VFT Series Vortex Flow Meter
Operation Manual



Chongqing Chuanyi Automation Co., Ltd.
Flow Meter Branch

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Chapter I Function and System Design

The VFT vortex flow meter is a high-performance product. This series features a structure that separates the measurement area from the medium area, ensuring the probe is not wetted. The probe can be replaced online, marking a new innovation for vortex flow meters and elevating the product to a new level. This meter is still able to measure accurately when the vibration intensity of the pipeline is as high as 1.5g and the liquid flow velocity is as low as 0.3 m/s (3 m/s for gas). The VFT enhanced vortex flow meter has super stability, vibration resistance and anti-interference performance, which is particularly suitable for harsh working environments.

I. Application

• The measurement principle is particularly suitable for the measurement of saturated steam/superheated steam, gas and liquid (as well as high/low temperature media)

• It is widely used, optimized for steam measurement, and allows for steam calibration

II. Meter characteristics

• The FFT technology is used to analyze and process the vortex flow signal, which can accurately detect the vortex information in the small signal low flow area, so that the meter has super stability and reliability in the low flow area.

• The reverse protection and purification technology is adopted for power supply, and the isolation technology is adopted for vortex signal processing, with super anti-EMI capability.

• The unique structural design effectively resists the water hammer effect.

• The sensor is not wetted, which ensures the safe and stable measurement of steam and toxic gases and increases the online time of the meter.

• The optimized lift-type cantilever beam tail wing design provides a wide measurement range, with a maximum range ratio of up to 40:1.

• The pressure loss is small, about 1/4 to 1/2 of the throttling differential pressure flow meter.

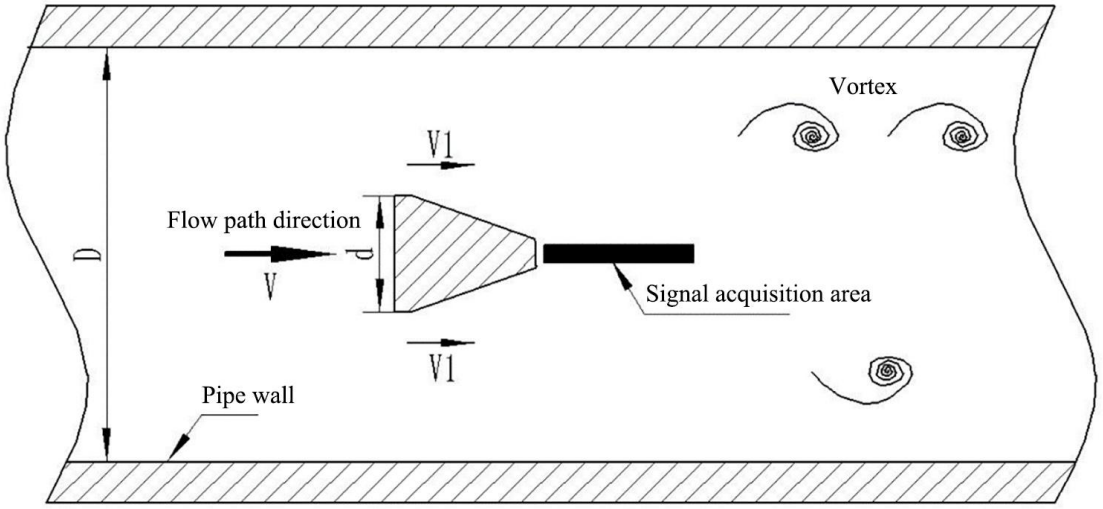
• The piezoelectric module has an isolation structure to facilitate online maintenance and troubleshooting.

• The optimized mass balance and anti-vibration algorithm of the sensor enhance the vibration resistance of the meter up to 1.5g.

• The probe is isolated from the medium by air and mechanical parts, so its temperature remains close to room temperature, which effectively broadens the operating temperature range of the instrument. The medium temperature range can be as wide as -40°C to 400°C.

III. Measurement principle

Vortex flow meter is a fluid oscillation type flow meter made according to the Karman vortex principle. When a cylinder with a non-streamlined cross section is inserted into a flowing fluid, periodic pressure differences will alternately occur on both sides of the baffle, and alternating low-pressure vortices will be generated at the tail of the cylinder. The vortices flow downstream, growing first and then decaying within a certain pipe length range, asymmetrically forming two rows of staggered vortices, as shown in Fig. 1.



Staggered vortices

The vortex shedding frequency *f* is directly proportional to the average flow velocity *v* on both sides of the cylinder and inversely proportional to the cylinder width *d*:

$$f = S\frac{V_1}{d} = St\frac{V}{md} \quad \text{.....（1）}$$

Where,

f: Vortex shedding frequency, *Hz*;

St: Dimensionless constant (Strouhal); d: Width of the flow-facing face of the cylinder, *mm*;

V1: Average flow velocity on both sides of the cylinder, *m/s*; *V*: Average flow velocity at the front end of the cylinder, *m/s*;

m: Ratio of the bow area on both sides of the vortex generator to the cross-sectional area of the pipeline, a constant related to the structure

The fluid flow velocity and instantaneous flow can be measured by measuring the vortex shedding frequency, and *the* Strouhal number *St* is a dimensionless constant that can be determined experimentally. 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 flow meter. The velocity of the fluid in the pipe can be obtained by measuring the frequency, and then the volume flow can be obtained from the flow 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 meter coefficient (coefficient K).

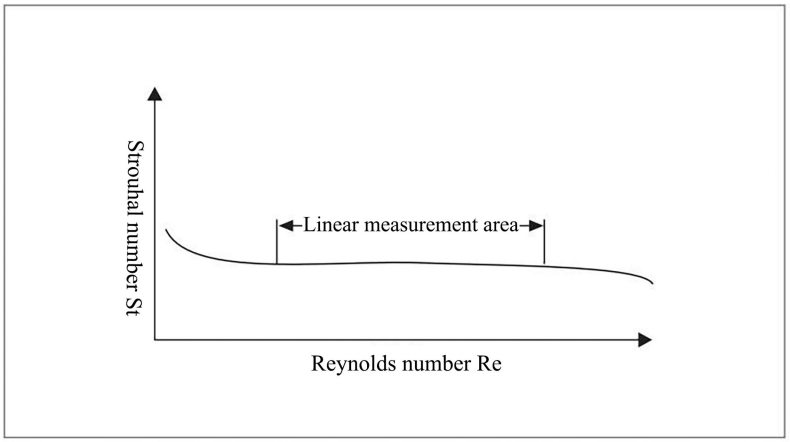
$$K=N/Q \quad \text{.....（2）}$$

Where,

K: Meter coefficient,$1/m^3$;

N: Number of pulses;

Q: Fluid volume, m^3;



Variation relationship between Strouhal number *St* and Reynolds number *Re*

According to the principle of vortex flow meter, when the Reynolds number *Re* is greater than 20000, the K coefficient depends on the geometric dimensions of the flow meter and has nothing to do with fluid properties (density and viscosity) or medium flow velocity and type (liquid, gas and steam). The K coefficient of each meter shall be calibrated and confirmed on standard equipment before delivery. The calibration requirements shall conform to national metrological verification standards. The vortex flow meter collects fluid frequency, has no zero drift, features a rigid overall structure, contains no active parts, and ensures stable and reliable.

The vortex flow meter sensor features a robust structure, capable of adapting to medium measurement under various working conditions. The converters are interchangeable. Replacing them does not affect measurement accuracy. The meter has passed vibration resistance and full performance tests. Using the industry's most mature piezoelectric sensor technology, it sensitively converts vortex signals into electrical signals.

IV. Temperature and pressure measurement

When the main model is selected as "VFT" and external temperature and pressure compensation is selected in the ordering contract, the flow meter can only measure the work under working conditions. If it is necessary to measure the gas flow under standard conditions, a temperature measuring meter and a pressure measuring meter need to be installed downstream of the flow meter respectively, and the flow integration is performed in the integrator to obtain the flow under standard conditions. Under normal circumstances, the temperature measurement position is set at (2~5) D downstream of the flow meter (D is the pipe diameter, and the same applies below), and the pressure measurement position is set at (2~7) D downstream of the flow meter. The flow under working condition measured by the flow meter, the temperature under working condition measured by the temperature measuring meter and the pressure under working condition measured by the pressure measuring meter are all input into the integrator to obtain the accumulated flow under standard condition and output it. If the steam mass flow needs to be measured, the steam density compensation can also be performed in the integrator according to the above configuration to obtain the medium density under working condition and then the medium mass flow. An independent temperature and pressure transmitter is installed externally, and the flow compensation calculation is performed through the integrator, which can be used for trade settlement. The vortex flow meter can be configured and set as required when measuring the flow under standard conditions or mass flow of the medium.

If the working conditions of medium are stable and the temperature and pressure under working condition are constant, fixed temperature and pressure compensation parameters can also be set in the VFT vortex flow meter to measure the flow of the gas medium under standard

conditions or the mass flow of the steam medium. For working conditions where the medium density is known and stable, fixed density compensation can be set in the flow meter to obtain the mass flow of the medium under working conditions.

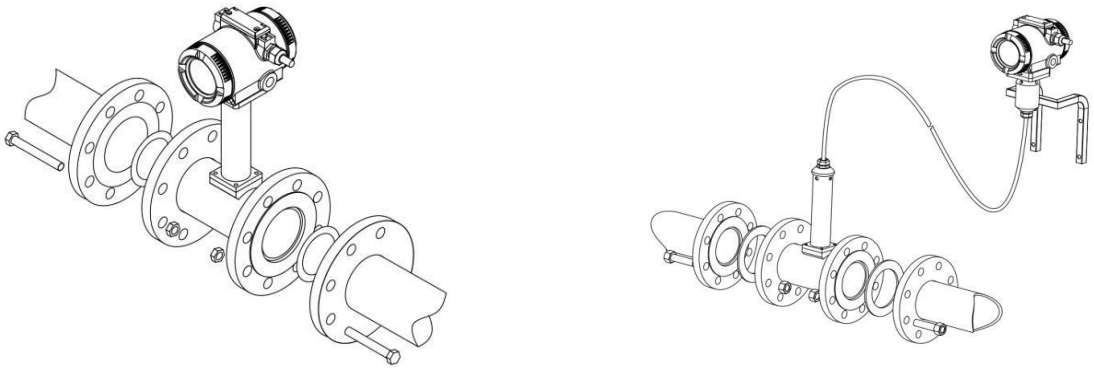
Internal armored wiring is adopted for the VFT vortex flow meter sensor. It is strictly prohibited to rotate the converter by more than 90° without disconnecting the probe connector. Improper operation may damage the probe's armored wire inside the sensor.

V. Requirements for installation of straight pipe section

The length of the straight pipe sections upstream and downstream of the vortex flow meter affects the stability of the flow field of the measured medium. Generally, a straight pipe section of 15D upstream and 5D downstream is required. When there are fans, pumps, or other equipment causing severe turbulence upstream of the flow meter, the requirements for the straight pipe section are more stringent. For details, refer to the installation chapter. If the installation requirements cannot be met, it is necessary to ensure at least a straight pipe section of 10D upstream and 5D downstream of the flow meter, and install a rectifier between the flow meter and the turbulence-causing equipment to improve the stability of the flow field at the flow meter inlet.

VI. Measurement system

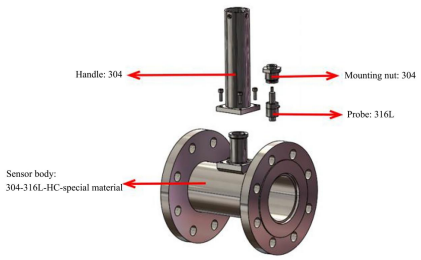
The vortex flow meter consists of a sensor and a converter. Based on whether cables are configured, it is classified as either integrated or split type. The integrated type vortex flow meter is single equipment comprising both the sensor and converter. The split type vortex flow meter connects the sensor to a remotely installed converter via a signal cable to ensure signal transmission.



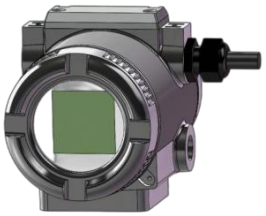
(a) Integrated type (b) Split type

Composition Diagram of Vortex Flow Meter

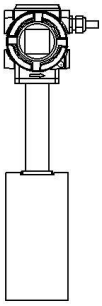
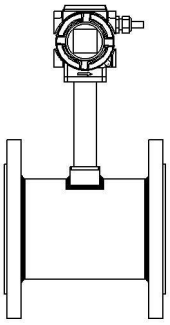
➢ **Sensor characteristics**

VFT type sensor 	Flange type/Clamp-on type; Nominal diameter: DN15-DN300; Material: 304/316L/HC; Nominal pressure: European standard maximum nominal pressure: 4 MPa; American standard maximum nominal pressure: ANSI 300;

➢ Converter characteristics

Model	VFT converter
Structure Diagram	
Connection type	Integrated type/split type
Material	Aluminum alloy (default); Stainless steel 316L (special)
Surface coating	Conventional products are plastic-sprayed in RAL9007 gray aluminum. Meters with a no-copper/no-zinc requirement (<1% content) are painted in RAL7035 light gray.
Electrical interface	G1/2"、NPT1/2"、M20×1.5
Display	Glass segment code display
Button	Contact-type magnetic button
Main Interface	Flow interface (instantaneous flow/total) Temperature interface Pressure interface Density interface
Commissioning	Test mode commissioning

➢ Main technical indicators

VFT vortex flow meter		
	Clamp-on type	Flange type
Accuracy class	1.0 (gas, liquid); 0.75 (highest for liquid, other accuracies shall be determined as per agreement)	
Diameter	DN15、DN20、DN25、DN32、DN40、DN50、DN65、DN80、DN100、DN125、DN150、DN200、DN250、DN300 (Other diameters shall be determined as per agreement)	
Pressure rating	1.0MPa、1.6MPa、2.5MPa、4.0MPa、ANSI150、ANSI300 (Other pressure shall be determined as per agreement)	
Material of wetted part of sensor	304, 316L, Hastelloy C (other materials shall be determined as per agreement)	
Protection rating	IP65、IP66、IP67	
Explosion-proof level	Intrinsically safe: Ex ia IIC T6Ga/Ex ia IIIC T20080°C Da; Flameproof: Ex db IIC T6 Gb; Ex tb IIIC T80°C Db;	
Medium temperature range	-40°C~+260°C (general type); -40°C~+400°C (high temperature type); (other medium temperatures shall be determined as per agreement)	
Ambient Temperature	Integrated type: (-40~70)°C; split sensor: (-52~70)°C; split converter: (-40~70)°C;	

Repeatability	1/3 of accuracy class
Turndown ratio	1:20 (maximum 1:40)
Flow velocity range	Reference range: liquid: 0.3~7, gas: 3~75, steam: 2.5~75, Unit (m/s)
Outgoing line seal	G1/2"、NPT1/2"、M20×1.5
Power supply voltage	External Power Supply: supply voltage range (16.5~42) VDC without communication; with HART communication, requiring a minimum load of 250 ohms and power supply voltage of 21.5 VDC; FF bus supply voltage range (9~32) VDC; with Modbus communication, voltage range (21.6~26.4) VDC.
Output signal	Analog output 4~-20mA, pulse output
Communication protocol	HART, Modbus（RS485）, FF

Note: The products with specifications not included in the above table can be ordered upon agreements with the Company.。

Chapter II Input

I. Directly measured variables

Ordering option "Sensor type; structural material code (body - generator - detector)①"		
Model selection code	**Description**	**Measured variables**
2	HC-HC-HC②	◆ Volume flow
3	304-304-316L	
4	304-316L-316L	
6	316L-316L-316L	
9	Other	

① The structural material combination sequence for the VFT type is: body - generator - detector;

② The structural material code "2" is primarily used for measuring common acidic corrosive media.

