Vortex Flowmeter

Operation Instructions



Chongqing Chuanyi Automation Co., Ltd. Flowmeter Branch

An Open Letter to Users of Flowmeter Branch

Dear users,

Thanks for your continued support to Chongqing Chuanyi!

Chongqing Chuanyi has fully implemented GB/T24001-2004 and 28001 standards. We hope that our environmental protection activities can get your support and cooperation. We advise you that:

1. Understand the Operation Instructions before use. Install and use the instrument in strict accordance with the Instructions to avoid safety accidents.

2. Ensure that the instrument installation, transportation, operation, storage, repair and scrapping meet applicable requirements of laws, regulations and environmental protection.

3. Properly keep combustible, explosive or poisonous dangerous goods, and take corresponding precautions during storage and transportation to prevent fire, explosion or spillage & leakage accidents that cause environmental pollution.

4. During construction, give priority to pollution-free or less-pollution construction equipment and advanced construction methods rather than those prohibited by national or local authority, take necessary measures to reduce the noise pollution, and dispose of wastes on the construction site properly.

5. Give active cooperation during operations, which may affect you in terms of environmental protection, by our service personnel in strict accordance with rules and regulations of the Company as well as relevant requirements.

Let us work together to protect the environment and the Earth!

Dear users,

Welcome to use our products. Before use, please read the Instructions carefully to have a good understanding of correct installation and operation methods of products, thus ensuring the correct installation and operation and the best performance of the instrument.

We always insist on the service tenet of "SIC accompanies customers and customers in the heart of SIC". If you encounter any problem during use of the instrument, please contact us. We will assume no liability for performance degradation or damage of the instrument due to repair or replacement of components without authorization.

Customer service center: 023-67032695

CHONGQING CHUANYI AUTOMATION CO., LTD. FLOWMETER BRANCH

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I. Introduction

VF series of vortex flowmeter must pass the strict inspection of 8 technical indexes before leaving the factory.

After receiving the vortex flowmeter, please be sure to check its appearance to confirm whether the flowmeter is damaged during transportation.

Please check the instrument accessories against this Chapter. *The warranty period of vortex flowmeter is one year (since the delivery date of the product).

The customer is responsible for urging relevant personnel to read, understand and abide by the instructions provided in this manual before installing this flowmeter.

* According to Article 13 of the *Metrology Law* of the People's Republic of China and the relevant provisions of the *Detailed Rules for the Implementation of the Metrology Law* of the People's Republic of China, the Company applied to Chongqing Administration of Technology Regulation for type test of the vortex flowmeter, and obtained the type approval certificate after passing the examination, with the certificate No. of XPY [2009] No. 034.

1. Model and Specifications

The model and technical specifications are provided on the nameplate of the vortex flowmeter and the ex-factory calibration sheet. Check whether the model and technical specifications of the instrument are consistent with those of the ordered instrument.

涡街流量计
Vortex Flowmeter
型批渝[2015]041号
License No.[2015]041

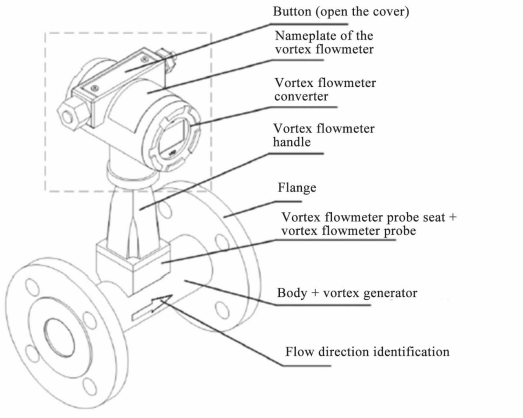
型号规格Model					
仪表口径Nominal Dia.	mm	流量范围Range		供电电源Supply	24VDC
产品编号Serial No.		仪表系数FACT	1/m³	防爆等级Ex Marking	Exia IIC T1~T6 Ga
准确度等级Accuracy	级	测量介质Fluid		防爆证号Cert No.	GYB21.3243X
公称压力P.MAX		介质温度T.PROC	℃	安装位号Install No.	
压力编号P.Sensor No.		环境温度T.AMB	℃	制造日期DATE	
执行标准Standard	JB/T 9249	本安参数Parameter	Ui 28V Ii 100mA Pi 0.7W Ci 0.02μF Li 0.6mH		

重庆川仪自动化股份有限公司流量仪表分公司制造
Chongqing Chuanyi Automation Co.,Ltd.Flowmeter Branch
中国 重庆 渝北区 黄山大道中段61号
No.61, Middle Section, Huangshan Ave.,YuBei District,Chongqing,China

Nameplate of the vortex flowmeter

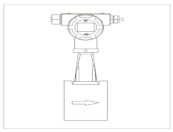
In case of any product quality problem or any problem encountered in the use of the instrument, please contact the Company, and specify the model, specification and number of the instrument, so as to solve the problem quickly.

Schematic diagram of vortex flowmeter parts is as follows:



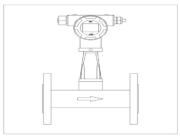
2. Packing List

⚠ When the products arrive, please confirm whether the following items are packed: vortex flowmeter (one set)
Operation Instructions (one copy)
Checklist (one copy)
Quality Certificate (one copy)
Cable (split type only, with length ordered by user)
External flange (provided when required by the user)
Bolts and nuts (provided when required by the user)
Accessories (one set of flexible graphite pads)



3. Precautions for Storage

⚠After arrival, if the instrument needs to be stored for a long time, special attention shall be paid to the following matters:
(1) The instrument shall be packed in the original packing box, and shall be kept in the same state as that before delivery as far as possible.
(2) The storage location shall be selected for the following conditions:
No exposure to weather.
No exposure to vibration or impact.
The junction box cover of the instrument shall not be opened to prevent moisture from affecting the normal operation of the instrument.
The ambient temperature, humidity and atmospheric pressure shall be as follows:
Ambient temperature: -20℃-+60℃; relative humidity: (5%-90%) RH:
Atmospheric pressure: 86kPa-106kPa



4. Precautions for Installation in Dangerous Areas

This instrument is allowed to be used in dangerous areas and has obtained the following certifications:
Intrinsically safe type: Exia II CT6; Explosion-proof type: Exd II CT6
⚠ When the intrinsically safe type is used, safety barriers certified by explosion-proof institutions must be used; when the explosion-proof type is adopted, explosion-proof electrical connectors must be installed.

5. Precautions for Installation

(1) The flowmeter shall not be installed in an environment containing corrosive gas. If it must be installed in such an environment, ventilation measures must be taken.
(2) Although our flowmeter has good vibration-resistant performance, it is used in the place with less vibration if conditions permit. If the vibration is very strong (beyond the vibration resistance range of the flowmeter), it is recommended to reinforce the installation pipeline.
(3) Sufficient space should be reserved around the flowmeter during installation, which is convenient for wiring, installation and regular inspection.
(4) After installation, the front cover, back cover and electrical connector of the converter shall be tightened to prevent water from entering the converter and damage to the circuit board.

6. Other Precautions

(1) The wiring position should be as far away from the electrical noise sources as possible (such as high-power transformers, motors and mixers) to prevent electromagnetic interference;
(2) The electrical connector shall not be replaced without authorization. If necessary, the thread of the replaced electrical connector must match the internal thread of the electrical connector of the converter; otherwise, the sealing of the converter will be affected, and the circuit board will be damaged once water enters.
(3) The outer diameter of the power cord is (8-10) mm. If exceeding this range, the sealing of the

converter will be affected, and once water enters, the circuit board will be damaged.

7 Measuring Principles

The basic principle of vortex flowmeter is Karman vortex phenomenon. Vortex is generated alternately on both sides of vortex generator and forms vortex street downstream of cylinder. The vortex shedding frequency is directly proportional to the flow rate and inversely proportional to the width of vortex generator, which can be expressed by the following formula:

f=St×v/d formula (1)

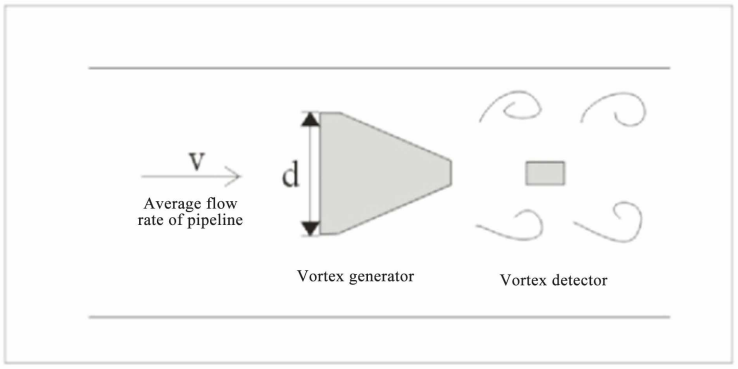
Where:

f: vortex shedding frequency

St: Dimensionless constant (Strouhal)

V: Flow rate of vortex generator

d: Width of flow-facing surface of the vortex generator



The fluid velocity and instantaneous flow can be measured by measuring the vortex shedding frequency. The Strouhal number St is a dimensionless constant that can be determined by tests. The linear part of the functional relationship between the Strouhal number St and the Reynolds number Re is the linear measurement range of the vortex flowmeter. The velocity of the fluid in the pipe can be obtained by measuring the frequency f, and then the volume flow can be obtained from the velocity. The ratio of the number of pulses output in a period of time to the volume of the fluid (corresponding number of pulses that flow through a unit volume of fluid) is called the instrument coefficient (coefficient K).

K=N/Q formula (2)

Where:

K: Instrument coefficient (1/L)

N: number of pulses

Q: Fluid volume (m^3)

The vortex shedding frequency used to measure the flow varies with the flow rate and is not affected by the fluid density and viscosity. The local pressure pulsation caused by vortex shedding is detected by the piezoelectric force sensor and converted into a pulse signal corresponding to the vortex frequency in the detection circuit. The signal converter converts this pulse signal into a standard current signal of 4-20mA and outputs it.

8. Main Technical Indicators

VFD Vibration-resistant Type Vortex Flowmeter

Accuracy grade	1.0 (gas); 0.5 (highest for liquid)
Caliber	DN15, DN20, DN25, DN32, DN40, DN50, DN65, DN80, DN100, DN125, DN150, DN200, DN250, DN300, DN350, DN400, DN450, DN500, DN600
Pressure grade	1.0MPa, 1.6MPa, 2.5MPa, 4.0MPa, ANSI150. ANSI300 (supplied by other pressure agreements)
Material of wetted part of sensor	304, 316L, Hastelloy C (supplied by other materials agreement)
IP code	IP65, IP67
Explosion-proof grade	Intrinsically safe type: Exia II CT6; Explosion-proof type: Exd II CT6
Medium temperature range	-40℃ - +200℃ (general type), -40℃ - +400℃ (high temperature type)
Ambient temperature	(-30∽70)℃
Repeatability	± 0.3% (liquid ±0.25%)
Range ratio	1:20
Flow rate range	Liquid: 0.3-7, gas: 3-60, steam: 2.5-60 unit: (m/s)
Outgoing line seal	G1/2", NPT1/2", M20×1.5
Supply voltage	External power supply, voltage range of 16.5-42VDC, (with HART communication, minimum load of 250 ohms and power supply of 21.5VDC are required); with Modbus required voltage range of 21.6-26.4VDC
Output signal	Analog output 4-20mA, pulse output
Communication protocol	HART, Modbus (RS485)

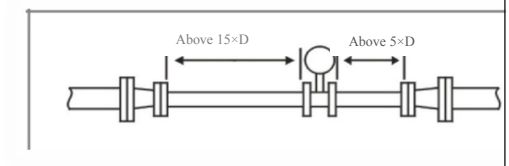
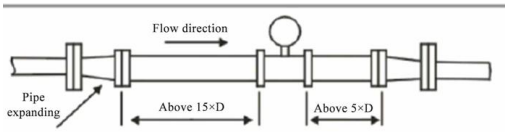
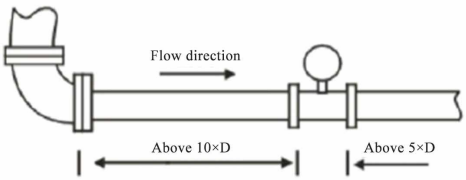
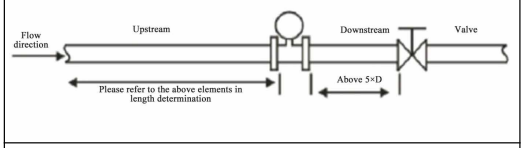
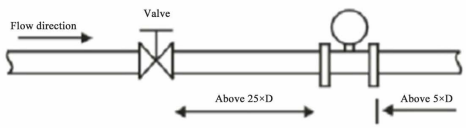
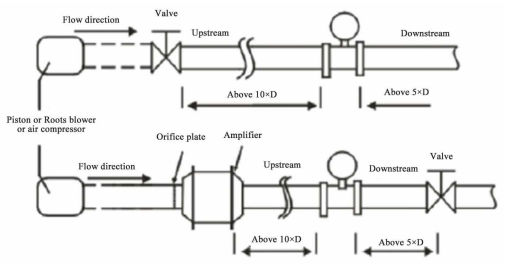
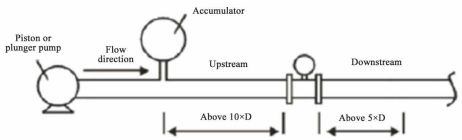
VFE Intelligent Type Vortex Flowmeter

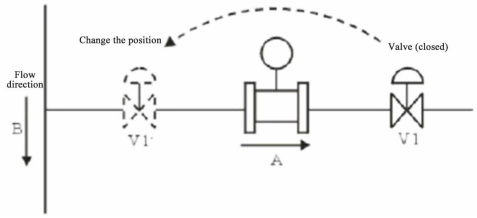
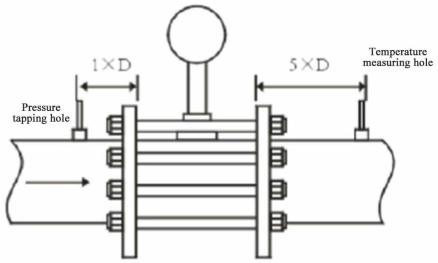
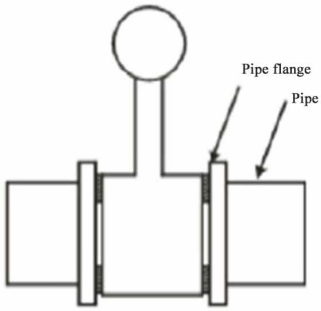
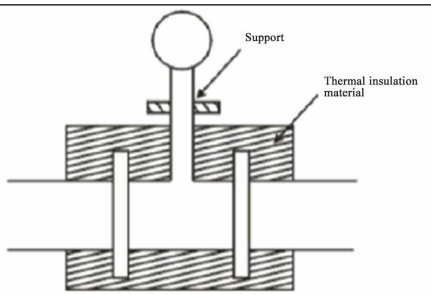
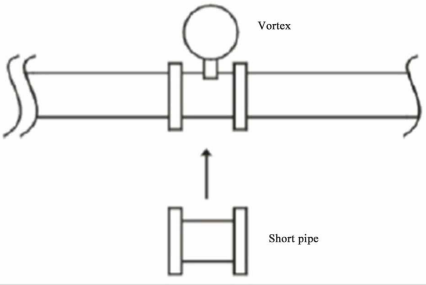
Accuracy grade	1.0 (gas/steam)
Caliber	DN15, DN20, DN25, DN32, DN40, DN50, DN65, DN80, DN100, DN125, DN150, DN200, DN250, DN300
Pressure grade	1.0MPa, 1.6MPa, 2.5MPa, 4.0MPa, ANSI150, ANSI300
Material of wetted part of sensor	304, 316L, Hastelloy C (supplied by other materials agreement)
IP code	IP65, IP67
Explosion-proof grade	Intrinsically safe type: Exia II CT6; Explosion-proof type: Exd II CT6
Medium temperature range	-40℃ - +200℃ (general type), -40℃ - +350℃ (high temperature type)
Ambient temperature	-30∽+70℃
Repeatability	±0.3%
Range ratio	1:20
Flow rate range	Liquid: 0.3-7, gas: 3-60, steam: 2.5-60 unit: (m/s)
Outgoing line seal	G1/2", NPT1/2", M20×1.5
Supply voltage	External power supply, voltage range of 16.5-42VDC, (with HART communication, minimum load of 250 ohms and power supply of 21.5VDC are required); with Modbus required voltage range of 21.6-26.4VDC
Output signal	Analog output 4-20mA/pulse output
Communication protocol	HART/Modbus (RS485)
Temperature error	±1℃
Pressure accuracy	±0.5%FS

