. Replace the pre-amplifier. 3. Repair or replace the power supply.
Unstable display of flow rate	1. Unstable flow in pipe 2. The higher or lower sensitivity of amplifier make the output pulses are more counted or less counted. 3. There is debris in the shell of meter. 4. Bad grounding. 5. The flow rate is under the low limit. 6. The downstream seal ring reaches into pipe, and make disturbance.	1. Begin to measure after the flow rate is stable. 2. Replace the pre-amplifier. 3. Remove the debris. 4. Check the grounding, make the grounding well.
The displayed total flow is inconsistent as actual total flow	1. The flow coefficient of meter is incorrect. 2. The flow rate on site is higher than the maximum flow of meter. 3. The bad quality of the flow meter.	1. Recalibrate the meter and input the new flow coefficient. 2. Reduce the flow rate in pipe or replace the flow meter. 3. Recalibration
Abnormal display	Bad contact of the key or dead lock the key	Replace the display board.
System halts after replacement new battery	The electrify reset circuit is abnormal, or the oscillating circuit can't afford to boost.	Reinstall the battery (Before reinstall the battery, the meter is needed to discharge more than 5 seconds)