II. Calculated values of measured variables

Ordering option "Sensor type; structural material code (body - generator - detector)①"		
Model selection code	**Body - generator - detector**	**Calculation output**
2	HC-HC-HC	◆ Under stable process conditions: ◆ Mass flow ② ◆ Volume flow under standard condition ③ ◆ Accumulated flow: ◆ Cumulative mass flow ② ◆ Cumulative volume flow under standard conditions ③
3	304-304-316L	
4	304-316L-316L	
6	316L-316L-316L	
9	Other	

① The structural material combination sequence for the VFT type is: body - generator - detector;

② For mass flow measurement, a temperature-pressure meter can be selected for steam to perform integration; in other cases, a fixed medium density must be input;

③ For flow measurement under standard conditions, a temperature-pressure meter can be selected for gas to perform integration. For non-temperature and pressure meters, the temperature and pressure under working conditions must be stable, and the temperature and pressure compensation function must be enabled, with compensation carried out using fixed temperature and pressure values.

III. Measurement range

The measurement range depends on the nominal diameter, fluid and environmental conditions. The flow range listed below is the maximum allowable flow measurement range (Qmin

~ Qmax) corresponding to each nominal diameter. Depending on the fluid properties and environmental conditions, the measurement range may be limited. The following table provides the lower and upper limits for different diameters.

- **VFT gas measurement flow range**

Diameter (mm)	Calibration flow range m^3/h	Calibration output frequency range Hz	Measurable flow range m^3/h	Reference range for measurable output frequency Hz
15	5-20	458-1830	3.2-26	323-2515
20	8-40	290-1448	4.5-56	201-2255
25	12-60	264-1320	7-106	178-2168
32	12-116	110-1068	11.3-202	104-2056
40	18-181	90-905	18-360	90-1980
50	28-283	75-758	28-560	75-1507
65	48-478	60-598	48-960	60-1195
80	72-724	41-412	72-1440	41-836
100	113-1131	35-350	113-2260	35-697
125	177-1767	26-259	177-3540	26-531
150	254-2545	23-230	254-5080	23-454
200	452-4100	15-150	452-9040	15-308
250	707-7069	12-120	707-14125	12-249
300	1018-10179	9-90	1018-20340	9-190

● Note: The reference conditions are 20°C and 0MPa. The gas is calibrated according to the calibration flow range by default when leaving the factory, and the nameplate is engraved according to the calibration flow. If it is necessary to calibrate the flow according to other flow, the supply needs to be negotiated.

- **VFT liquid measurement flow range**

Diameter (mm)	Calibration flow range m^3/h	Calibration output frequency range Hz	Measurable flow range m^3/h	Reference range for measurable output frequency Hz
15	0.32-3.2	57.6-576	0.3-5.7	54-993
20	0.56-5.6	19.2-192	0.34-10.1	12-338
25	0.9-9	15.8-158	0.53-15.8	9.3-280
32	1.5-15	13.3-133	0.9-26	8-230
40	2.3-23	9.2-92	1.4-40.7	5.6-160
50	3-30	7.1-71	2.1-63.5	5-153
65	6-60	7.5-75	3.6-107	4.5-134
80	9-90	4.8-48	7.2-162.7	3.9-87
100	14-140	3.9-395.3	11.3-254	3.2-72.6
125	22-220	3.6-355	17.7-397	2.9-64.5
150	45-320	3.4-24	38-572	2.9-43
200	79-560	2.6-16	56-1017	1.6-29
250	124-880	2.1-14.9	106-1588	1.8-27
300	178-1280	1.9-13.7	153-2290	1.7-24

● Note: The reference conditions are 20°C and 0MPa. The liquid is calibrated according to the calibration flow range by default when leaving the factory, and the nameplate is engraved according to the calibration flow. If it is necessary to calibrate the flow according to other flow, the supply needs to be negotiated.

➢ VFT saturated steam measurement standard flow range

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（℃）	**133.5**	**143.6**	**151.8**	**158.9**	**165.0**	**170.7**	**175.4**	**179.9**	**188.0**	**198.0**	**212.4**
Density（Kg/m3）	**1.651**	**2.163**	**2.669**	**3.170**	**3.667**	**4.162**	**4.655**	**5.147**	**6.127**	**7.602**	**10.050**
DN15 standard lower limit	8	11	13	16	18	21	23	26	31	38	50
DN15 standard upper limit	33	43	53	63	73	83	93	103	123	152	201
DN20 standard lower limit	13	17	21	25	29	33	37	41	49	61	80
DN20 standard upper limit	66	87	107	127	147	166	186	206	245	304	402
DN25 standard lower limit	20	26	32	38	44	50	56	62	74	91	121
DN25 standard upper limit	99	130	160	190	220	250	279	309	368	456	603
DN32 standard lower limit	20	26	32	38	44	50	56	62	74	91	121
DN32 standard upper limit	192	251	310	368	425	483	540	597	711	882	1166
DN40 standard lower limit	30	39	48	57	66	75	84	93	110	137	181
DN40 standard upper limit	299	392	483	574	664	753	843	932	1109	1376	1819
DN50 standard lower limit	46	61	75	89	103	117	130	144	172	213	281
DN50 standard upper limit	467	612	755	897	1038	1178	1317	1457	1734	2151	2844
DN65 standard lower limit	79	104	128	152	176	200	223	247	294	365	482
DN65 standard upper limit	789	1034	1276	1515	1753	1989	2225	2460	2929	3634	4804

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（℃）	**133.5**	**143.6**	**151.8**	**158.9**	**165.0**	**170.7**	**175.4**	**179.9**	**188.0**	**198.0**	**212.4**
Density（Kg/m3）	**1.651**	**2.163**	**2.669**	**3.170**	**3.667**	**4.162**	**4.655**	**5.147**	**6.127**	**7.602**	**10.050**
DN80 standard lower limit	119	156	192	228	264	300	335	371	441	547	724
DN80 standard upper limit	1195	1566	1932	2295	2655	3013	3370	3726	4436	5504	7276
DN100 standard lower limit	187	244	302	358	414	470	526	582	692	859	1136
DN100 standard upper limit	1867	2446	3019	3585	4147	4707	5265	5821	6930	8598	11367
DN125 standard lower limit	292	383	472	561	649	737	824	911	1084	1346	1779
DN125 standard upper limit	2917	3822	4716	5601	6480	7354	8225	9095	10826	13433	17758
DN150 standard lower limit	419	549	678	805	931	1057	1182	1307	1556	1931	2553
DN150 standard upper limit	4202	5505	6793	8068	9333	10592	11847	13099	15593	19347	25577
DN200 standard lower limit	746	978	1206	1433	1657	1881	2104	2326	2769	3436	4543
DN200 standard upper limit	6769	8868	10943	12997	15035	17064	19086	21103	25121	31168	41205
DN250 standard lower limit	1167	1529	1887	2241	2593	2943	3291	3639	4332	5375	7105
DN250 standard upper limit	11671	15290	18867	22409	25922	29421	32906	36384	43312	53739	71043
DN300 standard lower limit	1681	2202	2717	3227	3733	4237	4739	5240	6237	7739	10231
DN300 standard upper limit	16806	22017	27168	32267	37326	42365	47383	52391	62367	77381	102299

Note: The above flow is the reference flow for saturated steam. The specific flow shall be subject to the calculation sheet.

IV. Influence factors

➢ Reynolds number

Taking the large, medium, and small specifications of the VFT vortex flow meter as an example, the measurable flow velocities and corresponding Reynolds numbers under standard conditions are shown in the table below:

Diameter	Medium	Measurable flow velocity	Reynolds number range
DN15	Air	5~40m/s	6486~51888
	Water	0.5~9m/s	9900~133663
DN80	Air	4~80m/s	23060~461229
	Water	0.4~9m/s	31682~712871
DN300	Air	4~80m/s	86480~1729609
	Water	0.7~9m/s	207921~2673267

The lower range limit under turbulent flow conditions is constrained. It only increases when the Reynolds number reaches 5000. The Reynolds number is the ratio of the inertial force to the viscous force of a fluid and is a dimensionless value. When the Reynolds number of the medium in the pipeline is less than 5000, periodic vortices are no longer generated, making flow measurement impossible.

In gas applications, the Mach number of the measuring equipment imposes an additional constraint on the upper range limit, which must be less than 0.3. The Mach number Ma is the ratio of the fluid flow velocity *v* to the speed of sound c, i.e., the upper limit for gas measurement must be <102 m/s.

Measured Reynolds number limit for ensuring flow accuracy

Meter Specifications (in/DN)	Lower Reynolds number limit for ensuring flow accuracy
12~5/15~125	20000≤Re
6~12/150~300	40000≤Re

Where, Reynolds number:

$$Re = vD\rho / \mu_{cp} \quad \text{.....(3)}$$

Where,

v is the pipeline flow velocity, [*m/s*]

D is the pipeline inner diameter, [m]

ρ is the density of the medium under working conditions,[kg/m^3]

μ_{cp} is the dynamic viscosity of the medium under working conditions, [*Pa·s*]

Under normal temperature and pressure conditions:

$$v = \frac{4 \cdot Q\left[m^3/h\right]}{\pi \cdot D\left[m\right]^2} \cdot \frac{1}{3600\left[s/h\right]} \approx \frac{354 \cdot Q\left[m^3/h\right]}{D\left[mm\right]^2} \quad \text{.....(4)}$$

Substitute the value into Formula (3) to obtain the relationship between the Reynolds number and the flow:

$$Re = \frac{354 \cdot Q[m^3/h] \cdot \rho[kg/m^3]}{D[mm] \cdot \mu_{cp}[mPa \cdot s]} \quad \text{.....(5)}$$

Therefore,

$$V_{min} = \frac{Re_{min} \cdot \mu_{cp}}{\rho \cdot D} \quad \text{.....(6)}$$

- **Minimum and maximum measurable flow velocities**

Classification	Medium	Diameter	General type, low temperature type (Detector 316L material)	High temperature type, high corrosion type (Detector HC material)
Minimum measurable flow velocity (Take the maximum of the two)	Gas	DN15	$\sqrt{32.5/\rho}$or 5 (m/s)	$\sqrt{52/\rho}$or 6.3 (m/s)
		DN20-300	$\sqrt{22/\rho}$or 4 (m/s)	$\sqrt{40/\rho}$or 5 (m/s)
	Liquid	DN15	$\sqrt{250/\rho}$or 0.5 (m/s)	$\sqrt{490/\rho}$or 0.7 (*m/s*)
		DN20-125	$\sqrt{160/\rho}$or 0.4 (*m/s*)	$\sqrt{250/\rho}$or 0.5 (*m/s*)
		DN150-200	$\sqrt{360/\rho}$or 0.6 (*m/s*)	$\sqrt{490/\rho}$or 0.7 (*m/s*)
		DN250-300	$\sqrt{490/\rho}$or 0.7 (*m/s*)	$\sqrt{640/\rho}$or 0.8 (*m/s*)
Maximum measurable flow velocity (Take the minimum of the two)	Gas	DN15	$\sqrt{40000/\rho}$or 40 (*m/s*)	
		DN20	$\sqrt{40000/\rho}$or 50 (*m/s*)	
		DN25	$\sqrt{56000/\rho}$or 60 (*m/s*)	
		DN32	$\sqrt{76000/\rho}$or 70 (*m/s*)	
		DN40-300	$\sqrt{100000/\rho}$or 80 (*m/s*)	
	Liquid	DN15-300	$\sqrt{100000/\rho}$or 9 (*m/s*)	

Where ρ is the density of the process medium in a flowing state, in kg/m^3. Generally, for gas and steam, $\rho \geq 0.5$ kg/m^3; for liquids, $400 \leq \rho \leq 2000$ kg/m^3.

- **Long-term pressure loss**

The approximate long-term pressure loss ($\triangle P$) of the vortex flow meter can be determined from the following formula:

$$\Delta P = A \times \rho_f \times \frac{Q_f^2}{D^4} \quad \text{.....(7)}$$

Where $\triangle P$ is the long-term pressure loss (KPa), ρ_f is the density under working conditions (kg/m^3), Q_f is the actual flow (m^3/h), and D is the flow diameter (mm).

A is a constant, which is determined according to the model and medium as shown in the following table.

Determine the parameter A of long-term pressure loss $\triangle P$

Model of flow meter	A
VFT conventional type	135
VFT reducing type (one-level)	155

VFT reducing type (two-level)	242

- **Minimum back pressure (cavitation, liquid only)**

In liquid measurement, when the liquid pressure in the pipeline is very low and the flow velocity is very high, cavitation will be generated to affect the correct measurement of flow. To prevent cavitation, liquid vaporization shall be avoided. For liquid applications, the working pressure of the pipeline must be greater than the minimum back pressure to prevent cavitation. In general, the treatment plan shall consider installing a back pressure valve downstream of the meter. Calculation formula of minimum back pressure:

$$P=2.7\times\Delta P+1.3\times P_0 \qquad (8)$$

Where, *P* is the pipeline pressure at 2~7D downstream of the flow meter, i.e. the minimum back pressure; ⊿P is the long-term pressure loss (KPa), and P_0 is the saturated steam pressure KPa(A) of liquid under working conditions.

V. Measurable Turndown Ratio

Diameter		Gas/steam medium turndown ratio	Liquid medium turndown ratio
[in]	mm		
12	15	8:1	18:1
23	20	12:1	30:1
1	25	15:1	30:1
114	32	18:1	30:1
112	40	20:1	30:1
2	50	20:1	30:1
212	65	20:1	30:1
3	80	20:1	22:1
4	100	20:1	22:1
5	125	20:1	22:1
6	150	20:1	15:1
8	200	20:1	18:1
10	250	20:1	15:1
12	300	20:1	15:1

VI. Input signal

In order to improve the accuracy and measurement range of flow measurement and calculate the corrected volume flow, the system needs to continuously measure different medium parameters:

- **Medium pressure**

The VFT is equipped with an optional pressure sensor input terminal for measuring the pressure of gas or steam under working condition. It participates in temperature and pressure compensation for gas flow under standard conditions or steam mass flow;

- **Medium temperature**

The VFT is equipped with an optional temperature sensor input terminal for measuring the temperature of gas or steam under working conditions. It provides saturated steam temperature compensation and participates in temperature and pressure compensation for gas flow under standard conditions or steam mass flow.