II. Installation

1. Pipeline Design

(1) Installation instructions

Description	Diagram
The vortex flowmeter can be installed indoors or outdoors. Please install the flowmeter in a place with minor vibration. In case of intense pipe vibration, the pipeline shall be provided with supports. If the pipe is always filled with liquid, the pipe can be installed vertically or at any angle. The inner diameter of the connecting pipe must be slightly larger than the inner diameter of the vortex flowmeter, within (1-5mm).	
Pipe reducing: For the pipe shrinking, the length of the straight pipe section on the upstream side should be at least 15D, and that on the downstream side should be at least 5D. (D: Nominal inner diameter of vortex flowmeter)	
Pipe expanding: For the pipe expanding, the length of the straight pipe section on the upstream side should be at least 15D, and that on the downstream side should be at least 5D.	
Elbow: For the pipe bending, the length of the straight pipe section on the upstream side should be at least 10D, and that on the downstream side should be at least 5D.	
Valve position and length of straight pipe section: 1. The valve shall be installed downstream of the flowmeter. The length of the upstream straight pipe section depends on the upstream pipeline conditions (such as pipe expanding, pipe shrinking and pipe bending), as shown above. The length of the straight pipe section on the downstream side shall be at least 5D. 2. If the valve must be installed upstream of the flowmeter, the length of the upstream straight pipe section should be at least 25D, and the length of the downstream straight pipe section should be at least 5D.	 
Impact of pulsating flow: The fluid may vibrate on the gas pipeline using piston or roots blower or air compressor or on the high-pressure liquid pipeline using piston or column pump. Usually, the valve should be installed downstream of the flowmeter. If the flowmeter has to be installed upstream of the valve, a pulsating flow attenuator, such as throttle plate or expansion section, can be installed upstream of the flowmeter.	
Piston or plunger pump: An energy accumulator can be installed upstream of the vortex flowmeter to mitigate liquid vibration.	

Description	Diagram
Valve position (pulsating pressure caused by T-tube) When using a T-tube, a valve can be installed upstream of the flowmeter to avoid the impact of pulsating pressure. For example, as shown in the right figure, when the V1 valve is closed, the fluid flows in the direction of B, and the flow through the flowmeter is zero. However, due to the detected pulsating pressure, the zero point of the instrument fluctuates. To avoid this, change the installation position of the valve to V1.	
Pressure measuring hole and temperature measuring hole When pressure measurement is needed, the pressure measurement shall be made between 1D and 3D upstream of vortex flowmeter. When temperature measurement is needed, the temperature measuring hole shall be set between 3D and 5D downstream of vortex flowmeter.	
Sealing gasket Do not protrude the sealing gasket into the pipe, otherwise the reading will have error. Even the clamped vortex flowmeter should use a gasket with bolts. The spiral sealing gasket (without bolt holes) should be customized in the factory where sealing gasket is made, because the standard size may not be available for some flanges.	
Heat insulation Never wrap the converter bracket with heat insulation material when wrapping the integrated vortex flowmeter or split sensor installed on the pipeline for transporting high-temperature fluid.	
Pipe cleaning Newly installed or repaired pipes shall be cleaned before operation. The rust, scale, residue and sludge in the pipe shall be flushed. During flushing, the water flows to the bypass pipe to avoid damaging the flowmeter. If there is no bypass pipe, a short pipe is temporarily installed to replace the flowmeter.	

(2) Installation tips

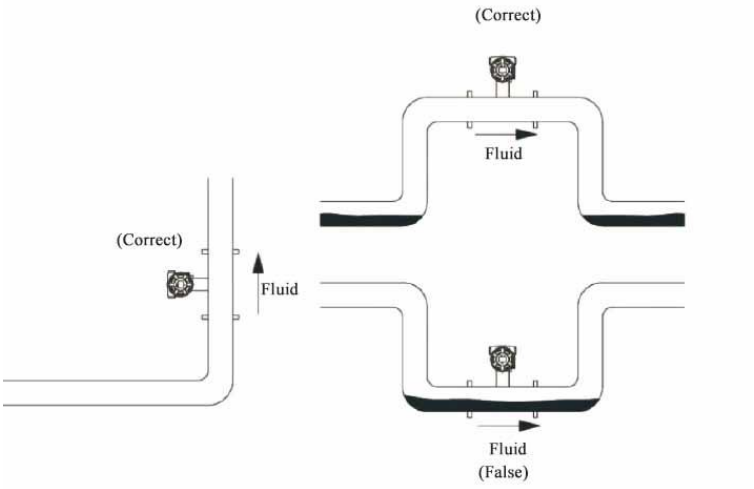
① Precautions for installation when measuring gas and steam

The pipeline for measuring gas or steam is to prevent the interference of accumulated liquid;

The flowmeter can be installed vertically on the pipeline to prevent fluid accumulation;

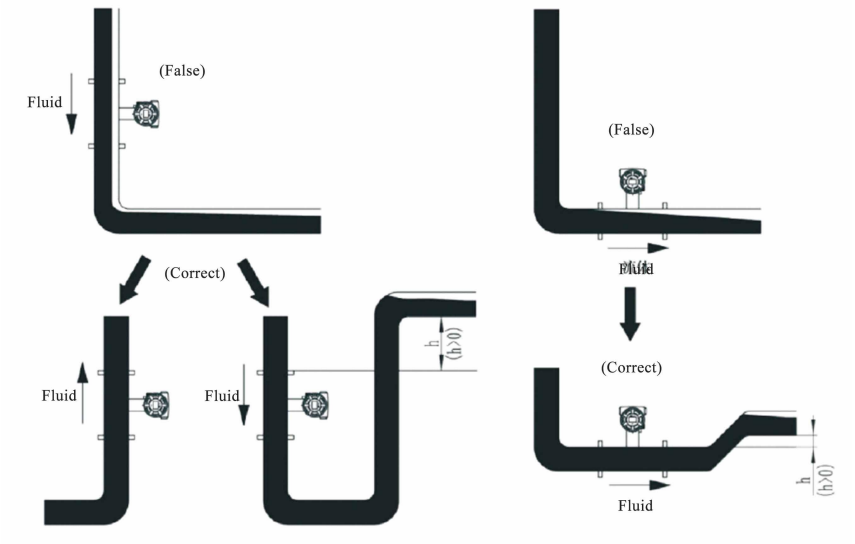
When installing the flowmeter horizontally, it is required to install the flowmeter at the highest position of the inverted U-shaped pipe:

It is forbidden to install it at the lowest position of the U-shaped pipe, where the condensate is easy to collect, and the condensation will form cavitation, which will lead to inaccurate measurement. In extreme conditions, the instrument will be damaged and the pipeline medium will leak.



② Precautions for installation when measuring liquid

In order to ensure accurate measurement, the measuring medium must fill the pipeline of the flowmeter; the fluid should flow upward; when the fluid flows downward, the installation position of the vortex flowmeter must be lower than the height of the downstream pipeline to ensure that the vortex flowmeter is full.



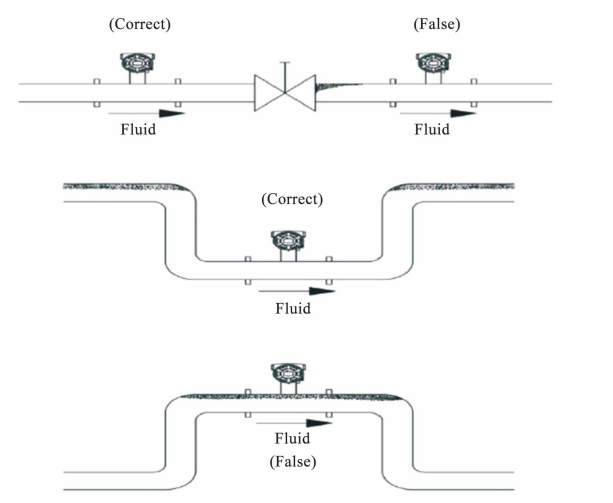
To avoid bubbles

If the medium is two-phase flow (containing liquid and gas), the measurement accuracy of the instrument will be affected, which will lead to abnormal operation of the flowmeter in severe cases;

When it is necessary to make the measuring medium liquid contain no bubbles, it is required to avoid bubbles when installing the pipeline;

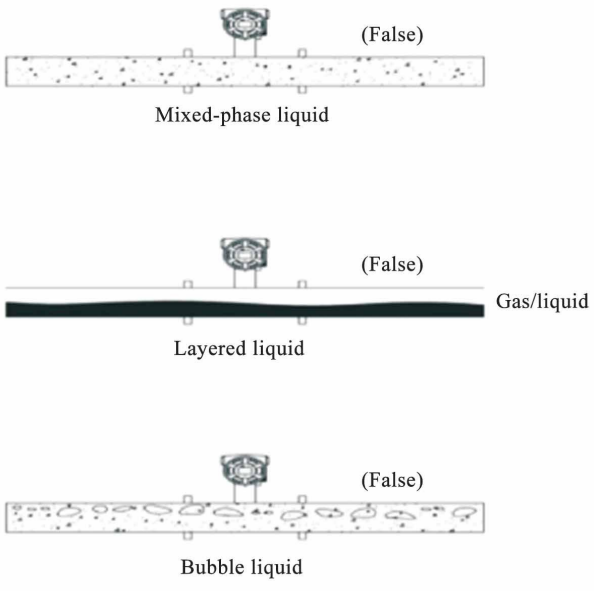
When the liquid flows through the control valve, bubbles will be generated due to pressure drop. If the flowmeter is installed downstream of the valve, the measurement will be inaccurate due to the influence of bubbles. The correct installation method is that the flowmeter should be installed upstream of the valve.

It is forbidden to install the flowmeter at the top of the inverted U-shaped pipe;

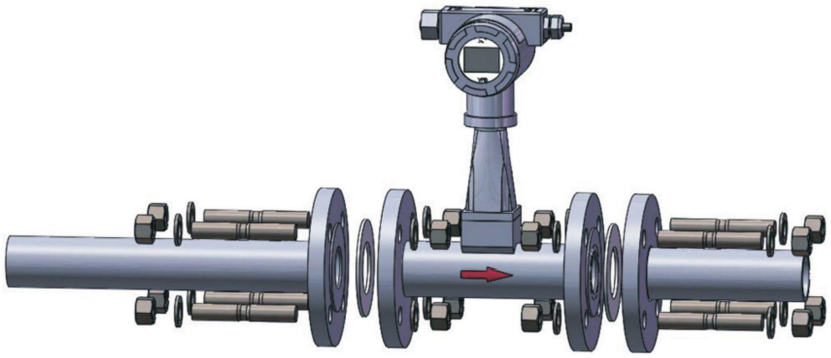


③ Mixed-phase flow

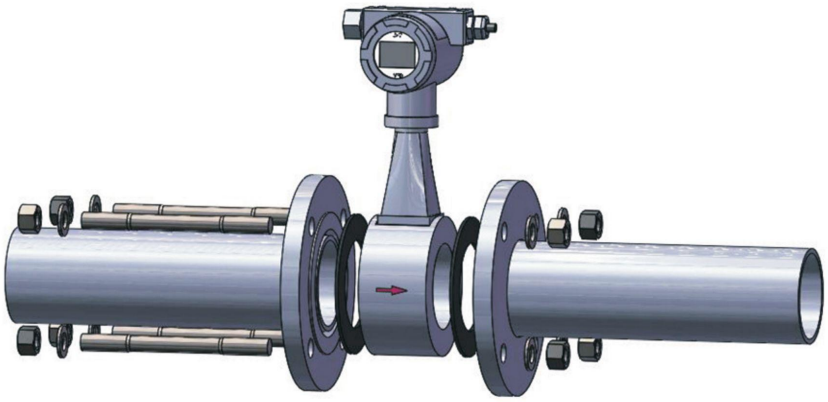
When the measured fluid is single-phase flow, the flowmeter can accurately measure gas, steam and liquid. When the measured fluid is a mixed-phase flow, the flowmeter cannot make an accurate judgment.



(3) Schematic diagram of installation



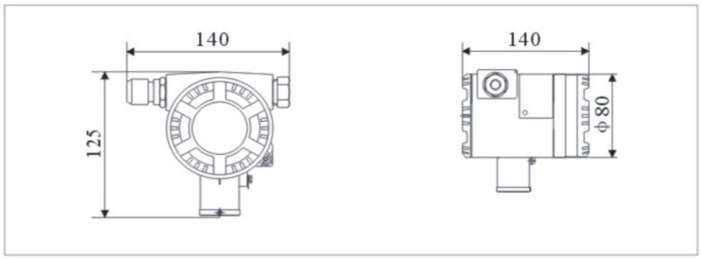
Installation Mode of Flange Flowmeter



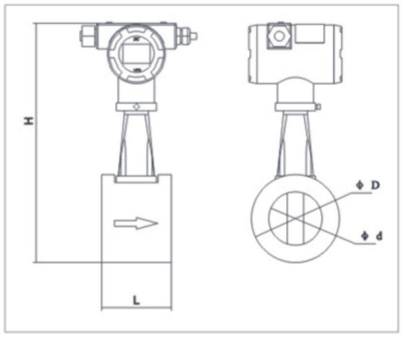
Installation mode of clamped flowmeter

2. Overall Dimensions

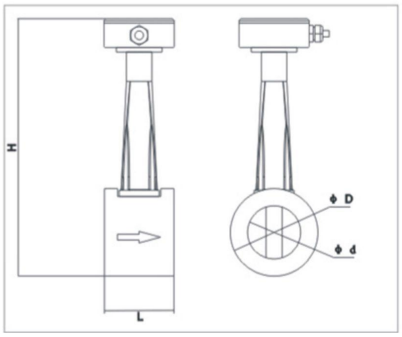
(1) Overall dimensions of the converter



(2) Overall dimensions of VFD card-mounted vortex flowmeter



Integrated type



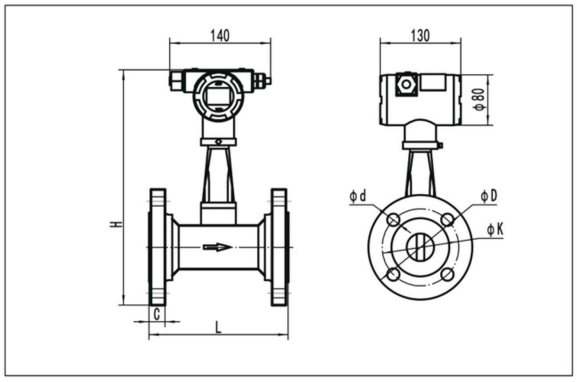
Split type (sensor)

Unit: (mm)

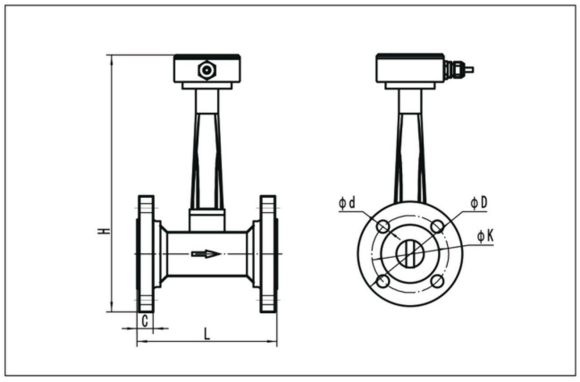
Nominal diameter	Length of meter body L	ID of meter body d	OD of meter body D	Height of meter body H	
				Integrated type	Split type
15	65	15	55	260	290
20	65	20	55	260	290
25	65	25	55	260	290
32	65	32	85	290	320
40	65	40	85	290	320
50	65	50	100	300	330
65	75	65	130	320	350
80	65	80	130	330	360
100	65	100	150	350	380
125	65	125	175	375	405
150	65	150	200	400	430
200	100	200	250	455	485
250	100	250	300	505	535
300	120	300	350	555	585

• Note: The clamp-on vortex flowmeter is provided with supporting flanges, bolts and gaskets in case of delivery from factory.

(3) Overall dimensions drawing of VFD flange vortex flowmeter (1.0MPa)



Integrated type

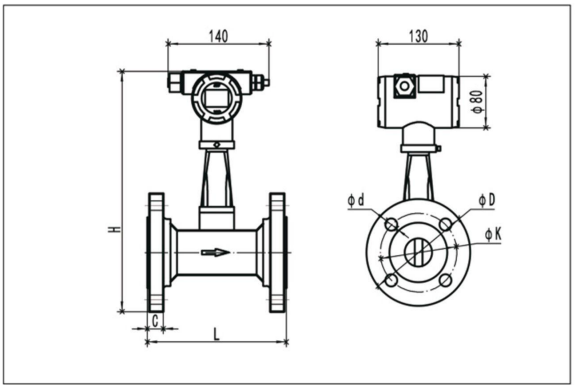


Split type

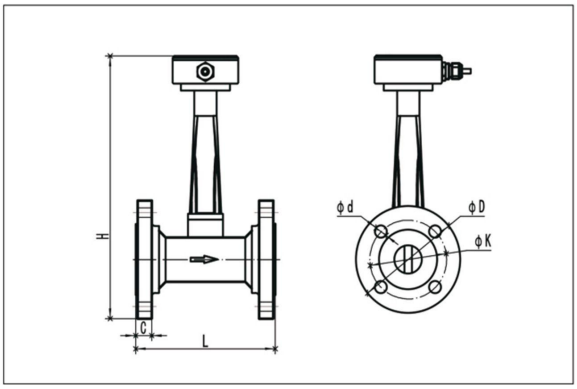
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
1.0 MPa	15	200	305	335	15	95	65	14	4	14
	20	200	310	340	20	105	75	14	4	16
	25	200	315	345	25	115	85	14	4	16
	32	200	325	355	32	140	100	18	4	18
	40	200	330	360	40	150	110	18	4	18
	50	200	345	375	50	165	125	18	4	20
	65	200	365	395	65	185	145	18	8	20
	80	200	375	405	80	200	160	18	8	20
	100	250	398	428	100	220	180	18	8	22
	125	250	420	450	125	250	210	18	8	22
	150	300	453	483	150	285	240	22	8	24
	200	350	510	540	200	340	295	22	8	24
	250	450	560	590	250	395	350	22	12	26
	300	500	610	640	300	445	400	22	12	26
	350	500	670	700	350	505	460	22	16	28
	400	600	723	753	400	565	515	26	16	32
	500	600	830	860	500	670	620	26	20	38
	600	600	938	968	600	780	725	30	20	42

(4) Overall dimensions drawing of VFD flange vortex flowmeter (1.6MPa)



Integrated type

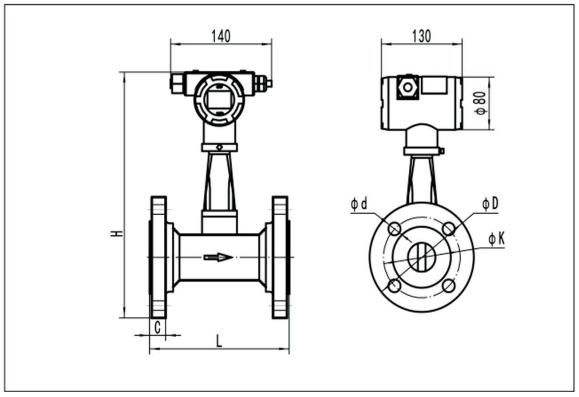


Split type

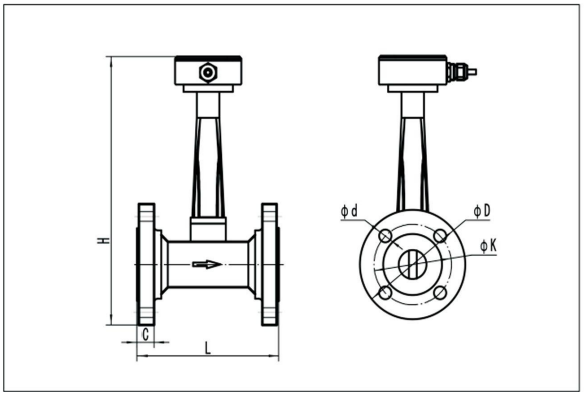
Unit: (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
1.6MPa	15	200	305	335	15	95	65	14	4	14
	20	200	310	340	20	105	75	14	4	16
	25	200	315	345	25	115	85	14	4	16
	32	200	325	355	32	140	100	18	4	18
	40	200	330	360	40	150	110	18	4	18
	50	200	345	375	50	165	125	18	4	20
	65	200	365	395	65	185	145	18	8	20
	80	200	375	405	80	200	160	18	8	20
	100	250	398	428	100	220	180	18	8	22
	125	250	420	450	125	250	210	18	8	22
	150	300	453	483	150	285	240	22	8	24
	200	350	510	540	200	340	295	22	12	26
	250	450	565	595	250	405	355	26	12	29
	300	500	618	648	300	460	410	26	12	32
	350	500	678	708	350	520	470	26	16	35
	400	600	730	760	400	580	525	30	16	38
	500	600	853	883	500	715	650	33	20	46
	600	600	968	998	600	840	770	33	20	52

(5) Overall dimensions drawing of VFD flange vortex flowmeter (2.5MPa)



Integrated type

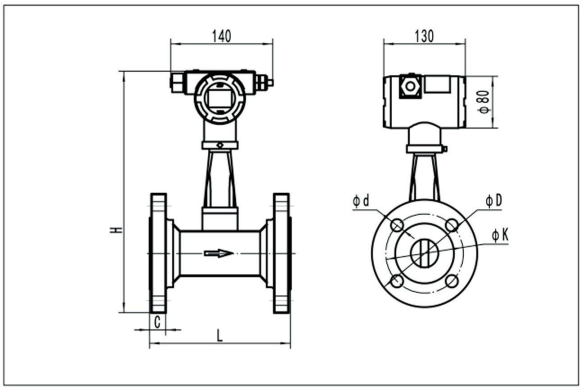


Split type

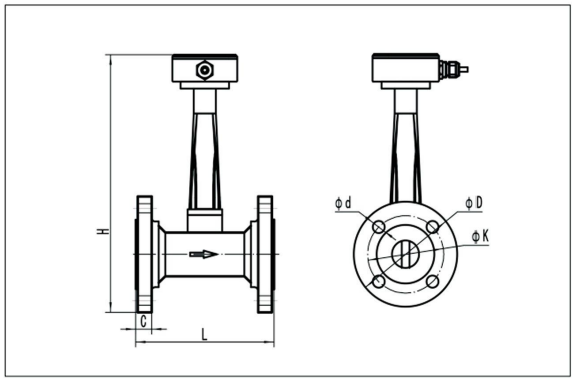
Unit: (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
2.5MPa	15	200	305	335	15	95	65	14	*4*	14
	20	200	310	340	20	105	75	14	*4*	16
	25	200	315	345	25	115	85	14	*4*	16
	32	200	325	355	32	140	100	18	*4*	18
	40	200	330	360	40	150	110	18	*4*	18
	50	200	345	375	50	165	125	18	*4*	20
	65	200	365	395	65	185	145	18	*8*	22
	80	200	375	405	80	200	160	18	8	24
	100	250	405	435	100	235	190	22	8	26
	125	250	430	460	125	270	220	26	8	28
	150	300	460	490	150	300	250	26	8	30
	200	350	520	550	200	360	310	26	12	32
	250	450	575	605	250	425	370	30	12	35
	300	500	630	660	300	485	430	30	16	38
	350	500	695	725	350	555	490	33	16	42
	400	600	750	780	400	620	550	36	16	46
	500	600	860	890	500	730	660	36	20	56
	600	600	970	1000	600	845	770	39	20	68

(6) Overall dimensions drawing of VFD flange vortex flowmeter (4.0MPa)



Integrated type

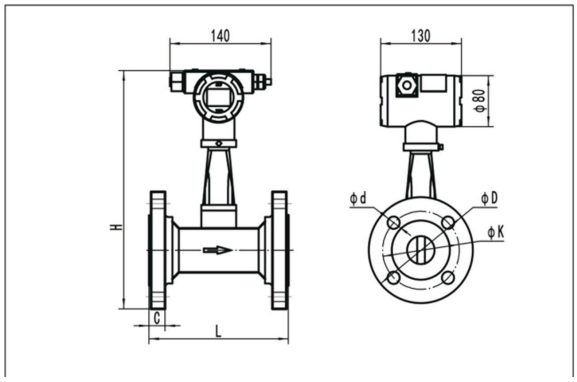


Split type

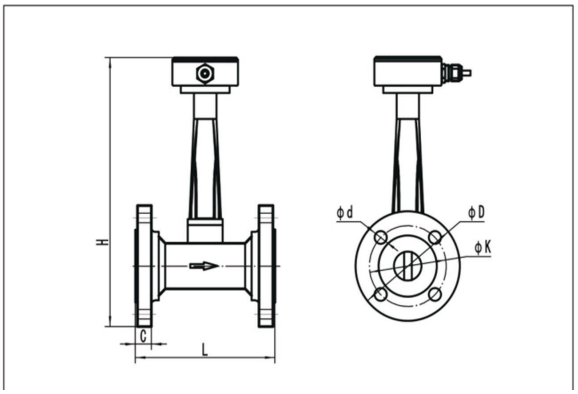
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
4.0MPa	15	200	305	335	15	95	65	14	4	14
	20	200	310	340	20	105	75	14	4	16
	25	200	315	345	25	115	85	14	4	16
	32	200	325	355	32	140	100	18	4	18
	40	200	330	360	40	150	110	18	4	18
	50	200	345	375	50	165	125	18	4	20
	65	200	365	395	65	185	145	18	8	22
	80	200	375	405	80	200	160	18	8	24
	100	250	405	435	100	235	190	22	8	26
	125	250	430	460	125	270	220	26	8	28
	150	300	460	490	150	300	250	26	8	30
	200	350	528	558	200	375	320	30	12	36
	250	450	589	618	250	450	385	33	12	42
	300	500	645	675	300	515	450	33	16	48
	350	500	708	738	350	580	510	36	16	54
	400	600	770	800	400	660	585	39	16	60
	500	600	873	903	500	755	670	42	20	72
	600	600	993	1023	600	890	795	48	20	84

(7) Overall dimensions drawing of VFD flange vortex flowmeter (ANSI150)



Integrated type

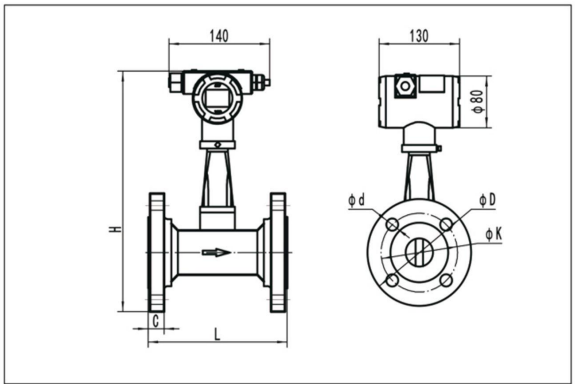


Split type

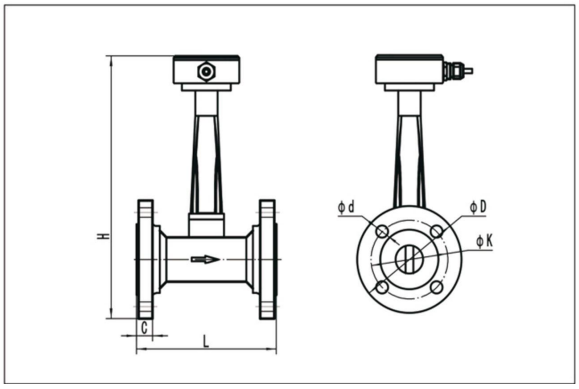
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
ANSI 150	15	200	303	333	15	90	60.3	16	4	11.6
	20	200	308	338	20	100	69.9	16	4	13.2
	25	200	313	343	25	110	79.4	16	4	14.7
	32	200	313	343	32	115	88.9	16	4	16.3
	40	200	318	348	40	125	98.4	16	4	18
	50	200	338	368	50	150	120. 7	18	4	19.5
	65	200	363	393	65	180	139. 7	18	4	22.7
	80	200	370	400	80	190	152.4	18	4	24.3
	100	250	403	433	100	230	190.5	18	8	24.3
	125	250	423	453	125	255	215.9	22	8	24.3
	150	300	450	480	150	280	241.3	22	8	26
	200	350	513	543	200	345	298.5	22	8	29
	250	450	565	595	250	405	362	26	12	30.6
	300	500	630	660	300	485	431.8	26	12	32.2
	350	500	685	715	350	535	476.3	30	12	35.4
	400	600	738	768	400	595	539.8	30	16	37
	500	600	845	875	500	700	635	33	20	43.3
	600	600	955	985	600	815	749.3	36	20	48.1

(8) Overall dimensions drawing of VFD flange vortex flowmeter (ANSI300)



Integrated type

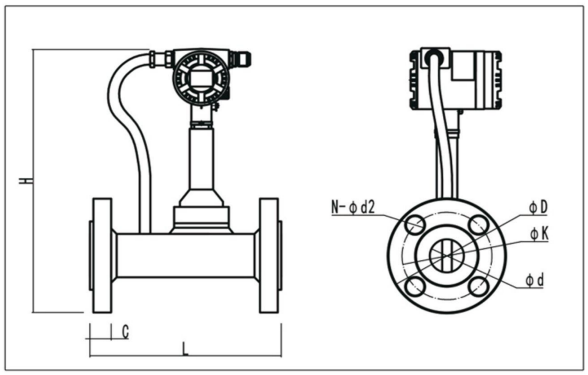


Split type

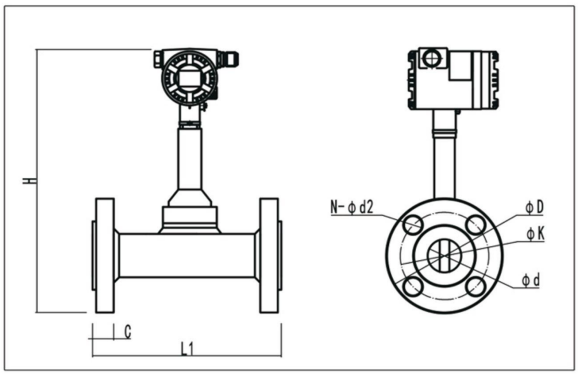
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Height of meter body H		ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
			Integrated type	Split type						
ANSI 300	15	200	305	335	15	95	66.7	16	4	14.7
	20	200	315	345	20	115	82.6	18	4	16.3
	25	200	320	350	25	125	88.9	18	4	18
	32	200	323	353	32	135	98.4	18	4	19.5
	40	200	333	363	40	155	114.3	*22*	4	21. 1
	50	200	345	375	50	165	127	18	8	22.7
	65	200	368	398	65	190	149.2	22	8	26
	80	200	380	410	80	210	168.3	22	8	29
	100	250	415	445	100	255	200	22	8	32.2
	125	250	435	465	125	280	235	22	8	35.4
	150	300	470	500	150	320	269.9	22	12	37
	200	350	530	560	200	380	330.2	26	12	41.7
	250	450	585	615	250	445	387.4	30	16	48.1
	300	500	648	678	300	520	450.8	33	16	51.3
	350	500	710	740	350	585	514.4	33	20	54.4
	400	600	765	795	400	650	571.5	36	20	57.6
	500	600	883	913	500	775	685.8	36	*24*	64
	600	600	1005	1035	600	915	812.8	42	*24*	70.3