- **HART communication**

Meter parameter values can be written to the measuring equipment from the automation system via HART communication;

- **RS-485 communication**

Meter parameter values can be written to the measuring equipment from the automation system via RS-485 communication;

- **FF fieldbus**

Meter parameter values can be written to the measuring equipment from the automation system through the foundation fieldbus (FF). Fieldbus-powered meters are not equipped with a separate 24V DC power supply;

- **Input information**

Voltage range	No communication: (16.5~42) V DC; With HART communication: (21.5~42) V DC; With RS-485 communication: (21.6~26.4) V DC; With FF communication: (9~32) V DC
Input fixed variables	Medium density Fixed temperature Fixed pressure Meter coefficient Meter No. Measuring medium Small signal cutoff Meter magnification Communication parameter

Chapter III Output

I. Output signal

➢ Current output

Current output	Passive
Resolution	<5μA
Damping time	（0.5~200）s
Assignable variables	Volume flow under working conditions Volume flow under standard conditions Mass flow

➢ Pulse output

Type	Passive
Output frequency	（0~5000）Hz
Damping time	（0.5~200）s
Duty ratio	50%
Assignable variables	Volume flow under working conditions Vortex signal frequency

➢HART communication

Modulation method	Frequency shift keying (FSK)
Data transmission	Superimposed on a 4~20 mA loop, communicating at 1200 bps

➢ RS-485 communication

Transmission mode	Balanced differential transmission/half duplex
Protocol	MODBUS-RTU

➢ FF fieldbus communication

Signal code	Manchester bus powered (MBP)
Data transmission	31.25 KBit/s, voltage mode

II. Alarm signal

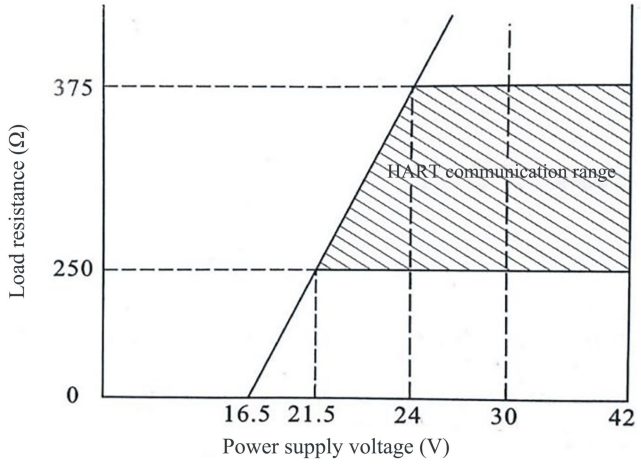
Depending on the interface type, the following fault information is displayed:

➢ 4~20 mA current output

Failure Mode	◆ Maximum current:21.6mA ◆ Actual value ◆ Recent effective value

III. Load

Load refers to the sum of the total resistances of power line, controller and related equipment. If a safety barrier is used, the resistance of the safety barrier must be included. The relationship between the power supply voltage and the load resistance is shown in the figure below:



Schematic Diagram of the Relationship between Power Supply Voltage and Load Resistance (4~20 mA DC Output)

IV. Explosion-proof parameters

➢ VFT intrinsically safe explosion-proof parameters

Explosion-proof type: Ex ia

Output signal	Output type	Safety parameters
Model selection code 1	4~20 mA analog quantity (passive), no communication	Ui=28V DC Ii=93mA Pi=0.65W
Model selection code 2	4~20 mA analog quantity (passive), Pulse output	Ui=28V DC Ii=93mA Pi=0.65W
Model selection code 3	4~20 mA analog quantity (passive), HART	Ui=28V DC Ii=93mA Pi=0.65W
Model selection code 4	ModBus Rs-485 output	Ui=3.78V DC Ii=42mA Pi=0.039W

V. Small flow cutoff

The small flow cutoff switch point has been preset to 0 and can be reset according to actual needs on site.

Due to strong electromagnetic interference and pipeline strong vibration interference in the field, sometimes even if the actual flow is zero, the vortex flow meter 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 flow meter always displays a fixed flow value when there is no flow in the pipeline. At this time, the variance calculation function of the meter can be turned on. Specific operations are as follows:

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

(2) Enter the signal processing menu, check the value of parameter "B3" (signal variance) for about 30 seconds, record the maximum value of "B3" within 30 seconds, and mark the maximum value of "B3" as the A value.

(3) Enter the signal processing menu and set parameter "B7" (variance threshold) to A.

b. There is a chaotic interference signal on site

The vortex flow meter still has a flow display when there is no flow in the pipeline. The interference flow signal fluctuates in real time and is not a fixed value. At this time, the messy interference signal can be cut off. Specific operations are as follows:

(1) When there is no flow inside the pipeline, enter the signal processing menu, check the parameter "B2" (signal amplitude) for about 30 seconds, and record the maximum value of "B2" during these 30 seconds. And mark the maximum value of "B2" plus 3 as the A value;

(2) Enter the signal processing menu and set parameter "B1" (cutoff amplitude) to A;

The above method needs to ensure that the minimum value of the signal amplitude "B2" when there is flow in the pipeline is greater than the maximum value of the signal amplitude "B2" when there is no flow in the pipeline.

➢ For the above parameters, refer to the "Parameter name and description" section.

VI. Electrical isolation

All input and output signals are electrically isolated from each other.

VII. Communication specification parameters

➢ HART

Manufacturer ID	0X00D4
Device type ID	0XD49E
HART revision No.	7
Device description file (DD)	Available
HART load	• Min：250Ω • Max：375Ω
Dynamic parameters	Measured variables corresponding to the main dynamic parameters (PV) Flow under working conditions Flow under standard conditions Mass flow Measured variable corresponding to the second dynamic parameter (SV) Total under working conditions Total under standard conditions Total mass Measured variable corresponding to the third dynamic parameter (TV) Temperature under working conditions Measured variable corresponding to the fourth dynamic parameter (QV) Pressure under working conditions

- **RS-485**

CYAC Protocol Address	Operation	Nature	Function Description
40001	c, r	Float	Density
40003	c, r	Float	Flow
40005	c, r	Float	Total quantity
40007	c, r	Float	Pressure
40009	c, r	Float	Temperature
40013	c, r	Float	Current
40015	c, r	Float	Frequency
40031	r/w	Float	Range
40033	r/w	Float	Diameter
40060	r/w	Long integer	Meter number
40080	r/w	(U) Integer	Cutoff amplitude
40081	r/w	(U) Integer	Gain
40088	r/w	(U) Integer	Flow unit
40089	r/w	(U) Integer	Total unit

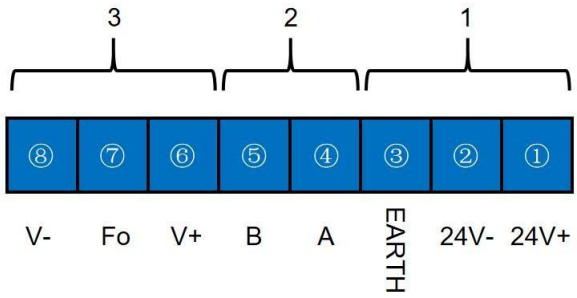
- **FF**

Manufacturer ID	000212
Device type ID	0008
FF revision No.	01
Device description file (DD)	0x01(DD4)，0x01(DD5)
Dynamic parameters	Instantaneous flow INSTANTANEOUS_FLOW_RATE (InsFlow) Total NET_TOTAL_AMOUNT (Tot) Flow percentage FLOW_PERCENT (PercentV) Density MEDIUM_DENSITY (MedDensi) Frequency output FREQUENCY_OUTPUT (FreValue) Standard state pressure STANDARD_STATE_PRESSURE (StandPress) Standard state temperature STANDARD_STATE_TEMPERATURE (StandT)

Chapter IV Power Supply

I. Assignment of wiring terminals

Connection type



Upper limit of the number of matching wiring terminals
Wiring terminals ①-③, ⑥-⑧: built-in overvoltage protection unit

1 Output 1 (passive): power supply voltage and signal transmission;
2 Output 2 (passive): signal transmission;
3 Output 3 (external power supply): pulse output;
4 Wiring terminal ③ EARTH/mounting screw: cable shielding layer grounding terminal.

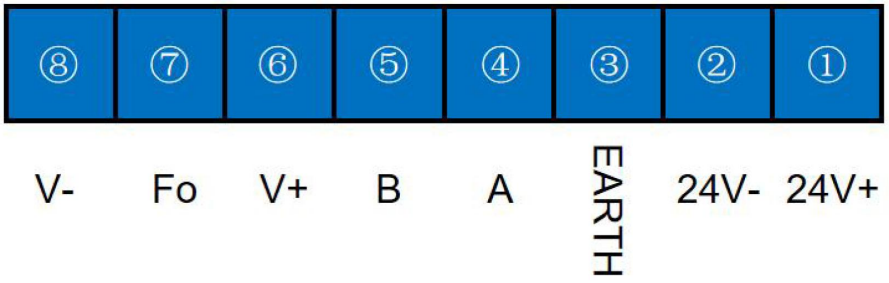
Ordering options	Wiring terminal No.						
	Output 1		Output 2		Output 3		
Output signal	24V+	24V-	A	B	V+	Fo	V-
Model selection code 1	4~20 mA analog quantity (passive), no communication		——		——		
Model selection code 2	4~20 mA analog quantity (passive)		——		Pulse (external power supply) (standard configuration)		
Model selection code 3	4~20 mA analog quantity (passive), 4~20 mAHART (passive)		——		Pulse (external power supply) (standard configuration)		
Model selection code 4	——		Modbus485		Pulse (external power supply) (standard configuration)		
Model selection code 5	FF communication		——		Pulse (external power supply) (standard configuration)		

1) The output 1 terminal must always be used for meter power supply;

2) 4~20 mA output, 4~20 mAHART output and 485 communication cannot be selected at the same time. For converters with 485 communication protocol, 4 must be selected;

3) FF communication, built-in polarity reversal protection. For converters with FF communication protocol, 5 must be selected.

II. External signal interface of equipment



Communication type	Interface position	Distribution
HART	1	4~20mA+
	2	4~20mA-
	3	Grounding
	4	Undistributed
	5	Undistributed
	6	Pulse power supply +
	7	Pulse signal
	8	Pulse power supply -
RS-485	1	Undistributed
	2	Undistributed
	3	Grounding
	4	Signal A
	5	Signal B
	6	Pulse power supply +
	7	Pulse signal
	8	Pulse power supply -
FF	1	FF+
	2	FF-
	3	Grounding
	4	Undistributed
	5	Undistributed
	6	Pulse power supply +
	7	Pulse signal
	8	Pulse power supply -

III. Power supply voltage

➢ Converter

Each output requires an external power supply.

➢ Power supply

Ordering option "Output signal"		Minimum terminal voltage	Maximum terminal voltage
Output signal	Model selection description		
Model selection code 1	4~20mA	≥16.5VDC	42V DC
Model selection code 2	4-20 mA, pulse	≥16.5VDC	42V DC
Model selection code 3	4~20 mA HART, pulse	>16.5VDC	42V DC
Model selection code 4	Modbus 485, pulse	≥21.6VDC	26.4V DC
Model selection code 5	FF communication, pulse	≥9VDC	32V DC

1) FF communication type vortex flow meter adopts an external FF bus power supply voltage and FF communication power regulator

2) The 24VDC power supply of the meter should be isolated from the 220VAC strong current to avoid interference with the meter power supply caused by the 220VAC strong current.

IV. Power consumption

Model selection code Output signal	Ordering option "Output signal"	Theoretical maximum power consumption
Model selection code 1	4~20mA	580mW
Model selection code 2	4-20 mA, pulse	580mW
Model selection code 3	4~20 mA HART, pulse	580mW
Model selection code 4	Modbus 485, pulse	910mW
Model selection code 5	FF communication, pulse	720mW

Note: The operating range of the 24VDC power supply voltage fluctuation is generally ±5%.

V. Current consumption

➢ Current output

4~20 mA or 4~20 mA HART current output: 4~21.6 mA.

➢ FF

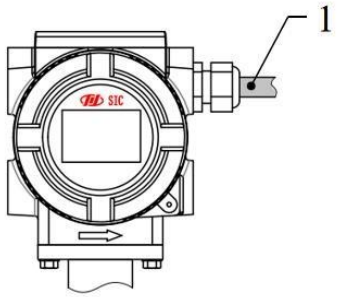
Constant current 22 mA.

VI. Power supply fault

Data (parameters, accumulated flow, etc.) are saved in EEPROM, and no spare battery is required.

VII. Electrical connection

➢ Connecting converter



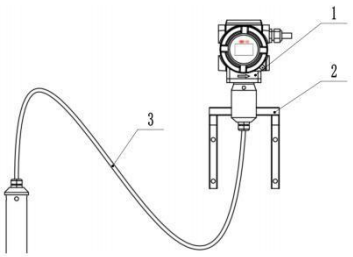
VFT type

Schematic Diagram of Cable Inlet Connection

1- Cable inlet, connecting input/output

Split connection

➢ Connecting cable



VFT type

Schematic Diagram of Split Type Cable Connection

1- Converter

2- Bracket

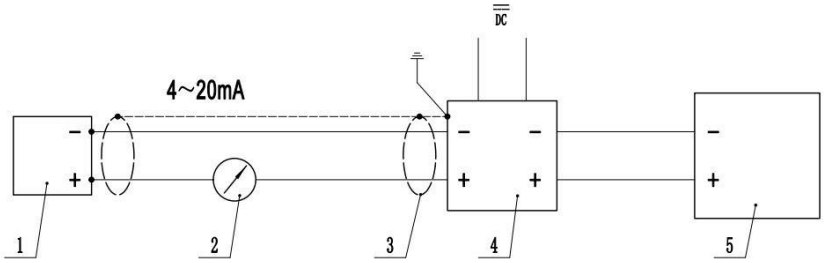
3- Connecting cable

- **Split wiring**

If a split type meter is used, the sensor and converter are installed separately and connected to each other by connecting cables. Cable connections are made between the handle connecting seat and the converter housing. For flameproof meters, flameproof electrical cable connectors need to be installed at both ends of the cable entry device.