(9) Overall dimensions drawing of VFE flange vortex flowmeter (1.0MPa)



Temperature and pressure compensation

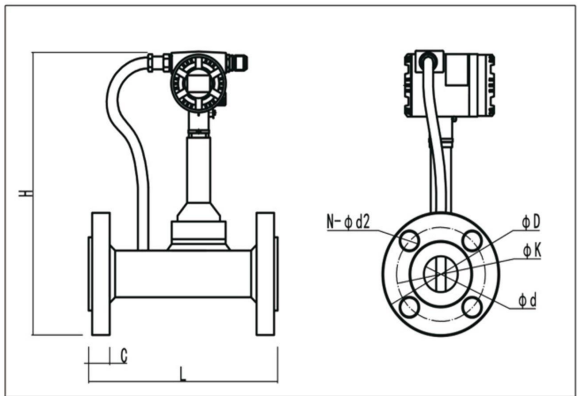


Temperature compensation

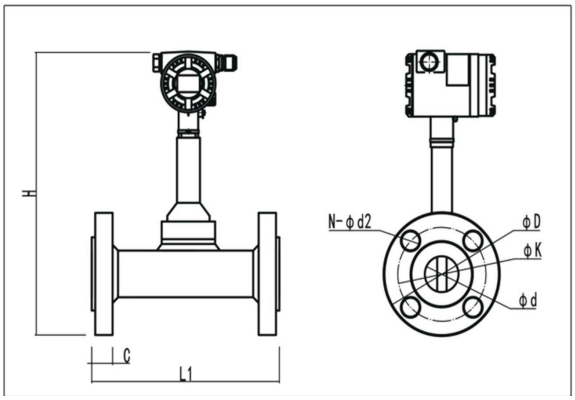
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
1.0MPa	15	250	200	435	15	95	65	14	4	14
	20	250	200	440	20	105	75	14	4	16
	25	250	200	445	25	115	85	14	4	16
	32	250	200	455	32	140	100	18	4	18
	40	200	200	460	40	150	110	18	4	18
	50	200	200	475	50	165	125	18	4	19
	65	200	200	495	65	185	145	18	8	20
	80	200	200	505	80	200	160	18	8	20
	100	250	250	528	100	220	180	18	8	22
	125	250	250	550	125	250	210	18	8	22
	150	300	300	583	150	285	240	22	8	24
	200	350	350	640	200	340	295	22	8	24
	250	450	450	690	250	395	350	22	12	26
	300	500	500	710	300	445	400	22	12	26

(10) Overall dimensions drawing of VFE flange vortex flowmeter (1.6MPa)



Temperature and pressure compensation

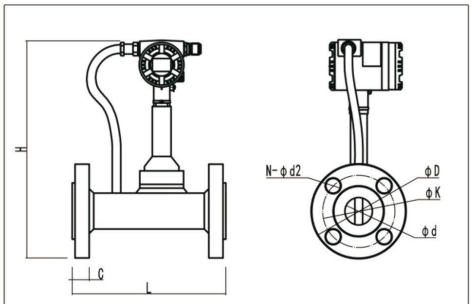


Temperature compensation

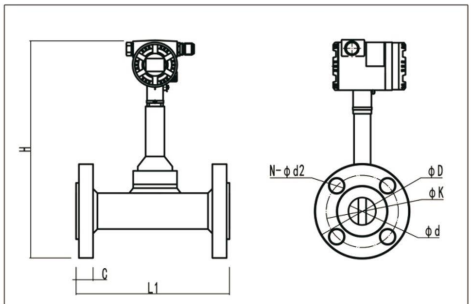
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
1.6MPa	15	250	200	435	15	95	65	14	4	14
	20	250	200	440	20	105	75	14	4	16
	25	250	200	445	25	115	85	14	4	16
	32	250	200	455	32	140	100	18	4	18
	40	200	200	460	40	150	110	18	4	18
	50	200	200	475	50	165	125	18	4	19
	65	200	200	495	65	185	145	18	8	20
	80	200	200	505	80	200	160	18	8	20
	100	250	250	528	100	220	180	18	8	22
	125	250	250	550	125	250	210	18	8	22
	150	300	300	583	150	285	240	22	8	24
	200	350	350	640	200	340	295	22	12	26
	250	450	450	695	250	405	355	26	12	29
	300	500	500	718	300	460	410	26	12	32

(11) Overall dimensions drawing of VFE flange vortex flowmeter (2.5MPa)



Temperature and pressure compensation

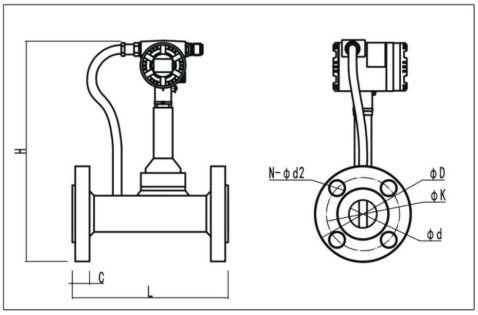


Temperature compensation

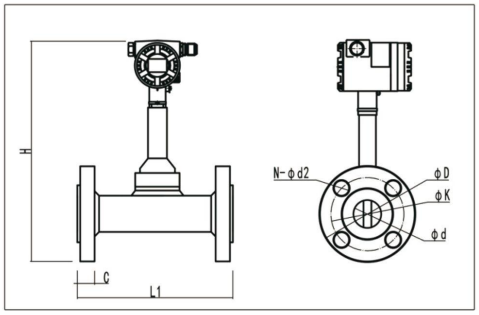
Unit: (mm)

Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
2.5MPa	15	250	200	435	15	95	65	14	4	14
	20	250	200	440	20	105	75	14	*4*	16
	25	250	200	445	25	115	85	14	*4*	16
	32	250	200	455	32	140	100	18	4	18
	40	200	200	460	40	150	110	18	*4*	18
	50	200	200	475	50	165	125	18	*4*	20
	65	200	200	495	65	185	145	18	*8*	22
	80	250	200	505	80	200	160	18	*8*	24
	100	250	250	535	100	235	190	22	*8*	26
	125	250	250	560	125	270	220	26	*8*	28
	150	300	300	590	150	300	250	26	*8*	30
	200	350	350	650	200	360	310	26	*12*	32
	250	450	450	705	250	425	370	30	*12*	35
	300	500	500	730	300	485	430	30	16	38

(12) Overall dimensions drawing of VFE flange vortex flowmeter (4.0MPa)



Temperature and pressure compensation

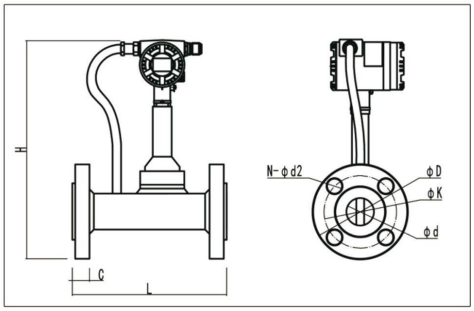


Temperature compensation

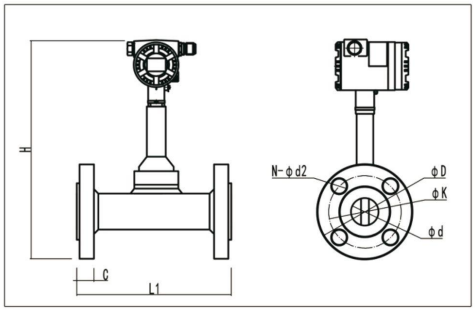
Unit (mm)

Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
4.0MPa	15	250	200	435	15	95	65	14	4	14
	20	250	200	440	20	105	75	14	4	16
	25	250	200	445	25	115	85	14	4	16
	32	250	200	455	32	140	100	18	4	18
	40	200	200	460	40	150	110	18	4	18
	50	200	200	475	50	165	125	18	4	20
	65	200	200	495	65	185	145	18	8	22
	80	250	200	505	80	200	160	18	8	24
	100	250	250	535	100	235	190	22	8	26
	125	250	250	560	125	270	220	26	8	28
	150	300	300	590	150	300	250	26	8	30
	200	350	350	658	200	375	320	30	12	36
	250	450	450	718	250	450	385	33	12	42
	300	500	500	745	300	515	450	33	16	48

(13) Overall dimensions drawing of VFE flange vortex flowmeter (ANSI150)



Temperature and pressure compensation

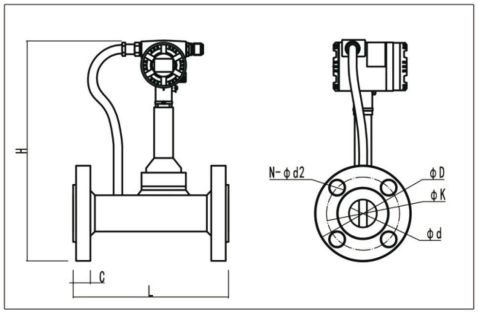


Temperature compensation

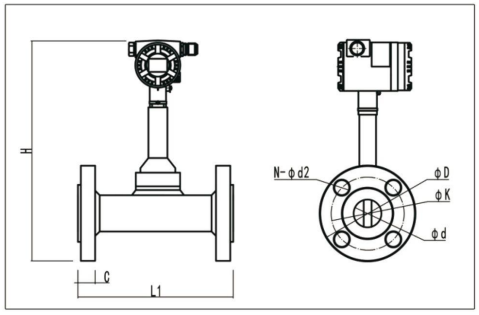
Unit: (mm)

Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
ANSI 150	15	250	200	433	15	90	60.3	16	4	11.6
	20	250	200	438	20	100	69.9	16	4	13.2
	25	250	200	443	25	110	79.4	16	4	14.7
	32	250	200	443	32	115	88.9	16	4	16.3
	40	200	200	448	40	125	98.4	16	4	17.9
	50	200	200	468	50	150	120.7	18	4	19.5
	65	200	200	493	65	180	139.7	18	4	22.7
	80	250	250	500	80	190	152.4	18	4	24.3
	100	250	250	533	100	230	190.5	18	8	24.3
	125	250	250	553	125	255	215.9	22	8	24.3
	150	300	300	580	150	280	241.3	22	8	25.9
	200	350	350	643	200	345	298.5	22	8	29
	250	450	450	695	250	405	362	26	12	30.6
	300	500	500	730	300	485	431.8	26	12	32.2

(14) Overall dimensions drawing of VFE flange vortex flowmeter (ANSI300)



Temperature and pressure compensation



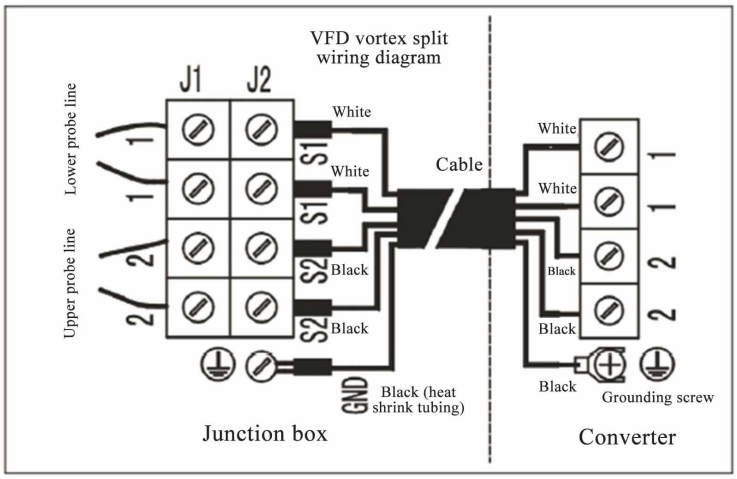
Temperature compensation

Unit (mm)

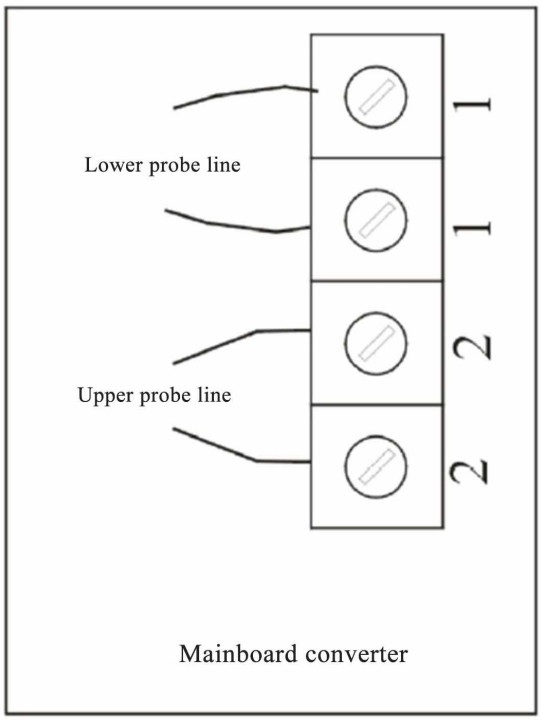
Nominal pressure	Nominal diameter	Instrument length L	Instrument length **L1**	Height of meter body H	ID of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Number of bolts N	Flange thickness C
ANSI 300	15	250	200	435	15	95	66.7	16	4	14.7
	20	250	200	445	20	115	82.6	18	4	16.3
	25	250	200	450	25	125	88.9	18	4	18
	32	250	200	453	32	135	98.4	18	4	19.5
	40	200	200	463	40	155	114.3	22	4	21.1
	50	250	200	475	50	165	127	18	8	22.7
	65	250	250	498	65	190	149.2	22	8	26
	80	250	250	510	80	210	168.3	22	8	29
	100	300	250	545	100	255	200	22	8	32.2
	125	300	250	565	125	280	235	22	8	35.4
	150	300	300	600	150	320	269.9	22	12	37
	200	350	350	660	200	380	330.2	26	12	41.7
	250	450	450	715	250	445	387.4	30	16	48.1
	300	500	500	748	300	520	450.8	33	16	51.3

3. Electrical Wiring

(1) Vortex street wiring diagram



Integrated wiring diagram



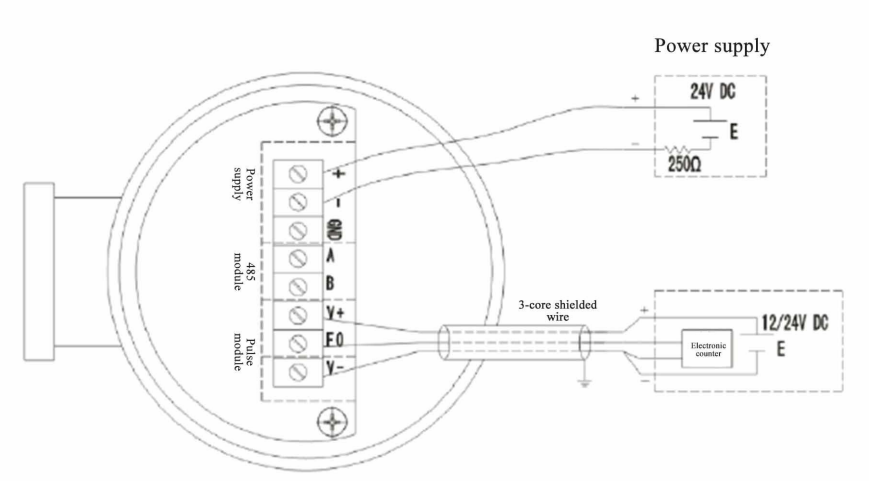
Notes:

Probe line color discrimination

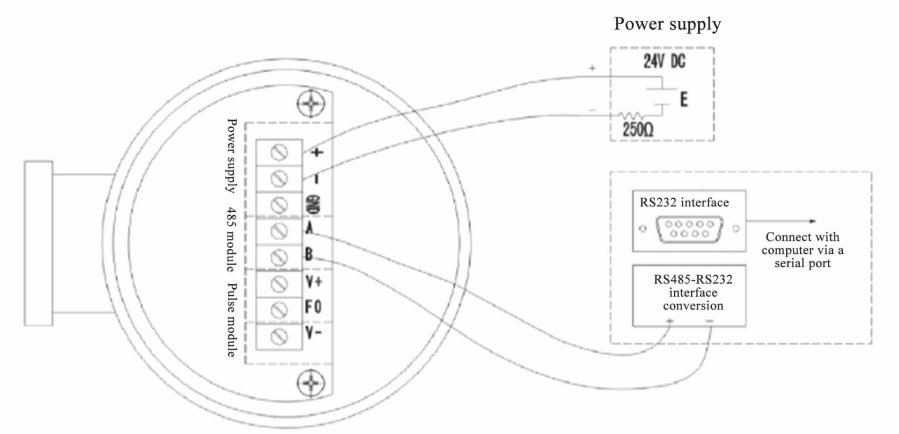
120℃:	Top blue Bottom white	200℃:	Top red White bottom	400℃:	Top yellow Bottom white (The white line is always the lower probe)

(2) Vortex converter wiring diagram

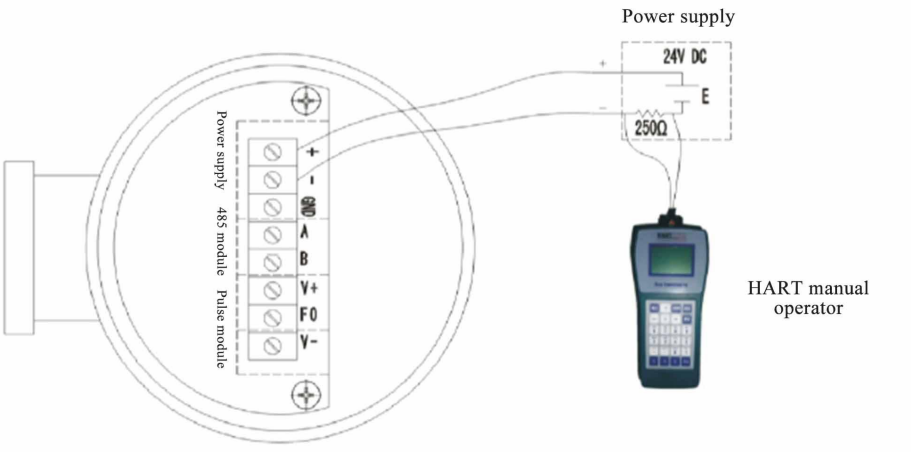
Analog/pulse output



Analog /RS485 output

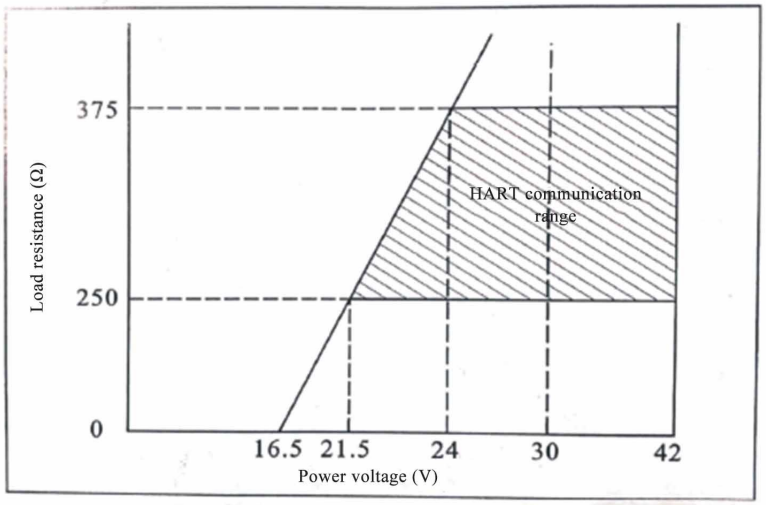


Analog /HART output



(3) Relationship between power supply voltage and load resistance

Load resistance refers to the sum of the total resistances of power cord, controller and related equipment. If a safety barrier is used, the resistance of the safety barrier must be included.

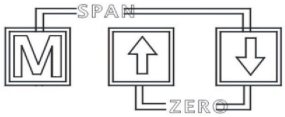


Relationship between power supply voltage and load resistance

(4-20mADC output)

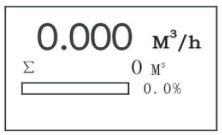
III. Parameter Settings

1. Converter Key Layout of Vortex Flowmeter:



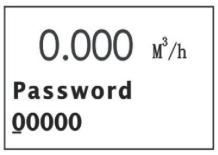
2. Main Interface:

The first line: Instantaneous flow. For details of flow unit, see menu settings;
The second line: Cumulative total. See the menu settings for details of the total unit (after setting Tot ClrEn to 1 in the parameter menu, you can reset the total by pressing ⇧);
The third line: Bar chart and range percentage, indicating the percentage value of current flow rate to full range; after ⇩ is pressed, the display will switch to the login interface, as shown in the following figure:



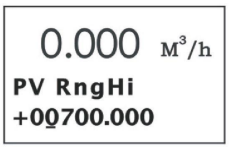
3. Login Interface:

The first line: Instantaneous flow. For details of flow unit, see menu settings;
The second line: Password input identifier;
The third line: Password input area (it is composed of five zeros by default, and the first zero flashes to indicate input. Press ⇩ to switch the input position in the lateral direction and press ⇧ to modify the value);
Instrument password: 04121;
After the password is entered, press M to confirm. If the wrong password is input, the display will switch back to the main interface; otherwise, the display will switch to the parameter modification interface, as shown in the right figure:



4. Parameter Modification Interface:

The first line: Instantaneous flow. For details of flow unit, see menu settings;
The second line: Parameter identifier, which displays PV RngHi (upper range limit) by default;
The third line: Parameter value corresponding to the current parameter identifier;
For the position of each parameter identifier, please refer to "5. Parameter Table of Vortex Flowmeter". For the definition of each parameter identifier, please refer to "6. Parameter Definition of Vortex Flowmeter";
⇩In working state, switch the parameter identifier in lateral direction;
MIn working state, switch the parameter identifier in longitudinal direction;
In working state, press and hold M first, and then press ⇧, the display will switch back to the main interface;


0.000 M³/h
PV RngHi
+00700.000

5. Parameter Table of Vortex Flowmeter:

Parameter Table of Vortex Flowmeter

Longitudinal switching of parameter identifier

Lateral switching of parameter identifier

Flow menu	Current menu	Frequency menu	Total amount menu	Temperature and pressure compensation menu	Temperature and pressure calibration menu	Alarm menu	Sensor menu	Test menu	Communication menu	Signal processing menu
PV RngHi	Anlg Fsd	Pls Fact	TotU Ltr	DsU SGU	Temt PntH	Ahn TripHi	Snsr No	Test Mode	Disp Res	Vot baseM
PV RngLo	Anlg Zero	Pls Cutoff	Tot ClrEn	Densty Set	Temt PFtH	Ahn TripLo	Snsr Gain	Test Flow	Wr Protect	Vot baseP
PVU Ltr/S	PVmA Value	Pls Max	Tot PassWd	Temper Val	Temt PntL	Ahn TrHyst	Gain SetEn	Test Per	Header Num/B and Rate	Vot baseN
PV Rspns1	PVmA Fsd	Pls Hz		Pres Val	Temt PFtL		Snsr Size	Test Hz	Net Adr	Vot medium
PV Cutoff	PVmA Zero	Pls Idle		Temper Val0	Pres Zero		Snsr Pls	Test mA	Copy Ref	Vot manu
		Pls Size		Pres Val0	Pres Fact		Snsr Fact1	Test Pls		Notch Fre
				Medium Unt	Pres Pnt1		Snsr Fact2	Test Alm		Notch Wid
					Pres PFt1		Snsr Pnt1			Notch Dep
					Pres Put2		Snsr PFt1			Notch Auto
					Pres PFt2		Snsr Pnt2			Fre RngH
					Pres Pnt3		Snsr PFt2			Fre RngL
					Pres PFt3		Snsr Pnt3			Rat Gain
					Pres Pnt4		Snsr PFt3			Soft Ver
					Pres PFt4		Snsr Pnt4			
					Pres Pnt5		Snsr PF t4			
					Pres PFt5		Snsr Pnt5			
					Pres Pnt1		Snsr PFt5			

Parameter modification

When ⇧ is pressed in the working state, the display switches to the user parameter setting state (the third line of values or the second half of characters on the second line begin to blink, indicating that the parameters enter the modifiable or selectable state, that is, the parameter setting state, such as password setting mode);

⇩Adjust the parameter input position laterally or switch options (the latter is generally used for unit selection) in the parameter setting state.

⇧Adjust the size of the selected parameter or switch options in the parameter setting state;

M Confirm and complete the current modification in the parameter setting state. The display is switched to the working state.

6. Parameter Definition of Vortex Flowmeter

Flow menu	
PV RngHi	Upper range limit
PV RngLo	Lower range limit
PVU Ltr/S	Flow unit (please refer to "Description of Flow Unit" in the following chapters for details)
PV Rspns1	Damping (seconds)
PV Cutoff	Small signal excision (default: 0, unit: m^3/h)
Current menu	
Anlg Fsd	Current value corresponding to the upper limit of flow output;
Anlg Zero	Current value corresponding to the lower limit of flow output;
PVmA Value	Current value;
PVmA Fsd	Current output full-scale correction (the current output increases or decreases by 0.004-0.005mA for every addition or subtraction of this value by 1);
PVmA Zero	Current output zero correction (the current output increases or decreases by 0.004-0.005mA for every addition or subtraction of this value by 1);
Frequency menu	
Pls Fact	The number of pulses generated by unit volume flow is 3.6 by default (Pls Idle 0/1 mode is effective).
Pls Cutoff	50Hz interference signal excision (1 on, 0 off, default 0)
Pls Max	The upper limit of output pulse frequency (Hz) is 2000 Hz by default (Pls Idle 0/1 mode is effective).
Pls Hz	Current output frequency (Hz)
Pls Idle	Frequency output mode (0/1: instrument operation frequency output; 3: sensor frequency output; default 3);
Pls Size	Output pulse width ms (0 for square wave, not open for modification temporarily);
Total amount menu	
TotU Ltr	Total unit (please refer to "Description of Total Unit" in the following chapters for details);
Tot ClrEn	Total amount reset enabling (default: 0; if total amount needs to be cleared, please set it to 1, and then operate according to the introductions in the second section, "Main Interface")
Tot PassWd	Password for total modification;
Tot FwdLng	Integer part of total value;
Tot FwdFlt	Decimal part of total value;
Temperature and pressure compensation menu	
DsU SGU	Density unit (not used yet)
Densty Set	Medium density (Kg/m^3)
Temper Val	Temperature in standard state (20℃ by default)
Pres Val	Local atmospheric pressure (KPa) is 101.3KPa by default.
Temper Val0	Working temperature/set temperature, in ℃ (default 0)
Pres Val0	Working pressure/set pressure, in kPa (default 0)
Medium Unt	Medium operation module (default 0): 0: No compensation, output volume flow in working condition, in m^3/h; 1: Ideal gas temperature and pressure compensation, output flow in standard condition. At this time, set the flow unit as m^3/h, and the total unit as Nm^3/h and Nm^3; 2: Natural gas temperature and pressure compensation, output flow in standard condition. At this time, set the flow unit as m^3/h, and the total unit as m^3, displaying as Nm^3/h and Nm^3; 3: Saturated steam temperature compensation, output mass flow. At this time, the flow unit and total unit are modified into mass units; 4. Saturated steam pressure compensation, output mass flow. At this time, the flow unit and total unit are modified into mass units; 5: Superheated steam temperature and pressure compensation, output mass flow. At this time, the flow unit and total unit are modified into mass units; 6: Hot water compensation, output mass flow. At this time, the flow unit and total unit are modified into mass units; 7: Liquid ammonia compensation, output mass flow. At this time, the flow unit and total unit are modified into mass units;

Temperature and pressure compensation menu	
Temt PntH	High point standard temperature (when this parameter is set to 0, the temperature in working condition can be set manually)
Temt PFtH	High point measured temperature
Temt PntL	Low point standard temperature
Temt PFtL	Low point measured temperature
Pres Zero	Automatic pressure reset (before using this function, ensure that the gauge pressure in the pipeline is 0, set it to 1 to start automatic reset, and wait for this parameter to become 0 to indicate the end of reset)
Pres Fact	Pressure coefficient
Pres Pnt1	Standard pressure at point 1 (when this parameter is set to 0, the pressure in working condition can be set manually)
Pres PFt1	Measured pressure at point 1
Pres Pnt2	Standard pressure at point 2
Pres PFt2	Measured pressure at point 2
……	
Pres Pnt5	Standard pressure at point 5
Pres PFt5	Measured pressure at point 5
Alarm menu	
Alm TnpHi	Upper limit of flow alarm; (Once exceeding the upper limit of flow, the instrument will display the word ^Hi, which defaults to 0 and there is no alarm.)
Alm TnpLo	Lower limit of flow alarm; (Once lower than the upper limit of flow, the instrument will display the word ^Lo, which defaults to 0 and there is no alarm.)
Alm TrHyst	Flow alarm hysteresis space (%);
Sensor menu	
Snsr No	Instrument number (can be used as device ID in HART communication):
Snsr Gain	Signal amplification coefficient;
Gain SetEn	Automatic gain enabling (1 on, 0 off, default 1)
Snsr Size	Diameter (mm)
Snsr Pls	Total number of actual pulse outputs (Pls Idle 0 mode is valid);
Snsr Fact 1	Instrument coefficient K/instrument coefficient K at point 0;
Snsr Fact2	Calibrated instrument frequency at point 0 (default: 0)
Snsr Pnt1	Instrument coefficient K at point 1 (default: 0);
Snsr PFt1	Calibrated instrument frequency at point 1 (default: 0);
Snsr Pnt2	Instrument coefficient K at point 2 (default: 0);
Snsr PFt2	Calibrated instrument frequency at point 2 (default: 0);
……	……
Snsr Pnt5	Instrument coefficient K at point 5 (default: 0);
Snsr PFt5	Calibrated instrument frequency at point 5 (default: 0);

Test menu	
Test Mode	Test mode enabling (1 on, 0 off, default 0);
Test Flow	Test mode flow size;
Test Per	Test mode range percentage;
Test Hz	Test mode pulse output (Hz);
Test mA	Test mode current output (mA):
Test Pls	(Undefined);
Test Alm	(Undefined);
Communication menu	
Disp Res	Number of decimal places (3 by default)
Wr Protect	Write protection
Header Num	Number of preamble characters required for response message for HART communication & number of preamble characters required for request message
Baud Rate	Modbus (RS485) communication baud rate setting (0 is 4800bps, 1 is 9600bps, 2 is 19200bps, and the default is 0)
Net Adr	Short frame address
Copy Ref	Curing of instrument parameters (setting this parameter to 19 will cure the parameter, which will automatically return to 0 after completion)
Signal processing menu	
Vot baseM	Cut-off amplitude (the disorderly interference signal on site can be removed, and when this value is greater than Vot baseP, the instrument will return to zero)
Vot baseP	Signal amplitude (positive end)
Vot baseN	Signal amplitude (negative end, not used yet)
Vot medium	Medium type (1: liquid, 0: gas/steam, default 0)
Vot manu	Sampling frequency (1: 686 Hz, 2: 1290 Hz, 3: 3125 Hz, 4: 6696 Hz, default 3)
Notch Fre	Trap center frequency, default 0 (trap closed)
Notch Wid	Notch width, in Hz, (default 20)
Notch Dep	Notch depth (adjustable range 0.001-1, the smaller the value, the deeper the filtering depth, the default is 0.5)
Notch Auto	Automatic flow reset (the fixed interference signal on site can be removed, and there shall be no flow in the pipeline before use of this function. Set to 1 to start automatic reset, and wait for this parameter to become 0 after about 60 seconds to finish reset; set to 2 to cancel the reset function)
Fre RngH	Upper limit of filtering frequency,
Fre RngL	Lower limit of filtering frequency,
Rat Gain	Measure the channel adjustment threshold,
Soft Ver	Software version No.