Connection example

- **4~20 mA HART current output**



Connection example of 4~20 mA HART passive current output

1- Converter

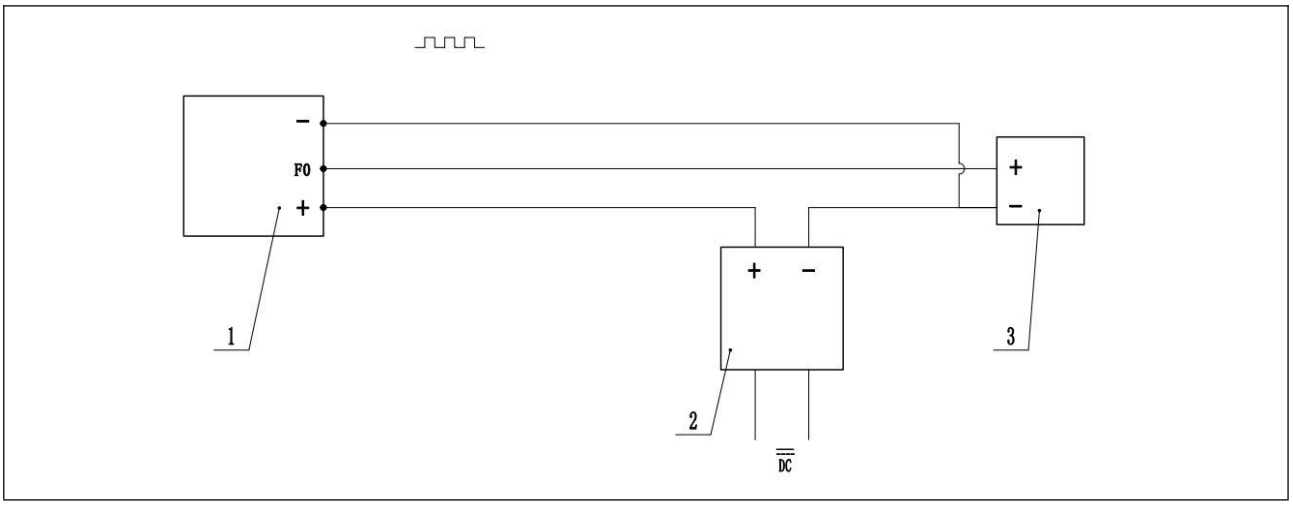
2- Analog display unit: note the maximum load

3- Cable shielding layer: The cable shielding layer must be grounded at both ends to ensure that EMC requirements are met; pay attention to the cable specifications

4- Power supply

5- Automation system with current input (such as PLC)

- **Pulse/frequency output**



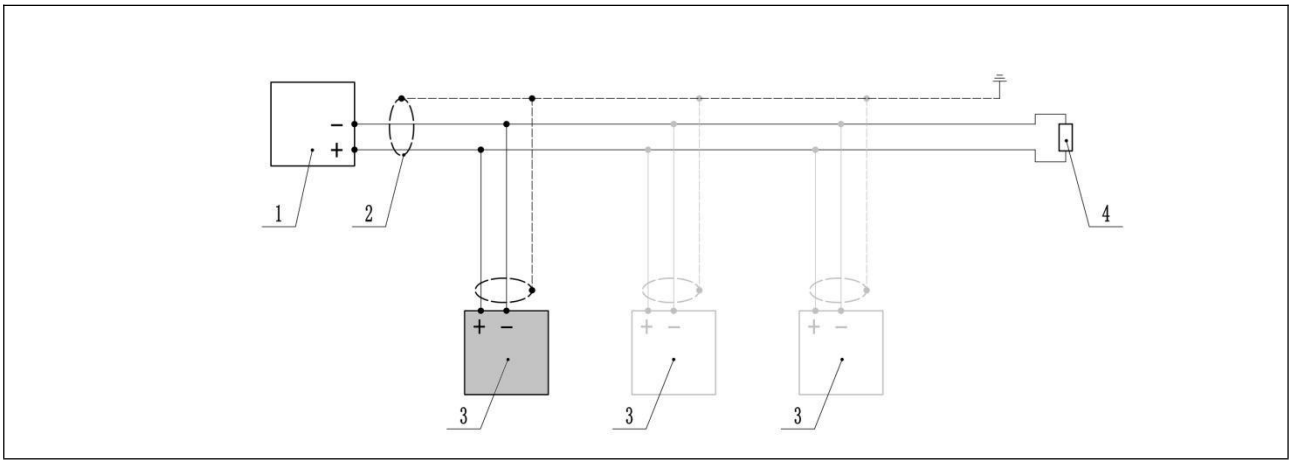
Connection example of pulse/frequency output (passive)

1- Converter: note the input parameters

2- Power supply

3- Automation system with pulse/frequency input (such as PLC)

- **RS-485 output**



Schematic Diagram of RS-485 Output (Passive Signal) Connection

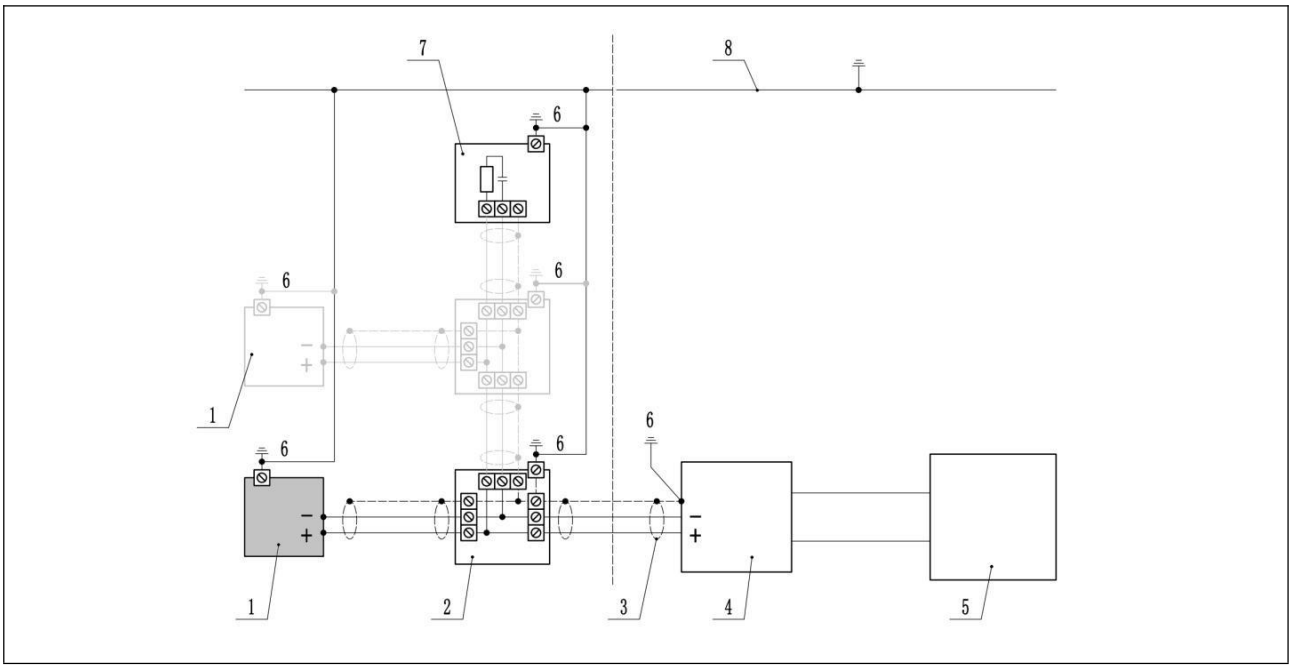
1- RS-232/485 conversion

2- Cable shielding layer: The cable shielding layer must be grounded at both ends to ensure that EMC requirements are met; pay attention to the cable specifications

3- Measuring meter

4- Terminal resistor

- **Foundation fieldbus (FF)**



Schematic Diagram of Foundation Fieldbus (FF)

1- Measuring meter

2- T-shaped box

3- Cable shielding layer: The cable shielding layer must be grounded at both ends to ensure that EMC requirements are met; pay attention to the cable specifications

4- Power regulator (foundation fieldbus (FF))

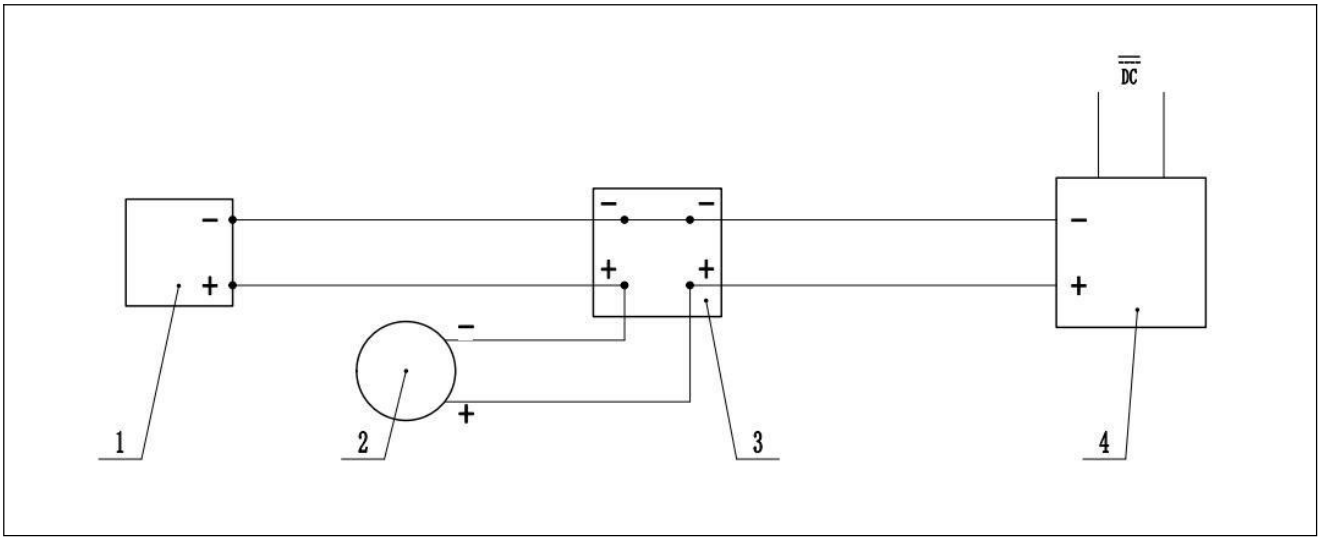
5- Control system (e.g. PLC)

6- Local grounding terminal

7- Bus terminator

8- Equipotential line

- **Current input**



Schematic Diagram of 4~20 mA Current Input Connection

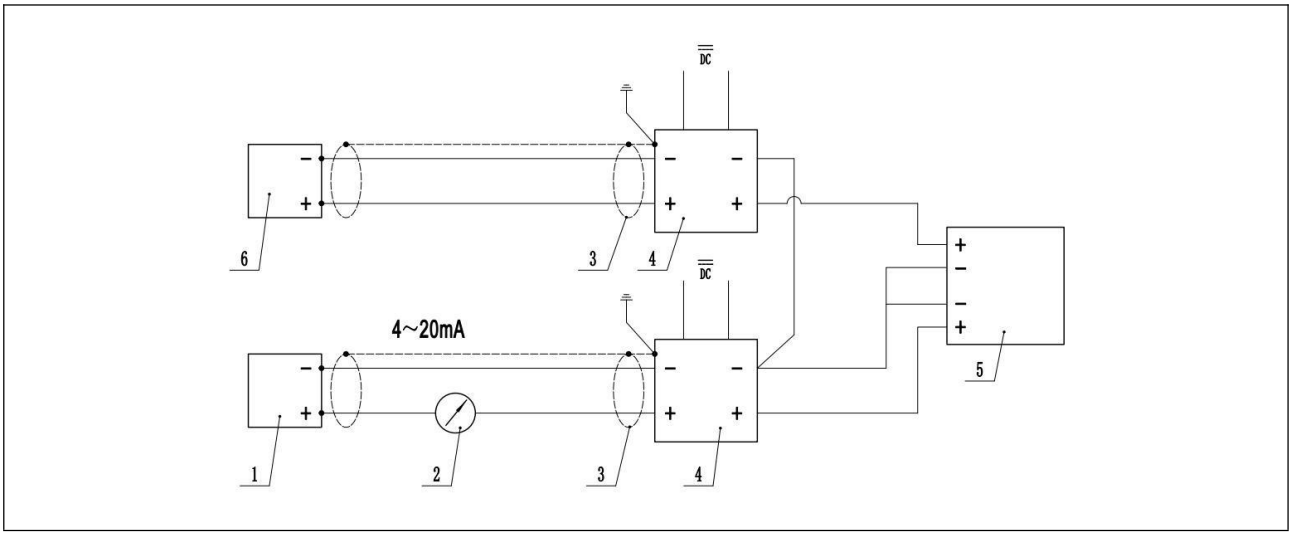
1- Converter: note the input parameters

2- External measuring equipment (e.g. for reading pressure or temperature values)

3- Junction box

4- Active fence of power supply (such as RN221N)

➢ **HART input**



Schematic Diagram of HART Passive Input Connection with Common Negative Terminal

1- Converter

2- Analog display unit: note the maximum load

3- Cable shielding layer: The cable shielding layer must be grounded at both ends to ensure that EMC requirements are met; pay attention to the cable specifications

4- Active safety barrier with power supply (e.g. RN221N)

5- Pressure measuring equipment (e.g. CerabarM, Cerabars): refer to requirements

6- Automation system with HART output (such as PLC)

VIII. Potential equalization

➢ **Requirements**

To ensure correct measurement, please pay attention to the following points:

◆ Fluid and sensor equipotential

◆ Split type meter: sensor and transmitter equipotential

◆ Grounding specifications inside the factory

◆ Pipe material and grounding

IX. Wiring terminal

The lifting wiring terminal is used, the threads are tightened, and the cross-sectional area of the wire core is 0.5~2.5 mm^2.

X. Cable inlet

Plastic cable gland (cannot be used in Exd explosion-proof occasions): The electrical interface thread of the converter housing is M20×1.5, and cables with a diameter of 8~12 mm are installed.

Metal explosion-proof cable glands are used in the explosion-proof area, and cables with a diameter of 8~12 mm are installed:

Electrical interface: M20×1.5, 1/2"NPT, G"1/2;

Cable gland material: nickel-plated brass (default), 304, 316L;

XI. Cable specification

■ Allowable temperature range

The installation guide requirements of the unit where the installation point is located must be followed.

The cable must be able to withstand the possible lowest and highest temperatures.

■ Signal cable

➢ 4~20 mA HART current output

It is recommended to use shielded cables. Please comply with the factory's grounding specifications.

➢ 4~20 mA current output

Use standard installation cables.

➢ Pulse/frequency/switch output

Use standard installation cables.

➢ Current input

Use standard installation cables.

➢ Foundation fieldbus (FF)

Use two-core, shielded twisted pair.

➢ Split type connecting cable

Standard cable	The core of the signal line is tinned copper wire with a diameter of 0.6±0.1 mm, an inner insulation layer thickness of 0.45±0.1 mm, and an inner insulation layer material of polyethylene. The outer diameter of the wire is 1.6±0.1 mm, the outer insulation layer thickness is 1±0.1 mm, the outer diameter of the wire is ø4.0±0.2 mm, and the outer insulation layer material is polyethylene
Shielding layer	Self-adhesive aluminum foil + tinned copper wire, weaving density (95±3)%, shielding performance>90 dB
Protective layer	304 stainless steel protective sleeve
Cable length	10m、20m、30m
Working temperature	For fixed installation: －40° C~+85° C For non-fixed installation: －25° C~+70° C

1) Strong ultraviolet radiation will damage the polyethylene outer sheath of the cable. Please avoid direct sunlight on the cable.

2) Other cable lengths and working temperatures shall be determined as per agreement.

XII. Overvoltage protection

The circuit is designed with overvoltage and lightning protection using varistors, gas discharge tubes, Zener diode, etc. When the instantaneous high voltage generated by lightning is applied to both ends of the varistor, the resistance value of the varistor becomes infinitesimal, so that the varistor is turned on and the large current generated by lightning is introduced into the earth, thereby protecting the power supply equipment from lightning damage.

Chapter V Performance Parameters

I. Reference operating conditions

- The maximum allowable error of the vortex flow meter meets the requirements of JJG1029 *Verification Regulation of Vortex-shedding Flowmeter*
- The ambient temperature is generally (5~45)°C
- The relative humidity is generally 35%~95%
- The atmospheric pressure is generally (86~106) KPa
- The calibration device features traceability, and the calibration laboratory has CNAS qualifications and meets relevant national standards
- The process connection of the calibration device meets relevant standards

Use Chuanyi vortex flow meter model selection software Vortex Type Selection to select the flow meter and determine the meter specifications and models

II. Maximum measurement error

➢ Basic measurement accuracy

Medium	Diameter	Range of Reynolds number	Accuracy
Gas	DN15-DN125	MAX（5000，$Re=\frac{3[m/s]*\rho\cdot D}{\mu_{cp}}$）-20000	10%
		≥MAX（20000，$Re=\frac{4[m/s]*\rho\cdot D}{\mu_{cp}}$）	1%
	DN150-DN300	MAX（5000，$Re=\frac{3[m/s]*\rho\cdot D}{\mu_{cp}}$）-40000	10%
		≥MAX（40000，$Re=\frac{4[m/s]*\rho\cdot D}{\mu_{cp}}$）	1%
Liquid	DN15-DN125	MAX（5000，$Re=\frac{0.3[m/s]*\rho\cdot D}{\mu_{cp}}$）-20000	10%
		≥MAX（20000，$Re=\frac{0.5[m/s]*\rho\cdot D}{\mu_{cp}}$）	1% (Maximum 0.75%)
	DN150-DN300	MAX（5000，$Re=\frac{0.5[m/s]*\rho\cdot D}{\mu_{cp}}$）-40000	10%
		≥MAX（40000，$Re=\frac{0.7[m/s]*\rho\cdot D}{\mu_{cp}}$）	1% (Maximum 0.75%)

➢ Temperature and pressure compensation accuracy

Medium type	Compensation type	Pressure sensor range	Flow accuracy
Steam	Temperature compensation	/	≤±1.0%
	Pressure compensation	0MPa~1.6MPa	At 0.753~1.6MPa≤±1.5% At 0.499~1.6 MPa, ≤±2.0% At 0.172~1.6 MPa, ≤±5% At 0~0.172 MPa, >±5%
		0MPa~4.0MPa	At 1.884~4.0 MPa, ≤±1.5% At 1.246~4.0 MPa, ≤±2.0% At 0.423~4.0 MPa, ≤±5%

Medium type	Compensation type	Pressure sensor range	Flow accuracy
			At 0~0.423 MPa, >±5%
Steam or gas	Temperature and pressure compensation	0MPa~1.6MPa	At 0.807~1.6 MPa, ≤±1.5% At 0.551~1.6 MPa, ≤±2% At 0.172~1.6 MPa, ≤±5% At 0~0.172 MPa, >±5%
		0MPa~4.0MPa	At 2.018~4.0 MPa, ≤±1.5% At 1.280~4.0 MPa, ≤±2% At 0.430~4.0 MPa, ≤±5% At 0~0.430 MPa, >±5%
Gas	Temperature and pressure compensation	0MPa~1.6MPa	At 0.734~1.6 MPa, ≤±1.5% At 0.484~1.6 MPa, ≤±2% At 0.168~1.6 MPa, ≤±5% At 0~0.168 MPa, >±5%
		0MPa~4.0MPa	At 1.835~4.0 MPa, ≤±1.5% At 1.210~4.0 MPa, ≤±2% At 0.421~4.0 MPa, ≤±5% At 0~0.421 MPa, >±5%

- Output resolution

Current output resolution: ± 10μA

III. Repeatability

For measuring multiple times, the repeatability of the flow meter will increase with the increase of single volume flow. Repeatability is not an inherent characteristic of the equipment, but a statistical variable that mainly depends on the flow volume under working conditions.

Under normal circumstances, the flow is guaranteed to be stable. The single acquisition time is not less than 30s, and the acquisition pulse is not less than 1000, and the meter repeatability is not less than 0.3%.

IV. Response time

When the flow damping is set to 0, the response time can be as fast as 0.5s (contract notes) and will not exceed 6s.

V. Influence of ambient temperature

Effect of temperature on current output: Current calibration is performed at 20°C. For every 10°C increase, the maximum current output deviation is ±0.12%; for every 10°C decrease, the maximum current output deviation is ±0.2%.

VI. Signal analysis

The converter adopts advanced FFT spectrum analysis signal processing circuit module, which can accurately detect the vortex information in a small signal and low flow area, so that the meter has super high stability and reliability in the low flow area, and the measurable flow range of the meter is greatly expanded. Besides, the fluid situation in the pipe can be analyzed, and the best judgment and adjustment can be made according to the analyzed data, reflecting high stability, intelligence and vibration resistance.

VII. Interchangeability

The converter can be used with sensors of various diameters.

VIII. Linear compensation

Meter polyline correction: 5 approximate polylines can be used to correct and compensate the linear error of the meter.

Reynolds number compensation: The output error when the Reynolds number is less than 10,000 can be compensated by 5 approximate polylines.

Chapter VI Installation

I. Preparation

Before installing the vortex flow meter:

- The pipe diameter and installation location of the flow meter need to be considered, and the appropriate flow meter diameter should be determined.
- At the same time, the Reynolds number and flow velocity of the medium must meet the meter requirements.
- The right flow meter diameter should be chosen to maximize the measurable range and minimize pressure drop and cavitation. The correct installation of the flow meter ensures accurate output of the flow, easy maintenance and measurement performance.

II. Installation and positioning

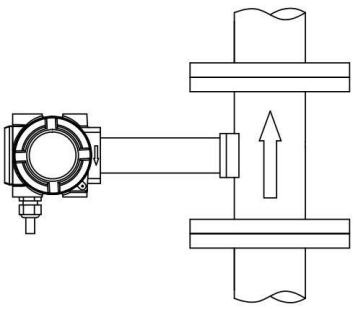
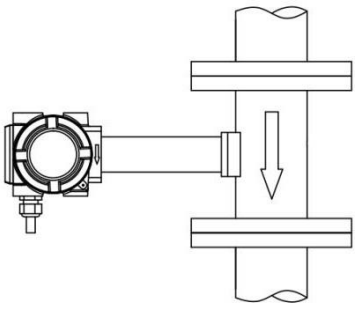
- Before installation, confirm the process pipeline so that the fluid can remain full in the meter and there is no entrained gas in the liquid medium.
- Provide sufficient straight pipe sections upstream and downstream of the meter and ensure non-bending symmetrical shapes.
- Install valves downstream of the meter whenever possible.
- Vertical installation is preferred because the upward flow of liquid can ensure that the flow meter is full.

III. Vertical installation

If the vortex flow meter is installed on a vertical pipe:

If the measuring medium is gas or steam, both installation methods can be used;

If the measuring medium is liquid, installation from bottom to top shall be adopted.

		
Installation method / Measuring medium	Installation from bottom to top	Installation from top to bottom
Gas or steam	✓	✓
Liquid	✓	/

IV. Horizontal installation

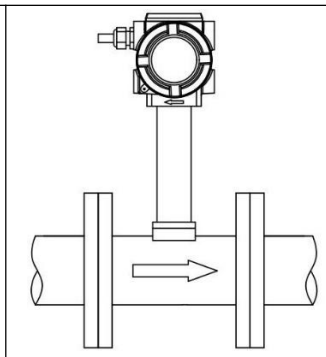
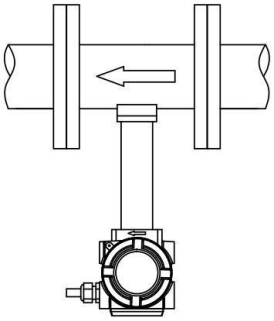
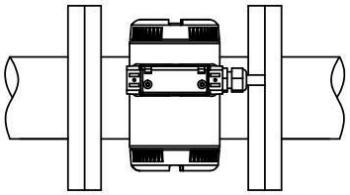
If the vortex flow meter is installed on a horizontal pipe:

If the measuring medium is liquid or steam, horizontal installation of the converter is preferred;

If the measuring medium is a high-temperature medium, it is recommended to install the converter

horizontally or downward;

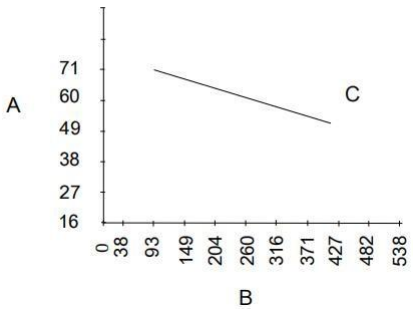
If the measuring medium is a low-temperature medium, it is recommended to install the converter horizontally or upward.

	 (1)	 (2)	 (3)
Installation method / Measuring medium	Upward installation of the converter	Downward installation of the converter	Horizontal installation of the converter
Gas	✓	✓	✓
Liquid	✓	/	✓
Steam	/	/	✓

V. Installation under high temperature

Since the maximum temperature resistance of the converter's electrical components is 70°C, the ambient temperature will change with the medium temperature when the vortex flow meter is working, as shown in the figure. Therefore, it is required that the flow meter body pipeline be insulated when installed under high temperature conditions. It is recommended to use 80 mm ceramic fiber coating to achieve the purpose of temperature isolation.

The upper end of the flow meter handle cannot be wrapped for heat insulation to avoid unsatisfactory heat dissipation and circuit damage caused by wrapping.



A. Ambient Temperature (°C)

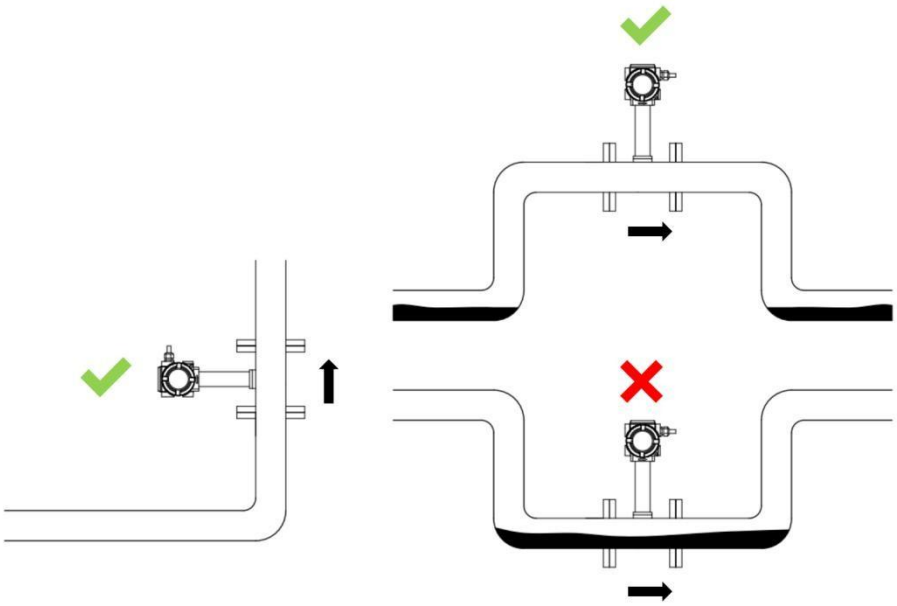
B. Medium temperature (°C)

C. 70°C housing temperature limit.

Variation of ambient temperature with medium temperature

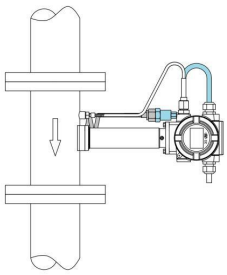
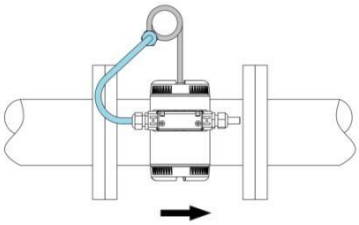
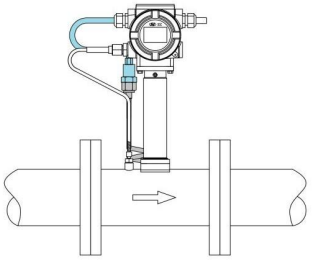
VI. Installation for steam application

For steam applications, the installation method shown in the figure should be avoided because such an installation may cause water hammer during startup due to steam condensation. Water hammer may overload the sensor and cause damage.



Schematic Diagram of Installation for Steam Application

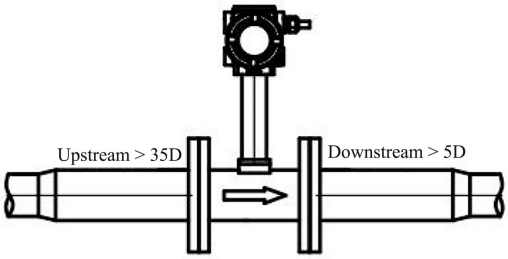
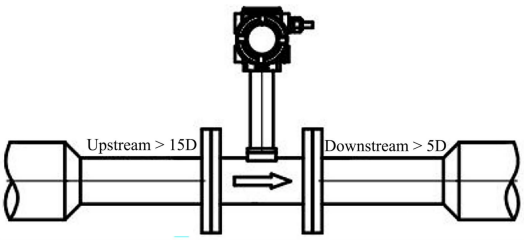
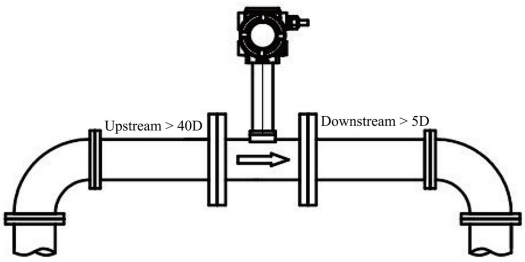
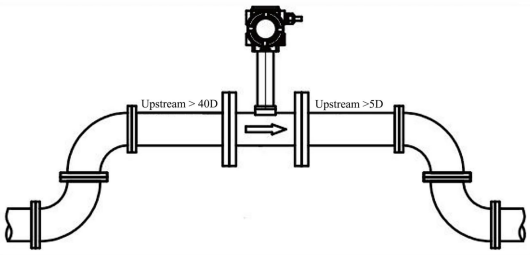
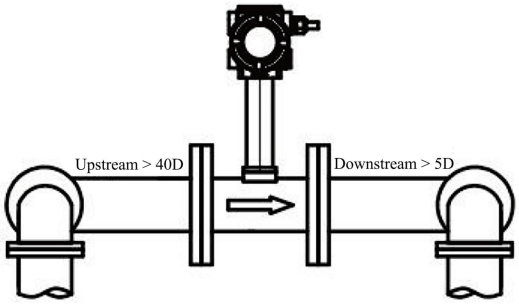
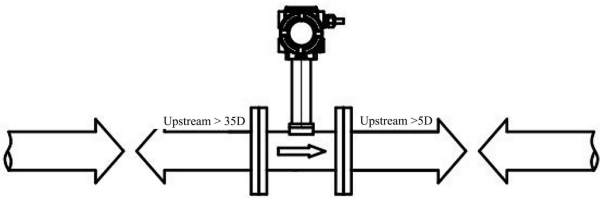
For the temperature-pressure vortex flow meter, if the measuring medium is steam, it is recommended to install it vertically from top to bottom and install the converter horizontally. The pressure sensor should be located above the pressure tapping point.