7. Description of Flow Unit:

Ltr/s	liter/second	Ft^3/D	cubic feet/day	Bbl/min	barrel/minute	MT/h	metric ton/hour
Ltr/min	liter/minute	Gal/s	gallon/second	Bbl/h	barrel/hour	MT/D	metric ton/day
Ltt/h	liter/hour	Gal/min	gallon/minute	Bbl/D	barrel/day	Ib/s	pound/second
MLtr/D	million liters/day	Gal/h	gallon/hour	g/s	gram/second	Ib/min	pound/minute
m^3/s	cubic meter/second	Gal/D	gallon/day	g/min	gram/minute	Ib/h	pound/hour
m^3/m	cubic meter/minute	MGal/D	million gallons/day	g/h	gram/hour	ib/D	pound/day
m^3/h	cubic meter/hour	LGal/s	UK gallon/second	kg/s	kilogram/second	ST/min	Short ton/minute
m^3/D	cubic meter/day	LGal/min	UK gallon/minute	kg/m	kilogram/minute	ST/h	Short ton/hour
Ft^3/S	cubic feet/second	LGal/h	UK gallon/hour	kg/h	kilogram/hour	ST/D	Short ton/day
Ft^3/M	cubic feet/minute	1Gal/D	UK gallon/day	kg/D	kilogram/day	LT/h	Long ton/hour
Ft^3/h	cubic feet/hour	Bbl/s	barrel/second	MT/min	metric ton/minute	LT/D	Long ton/day

8. Description of Total Amount Unit:

Lty	liter	Yd^3	cubic yard	Bush	bushel	ST	Short ton
hLtr	hectoliter	Gal	gallon	g	gram	LT	Long ton
m^3	cubic meter	lGal	UK gallon	kg	kilogram	US	ounce
Ln^3	cubic inch	Bbl	barrel	MT	metric ton		
Ft^3	cubic feet	BblL	fluid barrel	ib	pound		

9. Description of Density Unit:

SGU	Special gravity unit	Ib/Gal	Pounds per gallon	kg/Ltr	Kilogram/liter	ST/Yd^3	Short ton/cubic yard
g/cm^3	Gram/cubic centimeter	ib/Ft^3	Pounds per cubic foot	g/Ltr	Gram/liter		
kg/m^3	Kilogram/cubic meter	g/ml	Gram/milliliter	ib/in^3	Pounds per cubic inch		

10. Special Parameter Setting:

By default, the instrument can be corrected using only the sensor coefficient Snsr Fact1 if the sensor is linear over the measuring range. If the sensor is non-linear over the measuring range, multiple measuring points are required for polyline correction (in this case, the definitions of Snsr Fact1 and Snsr Fact2 will change, and they will be used as the first measuring point).

Instrument coefficient K at point X	Snsr Fact1	Snsr Pnt1	Snsr Pnt2	Snsr Pnt3	Snsr Pnt4	Snsr Pnt5
Calibrated instrument frequency at point X	Snsr Fact2	Snsr PFt1	Snsr PFt2	Snsi PFt3	Snsr Pft4	Snsr PFt5

Large frequency → Small frequency

From large to small, 2~6 measuring points shall be set as required, and the range can be divided into five sections at most for correction.

11. Important Notes

Due to electromagnetic interference and pipeline vibration interference in the field, sometimes even if the flow is zero, the vortex flowmeter may have flow output. In this case, the interference can be suppressed by the following operation methods.

a. There is a fixed interference signal on site

The vortex flowmeter always displays a fixed flow value when there is no flow in the pipeline, and the fluctuation range is within 3%FS (full scale). At this time, the automatic flow reset function can be started. The specific operations are as follows:

(1) Ensure that there is no flow in the pipeline.

(2) Enter the signal processing menu, set the parameter Notch Auto to 1, and start automatic reset. After about 60 seconds, wait for this parameter to change to. Then reset is completed. Please check whether the vortex flowmeter returns to zero.

(3) If no, it means that the interference signal is too large, and you can try to manually reset, as follows:

① Set the trap center frequency Notch Fre: Enter the frequency menu to check the value of parameter Pls Hz, and then set the parameter Notch Fre to the value (integer) of Pls Hz;

② Set Notch Wid (Hz) to 10;

③ Set Notch Dep, which can be set in the range of 0-1. The smaller the value, the deeper the filtering depth. This value should be set from large to small, so as to just remove the interference and make the vortex flowmeter return to zero. It should not be too small, which may affect the normal flow measurement.

b. There is a chaotic interference signal on site

The vortex flowmeter still shows the flow when there is no flow in the pipeline, and the fluctuation range is greater than 3%FS (full scale). At this time, the chaotic interference signals can be cut off. The specific operations are as follows:

(1) Enter the signal processing menu, check the parameter Vot baseP (signal amplitude) for about 30 seconds, and record the maximum value of Vot baseP in these 30 seconds. And mark the maximum value of Vot baseP plus 3 as A value;

(2) Enter the signal processing menu and set the parameter Vot baseM (cut-off amplitude) to A;

(3) The value of parameter Vot baseM is suggested to be less than 30; otherwise, it may affect the small flow measurement of vortex flowmeter.

12. MODBUS (RS485) Communication Protocol Operation

a. Overview of MODBUS

Flow Master vortex flowmeter provides remote microcomputer (PC, IPC and PLC) to realize the system programming, data acquisition and field monitoring of flowmeter via RS-485 digital interface.

Including various densities, instantaneous flow, total, pressure, temperature, flow percentage, current, and frequency, etc. Its features are as follows:

(1) RS-485 digital interface (differential, half-duplex)

(2) Electric power pulse output, open-collector optocoupler output

(3) Settable communication parameters (address, baud rate and data format)

b. Analysis of MODBUS communication protocol:

MODBUS protocol is a master-slave point-to-point communication protocol. It is divided into RTU protocol and ASCII protocol. ModBus RTU communication protocol is applied to several kinds of our instruments because it allows the data communication between one master and several slaves; in the communication system, the mater is microcomputer (PC, IPC or PLC) and slaves are Flow Master vortex flowmeters. In the decentralized communication system, the system is allowed to connect up to 128 instruments and the communication distance is 1.2KM. The communication mode is that a slave responds to the request of a master. That is to say, a master makes a command request and a slave receives and analyzes the data in response to the request. If the data meets the requirement of the communication protocol, the slave makes a data response.

Every data frame sent by the master-slave communication host contains the following information (**hex** system):

Slave address	Command word	Information word	Check word

Slave address (1 byte): Slave device number. The master identifies the slave device for communication from the slave address. This indicates the slave with user-set address will receive the message sent by the master. Every slave must have unique address code, and only the slave corresponding to the address code can send back a response.

Command word (1 byte): The function code sent by the master tells the slave which task has to be executed.

Information word (N bytes): Including data addresses, data length and data information used in communication between two devices.

Check code (2 bytes): Cyclic redundancy code (CRC16) used for detecting the data communication error.

Note: A data address/length has 2 bytes, and data information has N bytes.

The read point (holding register) can be operated by way of communication command. The holding register is a 16-bit (2 bytes, i.e., 1 word) value, with the lower bit preceded by the higher one. In this way, the data area in the register is expressed by word address. The master must send a command to the register in the form of word (via WORD address). The Modbus communication system is predominated by word communication. For details, see examples. This instrument supports word address rather than byte address.

c. Application of digital interfaces

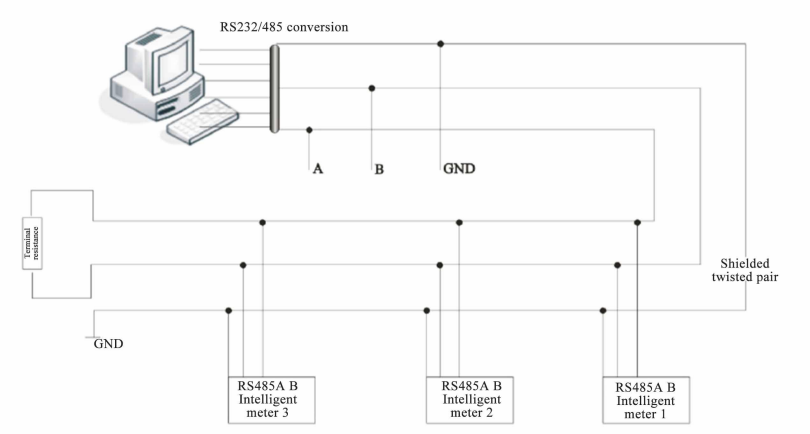
(1) Setting of communication parameter: The following communication parameters can be set from the programmable keyboard on the instrument.

Instrument address: Set the slave (instrument) address number in the communication network to 1~247. (Default 1)

Communication speed: Set the communication speed in the communication network to 4800bps (baud rate, optional).

Data format: The data format in the communication network is fixed to 1 start bit, 8 data bits, 1 stop bit and 0 check bit.

(2) Network connection: Connect the communication lines (RS485: A+, B-) on the instrument.



Note: It is recommended to use shielded twisted-pair cables as connecting lines. Every twisted-pair cable shall be earthed from both ends to reduce the field interference.

The reflective interference can be reduced by increasing the terminal resistance (Z0=120Ω). It is recommended to connect the lines when the communication speed is fast (>9600) or the communication distance is far (>700m).

(3) Communication test using communication test software

Communication (including instrument programming and data acquisition) can be realized after connecting communication interfaces (RS232/485), communication lines and instrument, running the test software ModS can / Modbus Pol1, and setting the parameters correctly.

(4) Packet format description

Command 03H: Read N bytes.

Master's request: Address command, data address, data length, check code

Slave's response: Address command, data length, data information, check code

(5) Example:

Read 2 data, density and flow, from the flowmeter with Address No. 2.

Solution: Select correct communication parameters according to data address list and command 3. Application of word communication mode:

Master's request: 02H 03H 00H 00H 00H 04H 44H 3AH (for information only. For correct addresses, please consult the parameter list)

Slave's response: 02H 03H 08H BYTE1 BYTE2 BYTE3 BYTE4 BYTE5? CRC16

Note: From data address list, it is known that the WORD address of current parameter is 0, i.e., 0000H. The data to be read is 4×2 BYTE data, meaning that the data length is 0004H. 44H3AH is CRC16 code.

The data sent back is 8-byte data, including flow rate (BYTE1, BYTE2, BYTE3 and BYTE4) and flow (BYTE5, BYTE6, BYTE7 and BYTE8). Its meaning meets the requirement of the data specification for float-point number format in IEEE-754.

(6) Description of IEEE-754 data format:

Float is consistent with IEEE-754. It has 7 significant figures in the decimal system. Float type data occupies four bytes (32-bit binary number). Such data in the memory are stored in the following form:

Byte address	+0	+1	+2	+ 3
Content of float-point number	S EEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

Where: S: sign bit, 0: +, 1: -. E is a level code. It occupies an 8-bit binary number. It is stored in two bytes. Note: The value of level code E is the exponent of 2 plus an offset (127). The purpose is to avoid a negative value of level code, but the exponent can be either positive or negative. The normal range of level code E is 1∽254, but the actual range is -126∽+127. M is the decimal part of mantissa represented by 23-bit binary number which is stored in three bytes. The integral part of mantissa is 1 forever. It is not stored but indeed exists. The decimal point follows the implicit integer bit “1”. The range of one float-point number is (-1) S×2E-127×(1.M).

For example, when the master reads XXX data, it can be known from the address table that XXX address is 0

(0000H), with a length of 2 (0002H).

Master: 01H 03H 00 00H 00 02H C4 0BH (for information only. For correct addresses, please consult the parameter list)

Slave: 01H 03H 04H 00 00 C1 48H ABH 95H

Among them, 00 00C1 48 is the communication format of current flow rate data, and the size is -12.5.

(According to IEEE754 format, it should be C1 48 00 00H). ABH and 95H are the low bit and high bit of check code CRC16 respectively.

(7) Introduction to check code algorithm:

The cyclic redundancy code CRC16 can be calculated according to the following algorithm flow chart. BYTE is the data code of each frame from beginning to end (Note: The high bit of CRC16 is preceded by low bit).