	 (1)	 (2)	 (3)
Installation method / Measuring medium	Vertical installation from top to bottom	Horizontal installation of the converter	Upward installation of the converter
Steam	✓	✓	✓

Note: The pressure sensor range of 1.6 MPa and 4.0 MPa can be selected. After condensation by the pressure tapping pipe assembly, the working temperature of the pressure sensor is -40～+100°C.

VII. Front and rear straight pipe sections

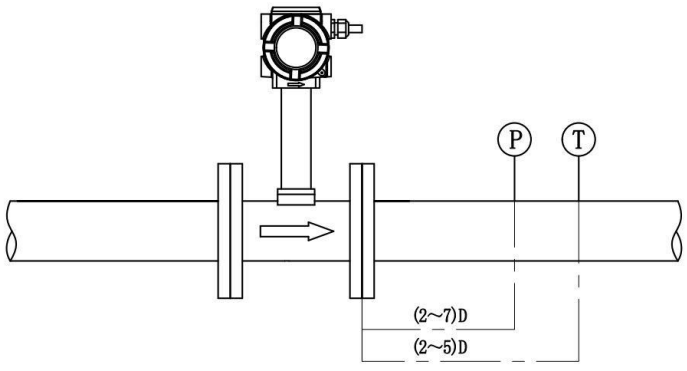
When installing the meter, it should be ensured that there is a straight pipe section length of at least 15D upstream and 5D downstream, which can ensure that the meter meets its accuracy indicators under changing process conditions.

1 Pipe expanding scenario	2 Pipe reducing scenario
	
3 Single elbow scenario	4 Double elbow scenario
	
5 Two elbow scenarios on different planes	6 Butterfly valve fully open scenario
	

Installation Diagram of Front and Rear Straight Pipe Sections

VIII. External pressure/temperature measurement

If the measured pressure and temperature signals need to be used to compensate and output mass flow or flow under standard conditions, but the flow meter is not a temperature-pressure flow meter, please install pressure measuring meters and temperature measuring meters downstream of the flow meter respectively. The installation positions are shown in the figure. In general, the temperature measurement position is set at (2~5)D downstream of the flow meter (D is the pipe diameter, and the same applies below), and the pressure measurement position is set at (2~7)D downstream of the flow meter.

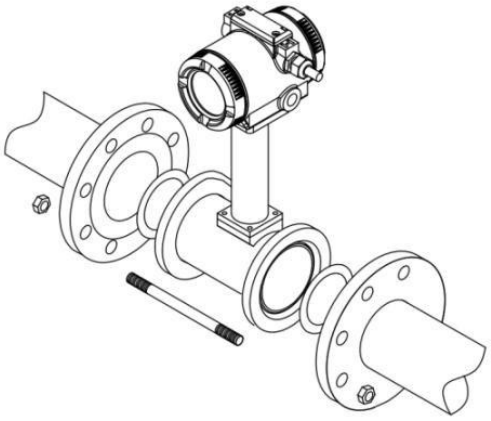


P Pressure measuring meter

T Temperature measuring meter

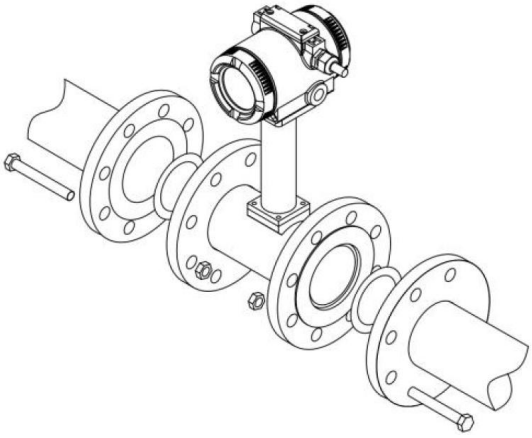
IX. Installation of integrated type meter

- **Clamp-on type installation**



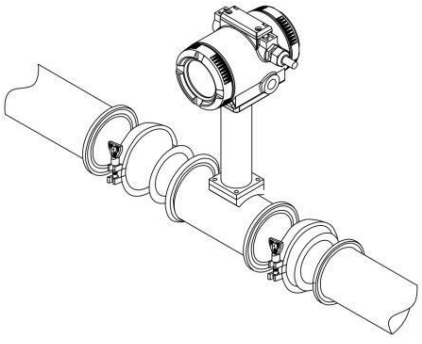
The flow direction is from left to right. The meter head display faces forward as the factory default standard direction

- **Flange type installation**



The flow direction is from left to right. The meter head display faces forward as the factory default standard direction

- **Clamp type installation**



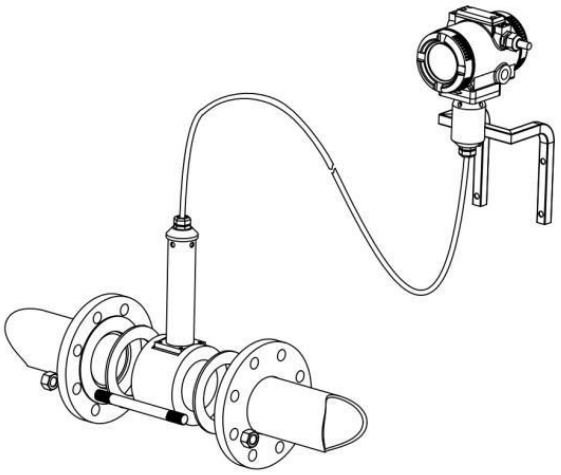
The flow direction is from left to right. The meter head display faces forward as the factory default standard direction

X. Installation of Split Type Meter

- **Length of connecting cable**

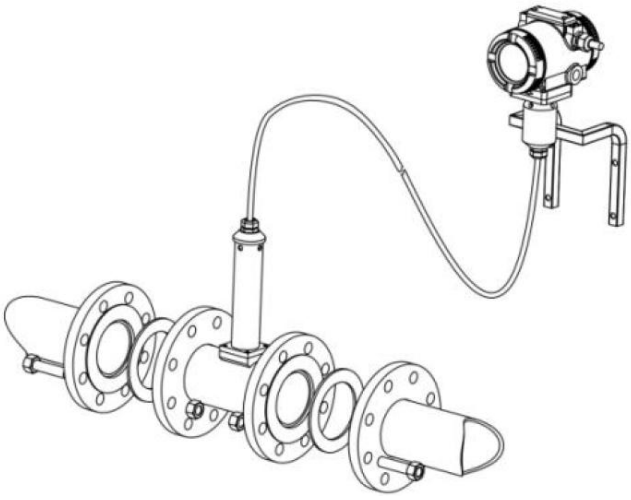
To ensure the normal operation of the flow meter, the maximum length of the connecting cable should be ≤30m during installation of a split type flow meter. For split type flow meters, our company provides shielded cables with lengths of 10m, 20m, and 30m. According to the on-site application requirements, the cable is covered with a 304 stainless steel protective cover to prevent the cable surface from being bumped, damaged, or bitten by rats.

- **Clamp-on type**



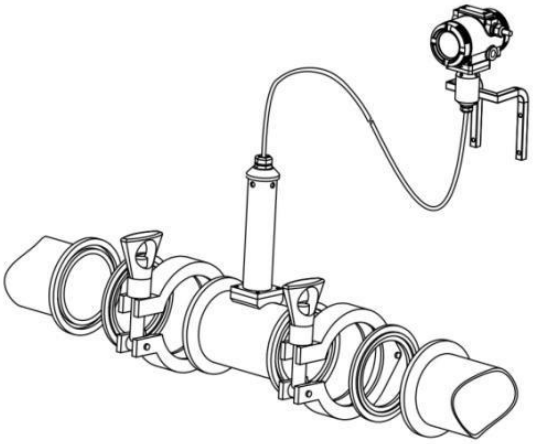
The split mounting bracket faces backward, and the meter head display faces forward as the factory default standard direction

- **Flange type**



The split mounting bracket faces backward, and the meter head display faces forward as the factory default standard direction

- **Clamp type**

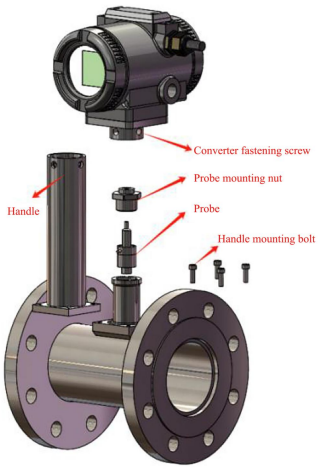


The split mounting bracket faces backward, and the meter head display faces forward as the factory default standard direction

XI. Installation of flow probe

If the flow meter probe needs to be tested or replaced, screw in the converter fastening screws, take out the converter vertically, loosen the probe connector, remove the handle mounting bolts, take out the handle, loosen the probe mounting nuts, and use the probe removing nuts to remove the probe.

After the probe inspection is completed, screw the probe into the mounting hole with the probe mounting nut, with tightening torque of 55N·m, and install the handle, handle mounting bolt, probe connector and converter in turn. After aligning the direction of the converter, unscrew the converter fastening screws and tighten them on the inner wall of the handle. After tightening, check whether the converter is loose to ensure that there are no loose parts.



Chapter VII Environmental Condition

I. Working ambient temperature range

Type	Category		Temperature range
Working ambient temperature without LCD display	Non-hazardous area		-40℃～70℃
Working ambient temperature with LCD display	Non-hazardous area		-30℃～70℃
Explosion-proof working ambient temperature	Intrinsically safe	EX ia ⅡC T6 Ga	-40℃～60℃
	Flameproof	EX db ⅡC T6 Gb	
	Intrinsically safe dust	EX ia ⅢC T200 80℃ Da	
	Flameproof dust	EX tb ⅢC T80℃ Db	

1) When the temperature is lower than -30°C, the LCD screen may not work normally.

2) When used outdoors: avoid direct sunlight, especially when used in hot areas.

II. Ambient Humidity Range

5% to 95% RH.

III. Storage Temperature

-40°C to 50°C.

IV. IP grade

Converter

- Standard: IP66/67
- Housing open: IP20
- Display module: IP20

Sensor

IP66/67

Connector/split cable

IP67

V. Vibration resistance

High vibration may cause the flow meter to erroneously record flow readings without actual flow. To minimize this effect, the design of the flow meter has taken into account relevant factors, and in most cases these errors can be eliminated through appropriate signal processing settings. If output errors are still detected under zero flow conditions, these errors can be further eliminated by adjusting the small flow cutoff value and filtering parameters. When the process medium begins to flow and passes through the flow meter, most of the disturbances caused by vibration are quickly suppressed by the flow signal.

The vibration resistance and sinusoidal wave vibration of the VFT vortex flow meter comply with IEC60068-2-6/GB/T2423.10 standards. The maximum vibration at or near the minimum liquid flow shall be 2.21 mm displacement amplitude or 1.5g acceleration, whichever is smaller. In

ordinary pipe-mounted devices, at or near the minimum gas flow, the maximum vibration should be 2.21 mm displacement amplitude or 0.5g acceleration, whichever is smaller. When the gas flow velocity is not less than 15 m/s and the Reynolds number is not less than 45000, the anti-vibration acceleration shall be 1.5g.

VI. Impact resistance

Impact resistance and half sine wave comply with IEC60068-2-27/GB/T2423.5 standard. The acceleration is 10g.

VII. Electromagnetic compatibility (EMC)

- **Immunity test**

① Test of immunity to radiated, radiofrequency, electromagnetic field

Comply with IEC61000-4-3/GB/T17626.3 standard, level 3: 10V/m (80 MHz~1 GHz), performance criterion requirements: Class A.

② Electrical fast transients/burst immunity test

Comply with IEC61000-4-4/GB/T17626.4 standard, signal line level 3: ±1 KV, 5 KHz, power line level 3: ±2 KV, 5 KHz, performance criterion requirements: Class A.

③ Electrostatic discharge immunity test

Comply with IEC61000-4-2/GB/T17626.2 standard, level 3: air discharge: ±8 KV, contact discharge: ±4KV, performance criterion requirements: Class A.

④ Surge (impact) immunity test (combined wave)

Comply with IEC61000-4-5/GB/T17626.5 standard, level: 2, performance criterion requirements: Class B.

⑤ Power supply voltage change immunity test

Comply with IEC61000-4-29/GB/T17626.29 standard, test level: 90%UT and 110%UT, performance criterion requirements: Class A.

⑥ Immunity test for short interruption of power supply

Comply with IEC61000-4-29/GB/T17626.29 standard, test level: 0%UT, performance criterion requirements: Class B.

⑦ Ripple immunity of DC power input port

Comply with IEC61000-4-17/GB/T17626.17 standard, test level 4: 15% of the relative DC nominal voltage, ripple frequency: 50 Hz, performance criterion requirements: Class A.

Comply with IEC61000-4-17/GB/T17626.17 standard, test level X: 30% of the relative DC nominal voltage, ripple frequency: 50 Hz, performance criterion requirements: Class A.

Chapter VIII Process Conditions

I. Medium temperature range

VFT：

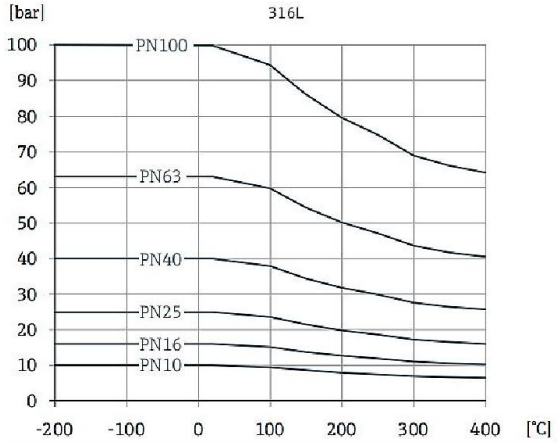
-40℃～260℃，304/316L/HC

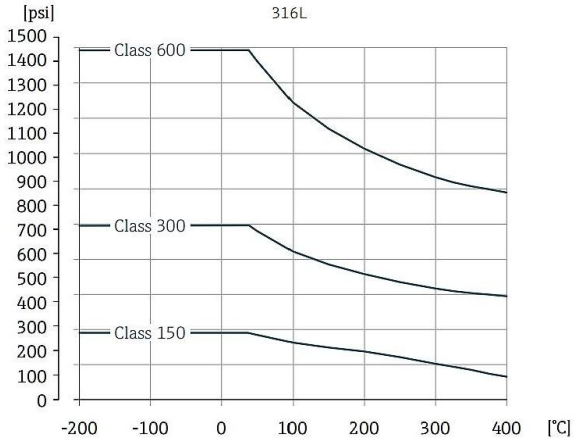
-40℃～400℃，304/316L/HC；

II. Pressure - temperature curve

The following pressure/temperature curves apply to all pressure-bearing parts of the meter, not just process connections. The figure shows the change trend of medium pressure with medium temperature of specific materials.

Pressure - Temperature Curve of 316L Material:





III. Nominal pressure of sensor

Series	Pressure rating			
PN	PN10	PN16	PN25	PN40
ANSI	ANSI 150	ANSI 300	/	/

IV. Pressure standard

The PN series pressure standard meets the requirements of HG/T 20592, and the maximum allowable working pressure at working temperature is shown in the following table.

Maximum allowable working pressure of 1.0 MPa steel pipe flange (20592 Section VII Pressure and Temperature Ratings)										
Material	Working temperature									
	20℃	50℃	100℃	150℃	200℃	250℃	300℃	350℃	375℃	400℃
304（2C1）	0.91 MPa	0.88 MPa	0.75 MPa	0.68 MPa	0.63 MPa	0.6 MPa	0.56 MPa	0.54 MPa	0.54 MPa	0.52 MPa
316L（2C3）	0.76 MPa	0.74 MPa	0.63 MPa	0.57 MPa	0.53 MPa	0.49 MPa	0.46 MPa	0.44 MPa	0.43 MPa	0.42 MPa

Maximum allowable working pressure of 1.6 MPa steel pipe flange (20592 Section VII Pressure and Temperature Ratings)										
Material	Working temperature									
	20℃	50℃	100℃	150℃	200℃	250℃	300℃	350℃	375℃	400℃

304（2C1）	1.47 MPa	1.42 MPa	1.21 MPa	1.1 MPa	1.02 MPa	0.96 MPa	0.9 MPa	0.87 MPa	0.86 MPa	0.84 MPa
316L（2C3）	1.23 MPa	1.18 MPa	1.02 MPa	0.92 MPa	0.85 MPa	0.79 MPa	0.74 MPa	0.71 MPa	0.69 MPa	0.68 MPa

Maximum allowable working pressure of 2.5 MPa steel pipe flange (20592 Section VII Pressure and Temperature Ratings)										
Material	Working temperature									
	20℃	50℃	100℃	150℃	200℃	250℃	300℃	350℃	375℃	400℃
304（2C1）	2.3 MPa	2.23 MPa	1.95 MPa	1.78 MPa	1.65 MPa	1.55 MPa	1.46 MPa	1.41 MPa	1.38 MPa	1.36 MPa
316L（2C3）	1.92 MPa	1.85 MPa	1.6 MPa	1.45 MPa	1.33 MPa	1.24 MPa	1.17 MPa	1.11 MPa	1.09 MPa	1.07 MPa

Maximum allowable working pressure of 4.0 MPa steel pipe flange (20592 Section VII Pressure and Temperature Ratings)										
Material	Working temperature									
	20℃	50℃	100℃	150℃	200℃	250℃	300℃	350℃	375℃	400℃
304（2C1）	3.68 MPa	3.54 MPa	3.03 MPa	2.75 MPa	2.55 MPa	2.41 MPa	2.27 MPa	2.19 MPa	2.16 MPa	2.12 MPa
316L（2C3）	3.06 MPa	2.96 MPa	2.55 MPa	2.31 MPa	2.12 MPa	1.98 MPa	1.87 MPa	1.78 MPa	1.75 MPa	1.71 MPa

The ANSI series pressure standard meets the requirements of HG/T 20615, and the maximum allowable working pressure at working temperature is shown in the following table.

Maximum allowable working pressure of ANSI150 (2.0 MPa) steel pipe flange (20615 Section VII Pressure and Temperature Ratings)											
Material	Working temperature										
	≤38℃	50℃	100℃	150℃	200℃	250℃	300℃	325℃	350℃	375℃	400℃
304（2.1）	1.9 MPa	1.83 MPa	1.57 MPa	1.42 MPa	1.32 MPa	1.21 MPa	1.02 MPa	0.93 MPa	0.84 MPa	0.74 MPa	0.65 MPa
316L（2.3）	1.59 MPa	1.53 MPa	1.33 MPa	1.2 MPa	1.12 MPa	1.05 MPa	1.0 MPa	0.93MPa	0.84MPa	0.74 MPa	0.65 MPa

Maximum allowable working pressure of ANSI300 (5.0 MPa) steel pipe flange (20615 Section VII Pressure and Temperature Ratings)											
Material	Working temperature										
	≤38℃	50℃	100℃	150℃	200℃	250℃	300℃	325℃	350℃	375℃	400℃
304（2.1）	4.96 MPa	4.78 MPa	4.09 MPa	3.7 MPa	3.45 MPa	3.25 MPa	3.09 MPa	3.02 MPa	2.96 MPa	2.90 MPa	2.84 MPa
316L（2.3）	4.14 MPa	4.0 MPa	3.48 MPa	3.14 MPa	2.92 MPa	2.75 MPa	2.61 MPa	2.55 MPa	2.51 MPa	2.48 MPa	2.43 MPa

V. Pressure range

➢ Flange type

Type	Diameter range	Optional maximum pressure rating
VFT flange type	DN15～DN300	ANSI300

➢ Reducing type

Type	Diameter range	Optional maximum pressure rating
VFT reducing type	DN15～DN300	ANSI300

➢ Clamping type

Type	Diameter range	Optional maximum pressure rating
VFT clamping type	DN15～DN300	ANSI300

VI. Pressure loss

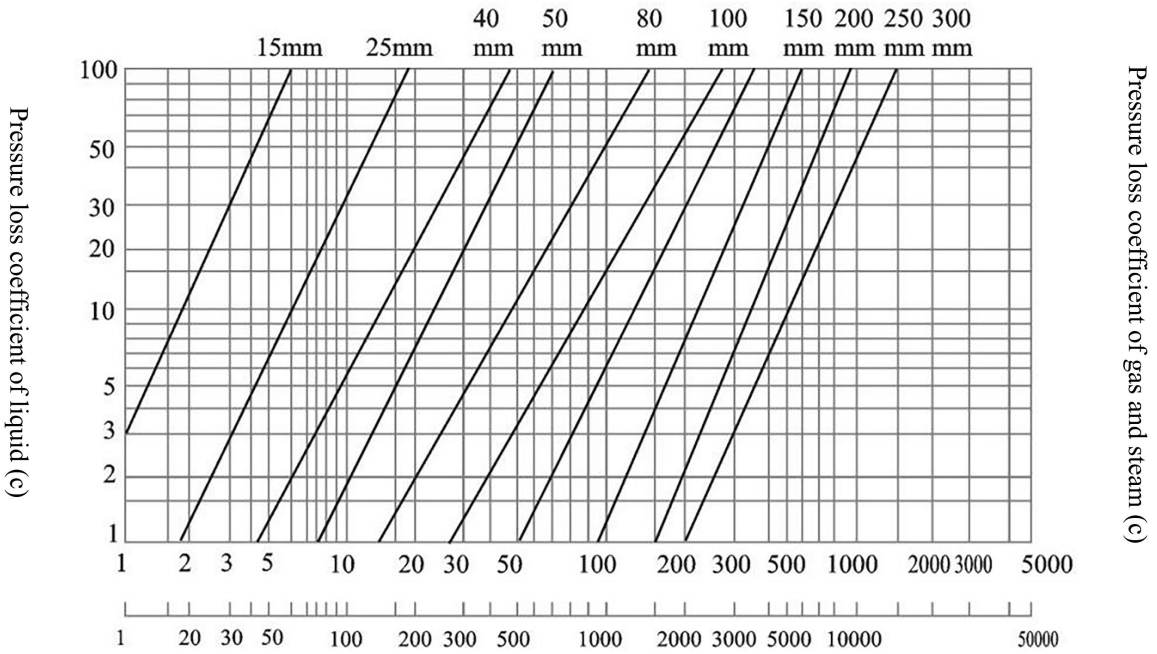
The speed of water is 10 *m/s*,ΔP=108*KPa*

When the atmospheric pressure air velocity is 80 *m/s*,ΔP=9*KPa*

Pressure loss can be obtained from the following formula:

$$\Delta P=108\times10^{-5}\times P_f\times v^2 \quad (1)$$

$$\Delta P=135\times P_f\times\frac{Q_f{}^2}{D^4} \quad (2)$$



Example of pressure loss calculation:

With diameter of 50 *mm*, water with temperature of 80°C, and flow of 30 *m/h*, the pressure loss is:

① The water density at 80°C is 972 kg/m^3. Put the value into Formula (2).

$$\Delta P=135\times972\times\frac{30^2}{51^4}=17.5\text{KPa}$$

② Calculate pressure loss with Formula (1). When the flow is 30m³/h, calculate the flow velocity with the following formula:

$$\Delta P=\frac{354\times Q_f}{D^2}=\frac{354\times 30}{51^2}=4.08m/s$$

Therefore, put the value into Formula (1):

$$\Delta P=108\times 10^{-5}\times 972\times 4.08^2=17.5KPa$$

③ Check the table to obtain pressure loss. The liquid pressure loss coefficient is 18.5, which can be calculated by the formula

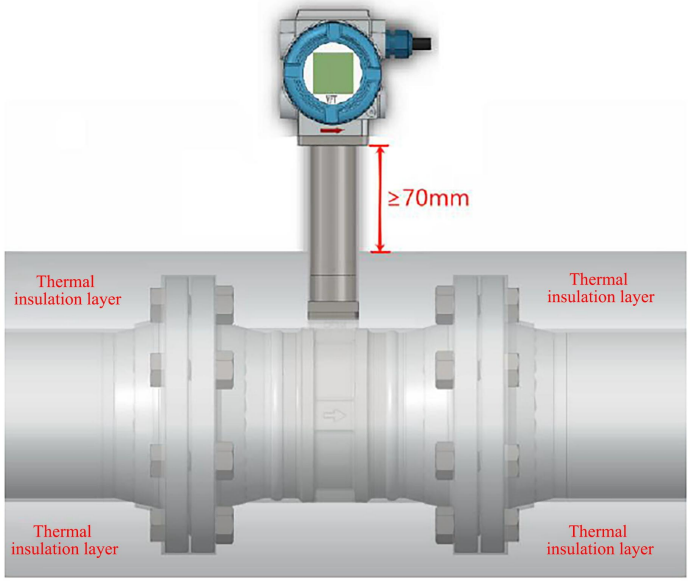
$$\Delta P=C\times\rho\times 10^{-5}$$

Where: ΔP- pressure loss (kg/cm^2), ρ - density (kg/m^3)

So $\Delta P=98.1\times 18.5\times 972\times 10^{-5}=17.6kPa$

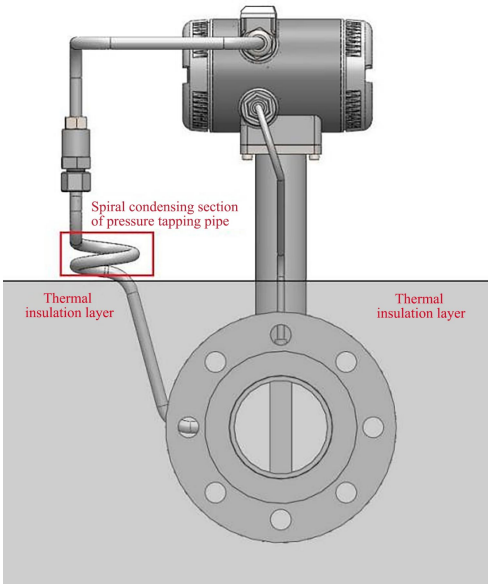
VII. Insulation

In order to optimize temperature measurement and mass calculation, heat exchange of some fluids at the sensor location must be avoided. Insulation requirements are achieved by installing insulation layer (ceramic fiber material).



1) The insulation layer at the handle is installed according to the height shown in the figure above, and the distance from the lower end face of the converter is ≥70 mm to prevent overheating or overcooling of electronic components.

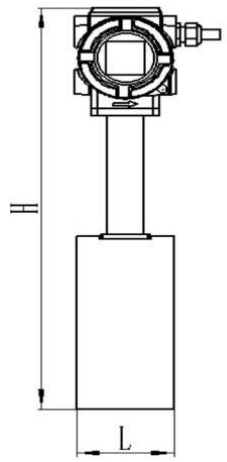
2) For temperature-pressure vortex flow meters with a medium temperature exceeding +260°C, in order to prevent the pressure sensor from overheating and damage, the insulation layer must be installed below the spiral condensing section of pressure tapping pipe (as shown in the figure below) .