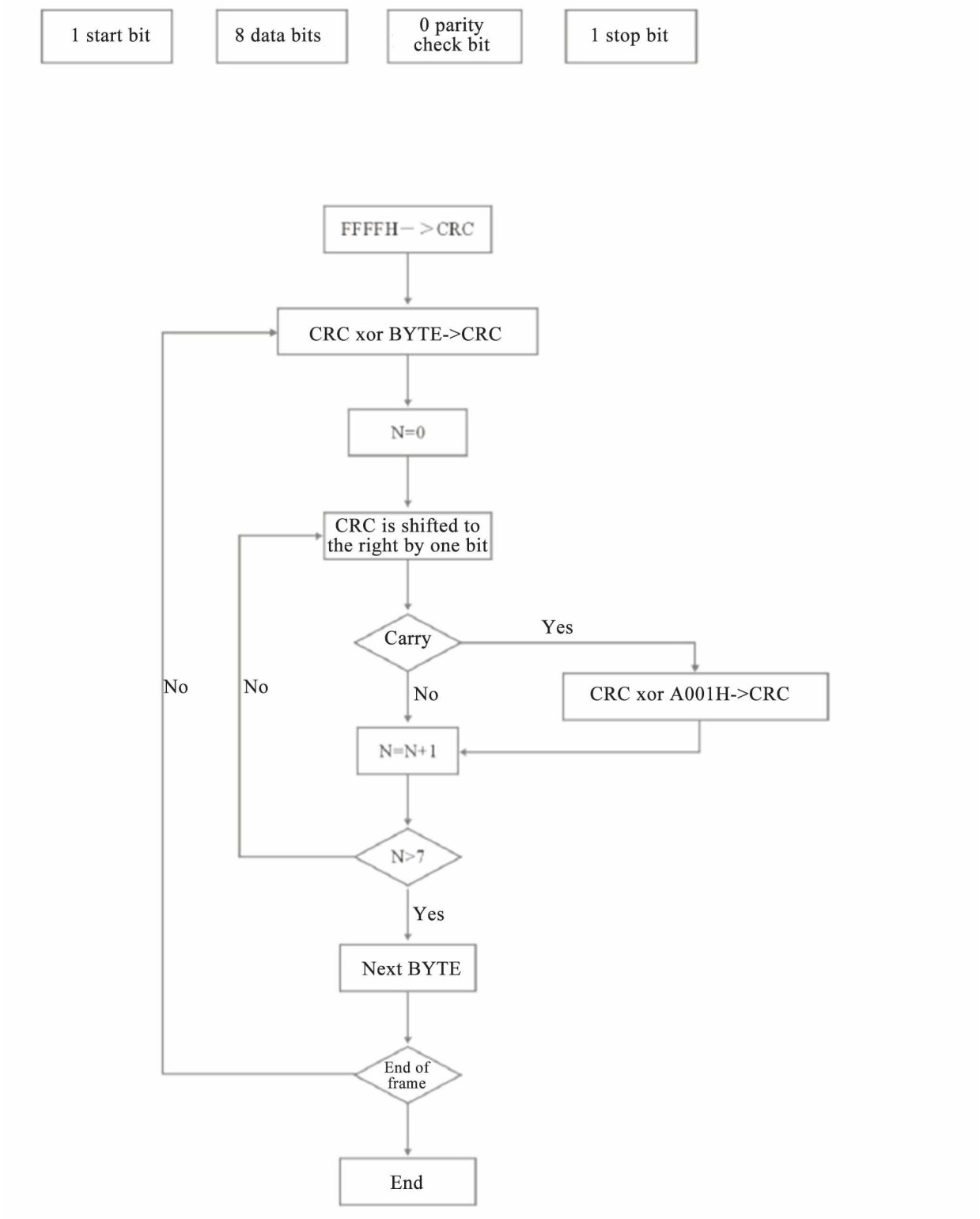
For example, the master requests 01H 03H 00 00H 00 02H C4 0BH (for information only. For correct addresses, please consult the parameter list).

The slave answers 01H 03H 04H 00 00 C1 48H ABH 95H.

Meaning: Read the next four bytes of data with instrument number 1 and flow rate address starting from 0, that is, flow rate data. The check code of the transmitted information frame is C4H 0BH, and the address, command, data length and information code sent back by the slave are

00 00C1 48H. After the high and low register positions are exchanged, the known flow rate is calculated by IEEE-754 =-12.5.

(8) Introduction to character transmission:



(9) Address list

Flow Meter (MODBUS)

SIC Protocol Address	Name of variable	Operation	Property	Functions
1	Read Density	c, r	Float-point	Density
3	Read Flow	c, r	Float-point	Flow rate
5	Read Total	c, r	Float-point	Total amount
7	Read Pressure	c, r	Float-point	Pressure
9	Read Temperature	c, r	Float-point	Temperature
11	Read Percent	c, r	Float-point	Flow percentage
13	Read Current	c, r	Float-point	Current
15	Read Pulse	c, r	Float-point	Frequency

Notes:

① The information in the address information list is classified into two types. One type is readable and rewritable (r/w) and programmable, while the other type is readable only (c, r) and acquirable.

Note: A parameter shall be modified to consider its address, length and value.

② Communication control and communication parameter setting

Communication control	**Communication parameter setting**
	Baud rate selection
0 (default)	4800
1	9600
2	19200
Others	4800

Appendix 1

Vortex flowmeter is a kind of high-precision flow meter, so we suggest that users regularly protect some simple components after using the flowmeter for a period of time, such as checking the wiring, and cleaning the surface and vortex generator. For those technical requirements that involve flowmeter performance and you don't understand, please read this document carefully and carry out routine maintenance on the basis of understanding. If it is necessary to carry out in-depth maintenance or replace parts, please consult our customer service center, and we will provide you with the most thoughtful and comprehensive technical support.
Vortex flowmeter can give corresponding alarm information through its own self-diagnosis function for faults in general application. See the table below for details.

Common Fault Diagnosis Table of Vortex Flowmeter

No.	Symptom	Cause analysis	Test method	Troubleshooting
1	The display screen has characters, but the version number is always displayed.	Power ripple interference	Check whether the power ripple voltage is within the range of 1V with oscilloscope.	Effectively ground both shielded ends of the power cord or replace the power supply.
		Mainboard is damp.	Visually observe whether there is obvious dampness on the mainboard.	Dry the mainboard.
		Insulation of temperature sensor decreases.	Use the multimeter to test the insulation resistance of temperature sensor signal line to ground, which is normally greater than 1MΩ.	Replace the temperature sensor.
2	The black screen has no character display and no current output.	The power supply is under voltage.	Use a multimeter to check whether the supply voltage is within the range of (21-42) VDC.	Replace the power supply.
		The power supply is not connected.	Check whether the wiring is correct and whether the line is unblocked.	Carry out connection again or check the cable.
		The mainboard fails.	Check whether the mainboard is normal or not. Refer to the *Converter Detection Procedure* for the test method.	Replace the mainboard.
		The pin connecting the front cavity and the back cavity is abnormal.	Visually observe whether the pins are bent or lacking.	Replace the pin.
3	The black screen has no character display but current output.	The monitor is not connected to the mainboard normally.	Check whether the 16-core connecting wire between the monitor and the mainboard is damaged.	Replace the connecting wire.
		The monitor model does not match the mainboard driver.	Check the monitor model and program version number.	Replace the monitor or rewrite the mainboard driver.
4	4-20111A of current output is abnormal.	The power supply is under voltage.	Use a multimeter to check whether the supply voltage is within the range of (21-42)V Dc. If the voltage is lower than 21V, the output of 20mA current will be affected.	Replace the power supply.
5	There is flow in the pipeline but no flow in the instrument.	The flow is too small to enter the measuring range of the instrument.	Increase the flow to see the display.	The flow needs to reach the measuring range of the instrument.
		The flow reaches the lower limit of the instrument, but the instrument magnification is not enough.	Enter the menu to view the parameter Snsr Gain.	Adjust the size of parameter Snsr Gain.
		The lower probe (signal probe) fails.	Use a multimeter to detect the resistance between the signal wire of the signal probe and the ground and between the two signal wires: if the resistance is greater than 10MΩ, it is judged that the probe is normal; if the resistance is less than 10MΩ and greater than 1MΩ, it is judged that the signal of the probe attenuates, which will affect the measurement of small flow; if the resistance is less than 1MΩ, the probe is judged to be damaged.	Replace the probe.

		The sensor is stuck.	If the above situation does not occur, please check whether the generator and probe of the sensor are stuck.	Clean the sensor and reinstall it.
6	There is no flow in the pipeline but flow in the instrument.	50Hz power frequency interference	Enter the menu to check whether the value of parameter Pls Hz is 50.	Choose shielded cable and ensure that the shielded wire is well grounded; if the 50Hz interference is not within the signal frequency range, the parameter Pls Cutoff can be set to 1.
		High-frequency interference is caused by high-voltage equipment near the instrument.	Check whether there is such equipment around.	Ensure that the instrument is reliably grounded and consider changing the installation location.
		The pipeline has strong vibration.	Check the pipeline vibration.	Reinforce the pipeline of instrument installation part.
		Instrument magnification setting is too large.	Enter the menu to view the parameter Snsr Gain.	Adjust the size of parameter Snsr Gain, reduce the magnification and increase the cutoff amplitude Vot baseM.
7	The flow is unstable and fluctuates greatly (the instrument is installed reversely, and the signal line is wrongly connected).	The straight pipe section is not enough and the flow field is unstable.	Check whether the straight pipe section meets the installation requirements.	Replace the installation position or lengthen the straight pipe section.
		The pipeline has strong vibration.	Check the pipeline vibration.	Reinforce the pipeline of instrument installation part.
		The inner diameter of the instrument and the inner diameter of the pipeline are not concentric.	Check the concentricity of instrument inner diameter and pipeline inner diameter.	Reinstall the instrument.
		The sealing ring extends into the pipeline to affect the flow field.	Check the installation of sealing ring.	Adjust the sealing ring and reinstall the instrument.
		The pipe is not full of fluid.	Check the fluid condition and the installation position of the instrument. When measuring the liquid, the fluid flow direction should be from bottom to top.	Reinstall the instrument.
8	The flow does not match the actual flow.	Air voids exist in the fluid.	Check the fluid condition.	Install a valve downstream of the instrument to increase the back pressure.
		The flow is below the lower limit or above the upper limit.	Check whether the flow in actual working condition is within the measurable flow range of the instrument.	Re-select the instrument according to the flow in actual working condition.
		The flow is small and the fluid viscosity is large.	Check the flow rate and fluid viscosity.	Re-select the instrument according to the flow in actual working condition.
		The mainboard signal processing circuit is faulty.	Replace the normal mainboard and observe whether the flow is stable.	Replace the mainboard.
		There is no real-time temperature and pressure compensation when measuring gas or steam.	Check whether the process pipeline is equipped with temperature and pressure compensation elements.	Increase temperature and pressure compensation elements.
		Error is caused by incorrect installation of temperature and pressure compensation elements.	Check the installation position of temperature and pressure compensation elements.	Install temperature and pressure compensation elements as required.
		Fixed temperature and pressure compensation is set inside the instrument, but the actual temperature and pressure do not match the set value.	Enter the temperature and pressure compensation menu to view the relevant parameters.	Reset related parameters of temperature and pressure compensation menu.

		Steam is neither saturated nor superheated.	Check the steam process flow.	Change process conditions, which is beneficial to instrument compensation.
		The compensation mode of flow totalizer is set incorrectly.	Enter the flow totalizer menu to check the temperature and pressure compensation mode.	Design the correct compensation mode according to the actual working conditions.
		The instrument full-scale value is inconsistent with the system full-scale value.	Enter the menu to check whether the value of parameter PV RngHi is consistent with the system full-scale value.	Reset the parameter PV RngHi.
9	Field 485 communication is abnormal.	There is no 485 communication version.	Check whether 485 communication version is included.	Install 485 communication version.
		Vortex software version is wrong.	Check whether the vortex software version is 1.7 series (soft ver is 1.7X).	Replace the 1.7 series mainboard.
		Baud rate or address mismatches.	Check whether vortex baud rate and address (Net Adr) match the system.	The vortex street is consistent with the address and baud rate of the system.
		Instrument address conflicts on bus.	Check whether the instrument addresses on the bus are consistent.	Change instrument address.
		The field communication connection is star connection. RS485 belongs to low-voltage differential level and has weak energy, so it is easy to be disturbed. Because of the star connection, the signal will be reflected and the communication will be abnormal.	Check the field instrument 485 communication connection mode.	Change the connection mode to serial connection, and reliably ground the 485 bus (shielded wire) at a single point.
Remarks: This fault diagnosis table is mainly aimed at VFD vibration-resistant vortex flowmeter /VFE intelligent vortex flowmeter, and the judgment method of VFC ordinary vortex flowmeter is similar, but some parameters are different.				

Appendix 2
Density in Standard Condition of Common Gas Media

Gas name	Density (kg/m3)	Gas name	Density (kg/m3)
Acetylene	1.172	Hydrogen	0.0899
Air	1.290	Methane	0.717
Ammonia	0.771	Natural gas	0.828
Butane	2.700	Nitrogen	1.250
Carbon dioxide	1.970	Oxygen	1.430
Carbon monoxide	1.250	Propane	2.020
Ethane	1.350	Propylene	1.915
Ethylene	1.260	Neon	0.890

Appendix 3
Table of Common Medium Flow Range of Vortex Flowmeter

1. Air flow range of vortex flowmeter

Caliber mm	Standard measuring range m^3/h	Output frequency range Hz
15	3-16	275-1467
20	4-48	145-1740
25	8-60	180-1500
32	14-100	130-1000
40	18-180	90-950
50	30-300	80-820
65	50-500	60-680
80	70-700	40-460
100	100-1000	30-350
125	150-1500	23-250
150	200-2000	18-190
200	400-4000	13-165
250	600-6000	11-120
300	1000-10000	9-110
350	1500-15000	8-95
400	1800-18000	7-85
450	2100-21000	6-70
500	2500-25000	5-65
600	3200-32000	3.5-50

2. Liquid flow range of vortex flowmeter

Caliber mm	Standard measuring range m^3/h	Output frequency range Hz
15	0.2-3.1	36-273
20	0.4-7	20-233
25	2-16	35-28()
32	2.2-20	20-195
40	2.5-25	10-125
50	3.5-35	8-110
65	6-60	7-95
80	13-130	6-80
100	20-200	5-75
125	30-300	4.5-65
150	50-500	3.58-42
200	100-1000	3.2-38
250	150-1500	2.5-28.5
300	200-2000	2.2-24.8
350	300-3000	1.7-20
400	350-3500	1.4-16.5
450	420-4200	1.2-13
500	500-5000	1.0-13.5
600	700-7000	0.7-10

3. Superheated steam flow range of vortex flowmeter

Unit: (kg/h)

Nominal diameter (mm)	Lower limit flow	Upper limit flow
15	$8.24\times\sqrt{\rho}$	$41\times\sqrt{\rho}$
20	$9.88\times\sqrt{\rho}$	$79\times\sqrt{\rho}$
25	$13.12\times\sqrt{\rho}$	$104\times\sqrt{\rho}$
32	$23.0\times\sqrt{\rho}$	$184\times\sqrt{\rho}$
40	$26.65\times\sqrt{\rho}$	$265\times\sqrt{\rho}$
50	$49.41\times\sqrt{\rho}$	$494\times\sqrt{\rho}$
65	$82.35\times\sqrt{\rho}$	$823\times\sqrt{\rho}$
80	$115.3\times\sqrt{\rho}$	$1153\times\sqrt{\rho}$
100	$164.7\times\sqrt{\rho}$	$1647\times\sqrt{\rho}$
125	$247.1\times\sqrt{\rho}$	$2471\times\sqrt{\rho}$
150	$329.4\times\sqrt{\rho}$	$3294\times\sqrt{\rho}$
200	$658.8\times\sqrt{\rho}$	$6588\times\sqrt{\rho}$
250	$988.2\times\sqrt{\rho}$	$9882\times\sqrt{\rho}$
300	$1647\times\sqrt{\rho}$	$16470\times\sqrt{\rho}$
350	$2471\times\sqrt{\rho}$	$24710\times\sqrt{\rho}$
400	$2965\times\sqrt{\rho}$	$29650\times\sqrt{\rho}$
450	$3459\times\sqrt{\rho}$	$34590\times\sqrt{\rho}$
500	$4118\times\sqrt{\rho}$	$41180\times\sqrt{\rho}$
600	$5270\times\sqrt{\rho}$	$52700\times\sqrt{\rho}$

Note: ρ represents the steam density in operating status

4. Saturated steam mass flow range table

Unit: (kg/h)

Absolute pressure (MPa)	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0
Temperature (℃)	133.54	143.62	151.84	158.94	164.96	170.71	175.36	179.88	187.96	198.4	212.37
Density (Kg/m^3)	1.651	2.163	2.669	3.170	3.667	4.162	4.655	5.147	6.127	7.602	10.05
DN15 standard lower limit	11	12	13	15	16	17	18	19	20	23	26
DN15 standard upper limit	63	73	81	88	85	101	107	112	123	136	160
DN20 standard lower limit	13	15	16	18	19	20	21	22	24	27	31
DN20 standard upper limit	102	116	129	141	151	161	170	179	196	218	250
DN25 standard lower limit	17	19	21	23	25	27	28	30	32	36	42
DN25 standard upper limit	133	153	170	185	199	212	224	236	257	287	330
DN40 standard lower limit	34	39	43	47	51	54	57	60	66	73	84
DN40 standard upper limit	340	390	430	470	510	540	570	600	660	730	840
DN50 standard lower limit	63	73	81	88	95	101	107	112	122	136	157
DN50 standard upper limit	630	730	810	880	950	1010	1070	1120	1220	1360	1570
DN65 standard lower limit	82	108	133	158	183	208	232	257	306	380	502
DN65 standard upper limit	820	1080	1330	1580	1830	2080	2320	2570	3060	3800	5020
DN80 standard lower limit	148	170	188	205	221	235	249	262	285	318	366
DN80 standard upper limit	1480	1700	1880	2050	2210	2350	2490	2620	2850	3180	3660
DN100 standard lower limit	222	242	269	293	315	336	355	374	408	454	522
DN100 standard upper limit	2220	2420	2690	2930	3450	3360	3550	3740	4080	4540	5220
DN125 standard lower limit	318	363	404	440	473	504	533	561	612	681	783
DN125 standard upper limit	3180	3630	4040	4400	4730	5040	5330	5610	6120	6810	7830

Table (continued)

Unit: (kg/h)

Absolute pressure (MPa)	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0
Temperature (℃)	133.54	143.62	151.84	158.94	164.96	170.71	175.36	179.88	187.96	198.4	212.37
Density (Kg/m^3)	1.651	2.163	2.669	3.170	3.667	4.162	4.655	5.147	6.127	7.602	10.05
DN150 standard lower limit	423	484	538	586	631	672	711	747	815	908	1044
DN150 standard upper limit	4230	4840	5380	5860	6310	6720	7110	7470	8150	9080	10440
DN200 standard lower limit	847	969	1076	1173	1262	1344	1421	1495	1631	1815	2089
DN200 standard upper limit	8470	9690	10760	11730	12620	13440	14210	14950	16310	18160	20890
DN250 standard lower limit	1270	1453	1614	1769	1892	2016	2132	2242	2446	2725	3133
DN250 standard upper limit	12700	14530	16140	17690	18920	20160	21320	22420	24460	27250	31330
DN300 standard lower limit	2116	2422	2691	2932	3154	3360	3553	3737	4077	4541	5221
DN300 standard upper limit	21160	24220	26910	29320	31540	33600	35530	37370	40770	45410	52210
DN350 standard lower limit	3175	3634	4037	4399	4732	5041	5331	5606	6116	6813	7833
DN350 standard upper limit	31750	36340	40370	43990	47320	50410	53310	56060	61160	68130	78330
DN400 standard lower limit	3810	4361	4844	5279	5687	6049	6397	6727	7339	8175	9400
DN400 standard upper limit	38100	43610	48440	52790	56870	60490	63970	67270	73390	81750	94000
DN450 standard lower limit	4445	5087	5651	6159	6624	7057	7463	7847	8562	9537	10966
DN450 standard upper limit	44450	50870	56510	61590	66240	70570	74630	78470	85620	95370	109660
DN500 standard lower limit	5291	6056	6728	7332	7886	8401	8894	9343	10193	11354	13055
DN500 standard upper limit	52910	60560	67280	73320	78860	84010	88940	93430	101930	113540	130550
DN600 standard lower limit	6771	7751	8610	9383	10092	10751	11370	11956	13045	14530	16707
DN600 standard upper limit	67710	77510	86100	93830	100920	107510	113700	119560	130450	145300	167070

Appendix 4 Solution of Water Hammer

(1). Introduction to water hammer

Water hammer effect is a kind of visual statement, which refers to a serious water hammer caused by the water impact on the pipeline when the feed pump is started and stopped. Because in the pipe, the inner wall of the pipe is smooth, the water flows freely. When an open valve is suddenly closed or the feed pump is stopped, the water flow produces a pressure on the valve and the pipe wall, mainly the valve or pump. Because the pipe wall is smooth, the subsequent water flow reaches the maximum force quickly under the action of inertia, and has a destructive effect, which is the "water hammer effect" in hydraulics, that is, positive water hammer. On the contrary, when a closed valve is suddenly opened, a water hammer is also produced, which is called negative water hammer, but not as large as the former.

Of course, the water hammer will occur not only in the water system, but also in the steam system. When it occurs in a steam system, a water hammer is sometimes called a "steam hammer".

(2). Hazard of water hammer

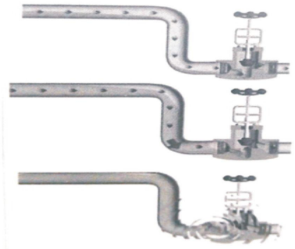
When the steam is assigned to the steam line or enters the equipment, you will hear the metal "bang, bang, bang" sound, and a similar situation will happen to many steam users.

When a water hammer occurs, it will instantly produce more than 10MPa pressure in the pipe.

This will cause serious impact on the pipe, equipment or equipment room, which may cause damage to the detection body of the flowmeter in serious conditions.

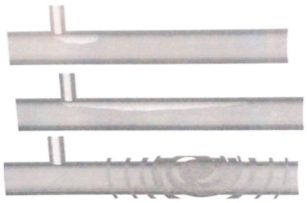
(3). Causes to water hammer

High-speed condensate produces a water hammer



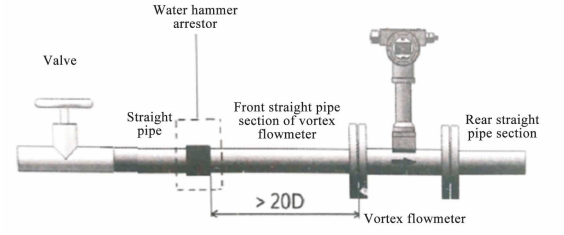
The collision of high-speed condensed water in the pipe produces a water hammer

The sudden condensation of steam produces water hammer.



When steam rapidly condenses and collides with each other, water hammer occurs.

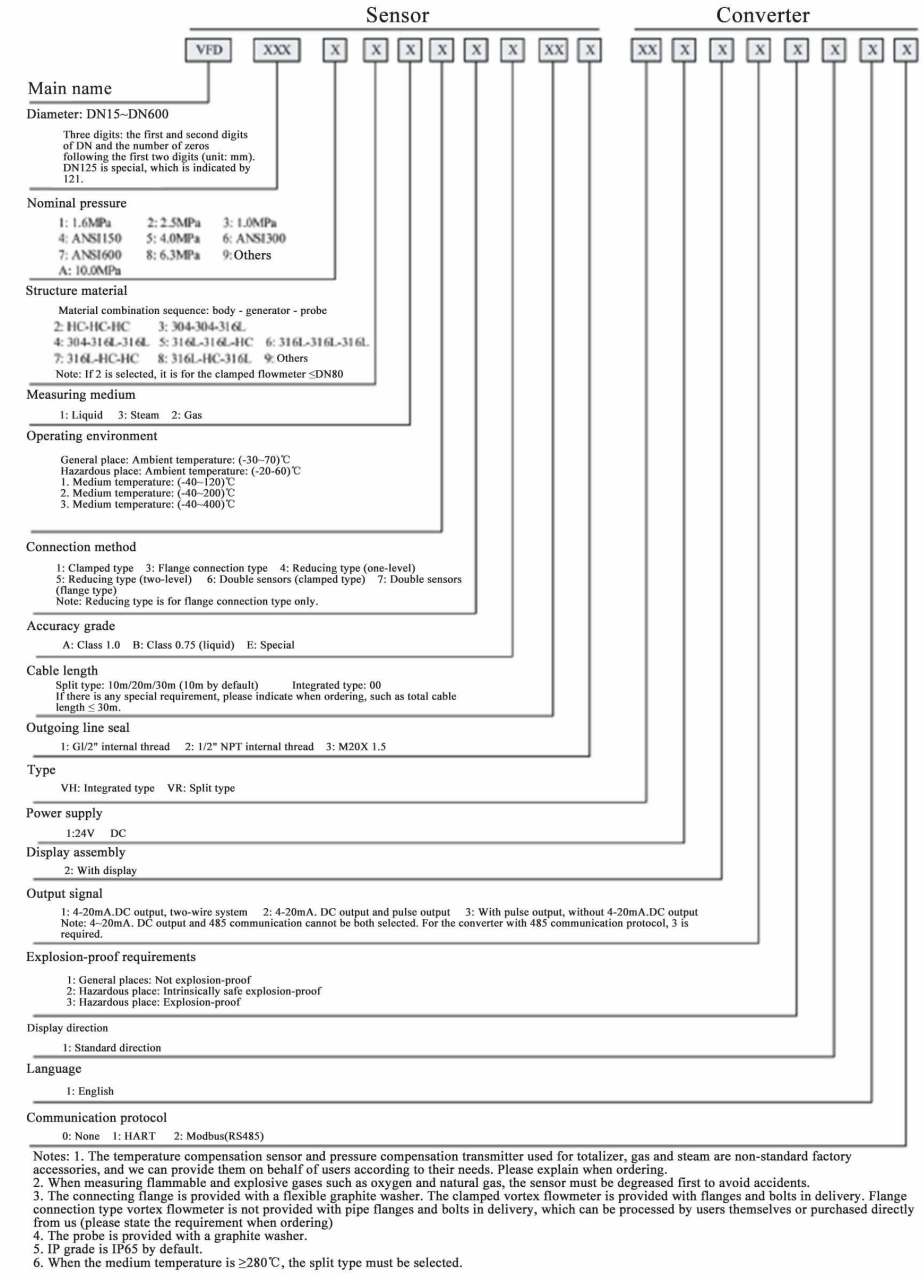
(4) Solution of Water Hammer



(5) Important tips (in case of the following process, it is recommended to add a water hammer arrestor to protect the flowmeter from damage)

1. The valve is opened or closed quickly;
2. The water pump unit is stopped or started suddenly;
3. Water is delivered to a high place through a single pipe (with water supply elevation difference of above 20m);
4. The water pump has a high total lift (or operating pressure);
5. Too high water flow rate in water delivery pipe:
6. Too long water delivery pipe, and great terrain change.

Selection Table of VFD Vibration-resistant Type Vortex Flowmeter



Notes: 1. The temperature compensation sensor and pressure compensation transmitter used for totalizer, gas and steam are non-standard factory accessories, and we can provide them on behalf of users according to their needs. Please explain when ordering.

2. When measuring flammable and explosive gases such as oxygen and natural gas, the sensor must be degreased first to avoid accidents.

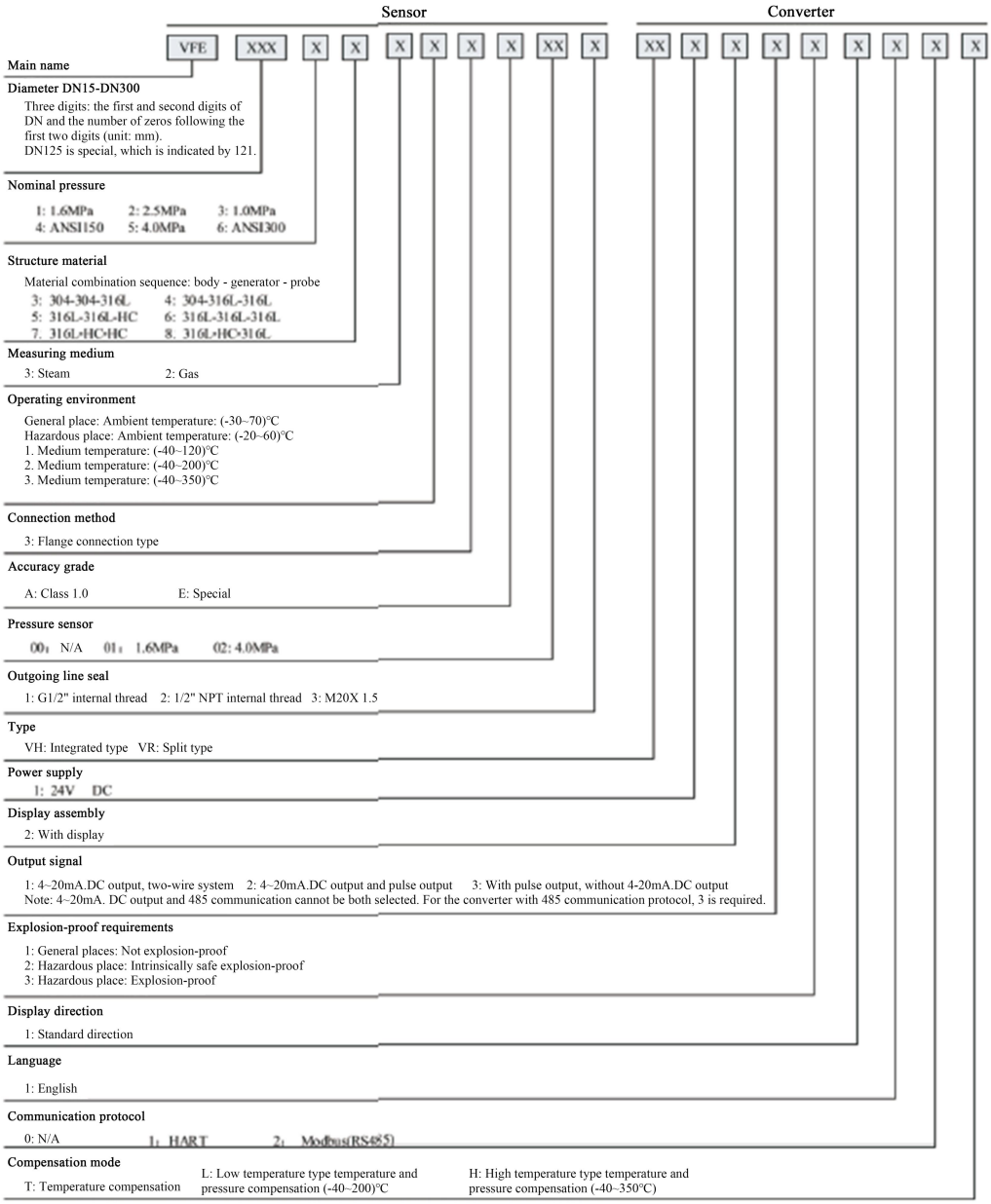
3. The connecting flange is standard equipped with a flexible graphite washer. The clamped vortex flowmeter is provided with flanges and bolts in delivery. Flange connection type vortex flowmeter is not provided with pipe flanges and bolts in delivery, which can be processed by users themselves or purchased directly from us (please state the requirement when ordering)

4. The probe is standard equipped with a graphite washer.

5. Protection grade is **IP65** by default.

6. When the medium temperature is ≥**280**℃, the split type must be selected.

Selection Table of VFE Intelligent Type Vortex Flowmeter



Notes: 1. When measuring flammable and explosive gases such as oxygen and natural gas, the sensor must be degreased first to avoid accidents.
2. The connecting flange is standard equipped with a flexible graphite washer. Flange connection type vortex flowmeter is not provided with pipe flanges and bolts in delivery, which can be processed by users themselves or purchased directly from us (please state the requirement when ordering)
3. The probe is standard equipped with a graphite washer.
4. Protection grade is IP65 by default.
5. The operating pressure of **VFE** vortex flowmeter is less than the allowable value of pressure sensor.

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Company address: No. 61, Huangshan Avenue Middle, Liangjiang District, Chongqing, China
Sales hotline: 023-67032678 Company Tel.: 023-67032666 Fax: 023-67032676
Technical support: 023-67032695 023-67032667
Http: //www.sicflow.com.cn E-mail: flowmaster@sicflow.com.cn

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