Spiral condensing section
of pressure tapping pipe
Thermal
insulation layer
Thermal
insulation layer

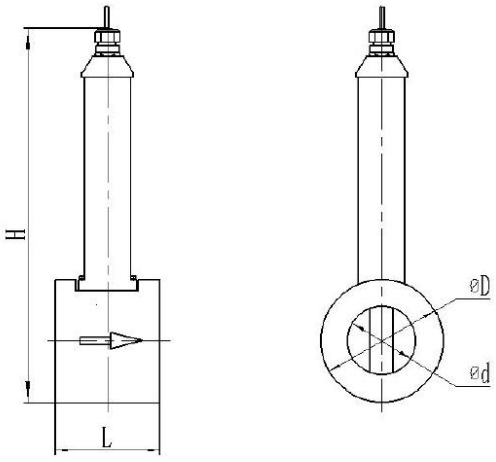
Chapter IX Mechanical Structure

I. Overall dimension and weight

➢ Overall dimensions of VFT clamp-on type vortex flow meter



Integrated type



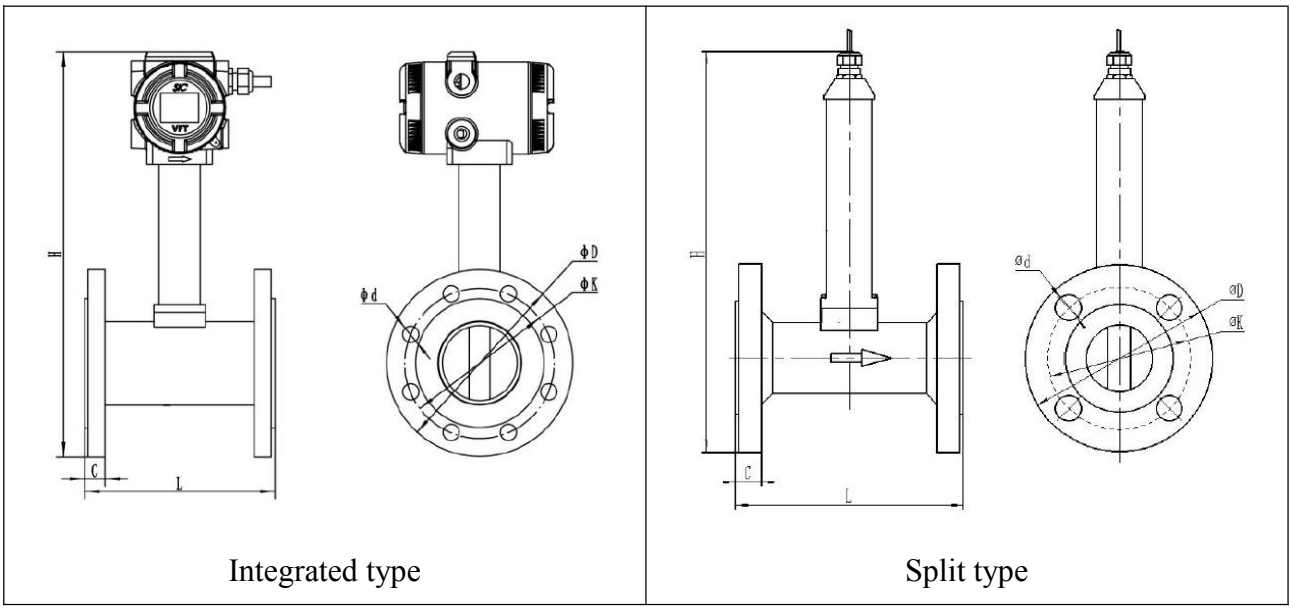
Split type

Unit (mm)

Nominal diameter	Length of meter body (L)	Inner diameter of meter body	Outer diameter of meter body (D)	Height of meter body (H)		Weight KG
				Integrated type (VH type)	Split type (VR type)	
15	65	15	55*64 square steel	370	305	3.8
20	65	20	55*68 square steel	373	308	4.1
25	65	25	58*68 square steel	375	310	4.5
32	65	32	76	373	308	3.8
40	65	40	88	387	322	4.2
50	65	50	95	386	321	4.6
65	70	65	104	402	337	5.8
80	80	80	125	423	358	6.7
100	90	100	150	445	380	8.1
125	100	125	175	475	410	9.5
150	110	150	206	508	443	13.6
200	125	200	248	548	483	21.4
250	140	250	298	598	533	35.5
300	160	300	358	658	593	46.3

The clamp-on type vortex flow meter is provided with matching flanges, bolts and gaskets when it leaves the factory.

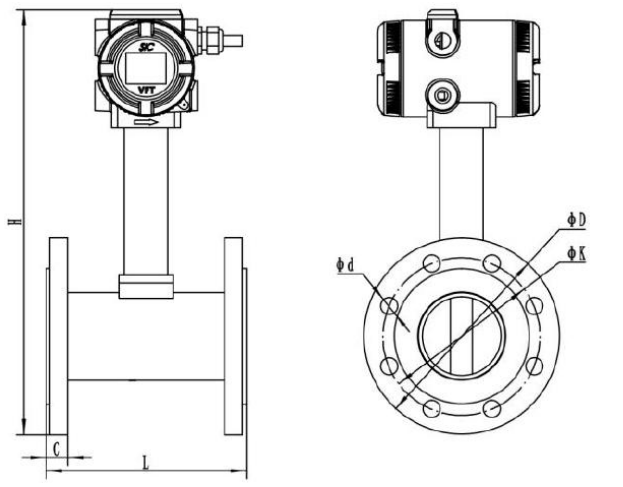
➢ Overall dimensions of VFT flange type vortex flow meter (1.0 MPa)



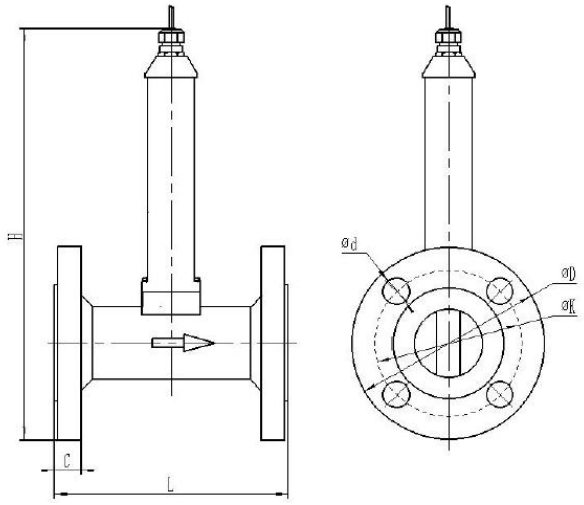
Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
1.0MPa	15	160	381	316	15	95	65	14	4	14	5.4
	20	160	386	321	20	105	75	14	4	16	5.8
	25	160	392	327	25	115	85	14	4	16	5.9
	32	170	408	343	32	140	100	18	4	18	7.3
	40	170	418	353	40	150	110	18	4	18	7.2
	50	180	430	365	50	165	125	18	4	20	8.7
	65	180	438	373	65	185	145	18	4	20	10.3
	80	200	462	397	80	200	160	18	8	20	12.9
	100	220	483	418	100	220	180	18	8	22	18.1
	125	220	510	445	125	250	210	18	8	22	23.4
	150	240	541	476	150	285	240	22	8	24	30.3
	200	280	600	535	200	340	295	22	8	24	42.5
	250	300	658	593	250	395	350	22	12	26	68.0
	300	320	712	647	300	445	400	22	12	26	92.2

➢ Overall dimensions of VFT flange type vortex flow meter (1.6 MPa)



Integrated type

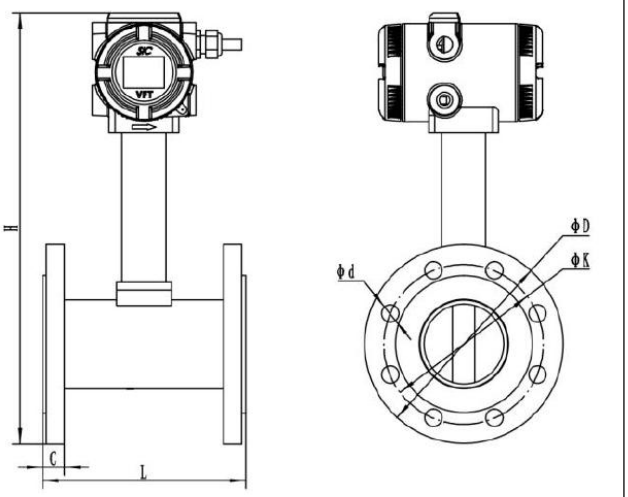


Split type

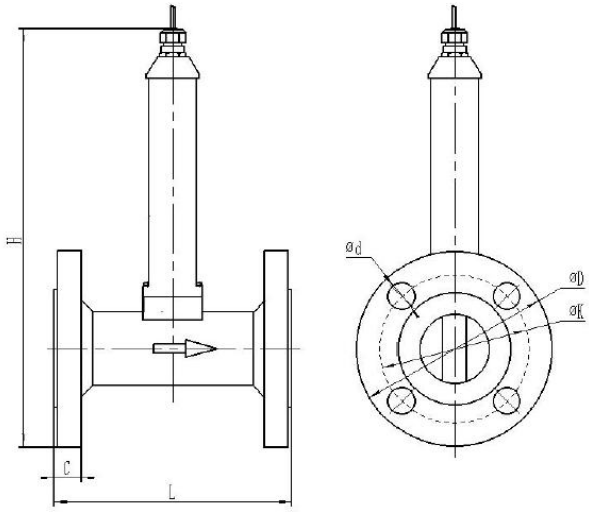
Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
1.6MPa	15	160	381	316	15	95	65	14	4	14	5.9
	20	160	386	321	20	105	75	14	4	16	6.3
	25	160	392	327	25	115	85	14	4	16	6.3
	32	170	408	343	32	140	100	18	4	18	7.9
	40	170	418	353	40	150	110	18	4	18	7.8
	50	180	430	365	50	165	125	18	4	20	9.4
	65	180	438	373	65	185	145	18	4	20	11.1
	80	200	462	397	80	200	160	18	8	20	14.0
	100	220	483	418	100	220	180	18	8	22	19.6
	125	220	510	445	125	250	210	18	8	22	25.3
	150	240	541	476	150	285	240	22	8	24	32.8
	200	280	600	535	200	340	295	22	12	24	46.0
	250	300	658	593	250	405	355	26	12	29	73.6
	300	320	712	647	300	460	410	26	12	32	99.8

➢ Overall dimensions of VFT flange type vortex flow meter (2.5 MPa)



Integrated type

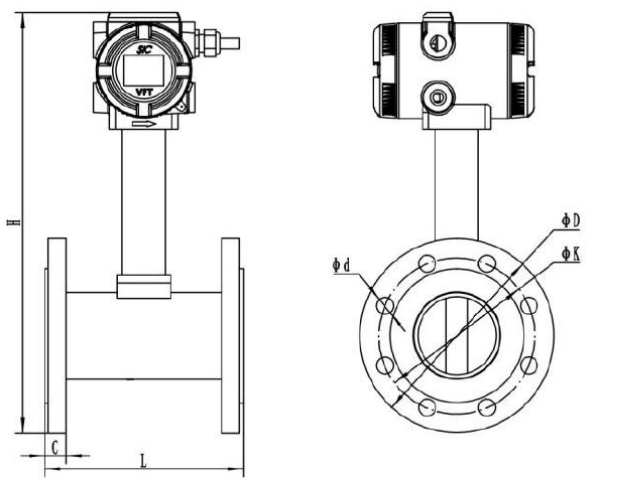


Split type

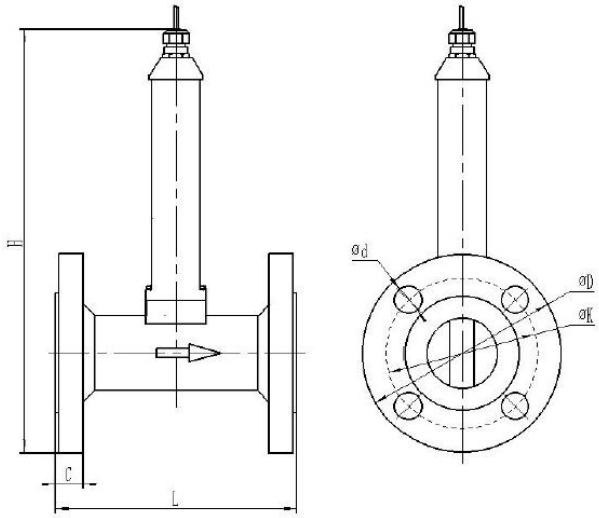
Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
2.5MPa	15	160	381	316	15	95	65	14	4	14	6.4
	20	160	386	321	20	105	75	14	4	16	6.8
	25	160	392	327	25	115	85	14	4	16	6.9
	32	170	408	343	32	140	100	18	4	18	8.6
	40	170	418	353	40	150	110	18	4	18	8.5
	50	180	430	365	50	165	125	18	4	20	10.2
	65	180	438	373	65	185	145	18	8	22	12.1
	80	200	462	397	80	200	160	18	8	24	15.2
	100	220	490	425	100	235	190	22	8	26	21.3
	125	220	520	455	125	270	220	26	8	28	27.5
	150	240	549	484	150	300	250	26	8	30	35.7
	200	280	610	545	200	360	310	26	12	32	50
	250	300	669	604	250	425	370	30	12	35	80
	300	320	725	660	300	485	430	30	16	38	108.5

➢ Overall dimensions of VFT flange type vortex flow meter (4.0 MPa)



Integrated type

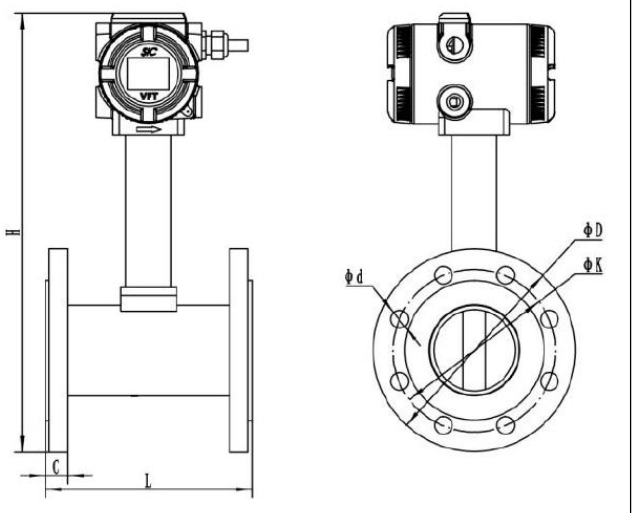


Split type

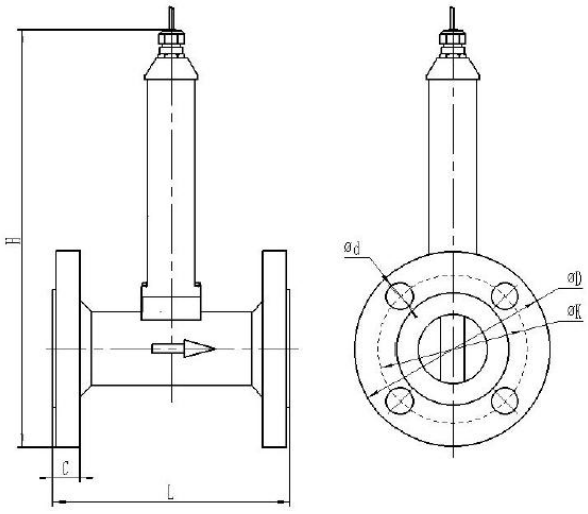
Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
4.0MPa	15	160	381	316	15	95	65	14	4	14	6.9
	20	160	386	321	20	105	75	14	4	16	7.3
	25	160	392	327	25	115	85	14	4	16	7.5
	32	170	408	343	32	140	100	18	4	18	9.3
	40	170	418	353	40	150	110	18	4	18	9.2
	50	180	430	365	50	165	125	18	4	20	11.0
	65	180	438	373	65	185	145	18	8	22	13.1
	80	200	462	397	80	200	160	18	8	24	16.4
	100	220	490	425	100	235	190	22	8	26	23.0
	125	220	520	455	125	270	220	26	8	28	29.7
	150	240	549	484	150	300	250	26	8	30	38.6
	200	280	618	553	200	375	320	30	12	36	54.0
	250	300	682	617	250	450	385	33	12	42	86.4
	300	320	740	675	300	515	450	33	16	48	117.2

➢ Overall dimensions of VFT flange type vortex flow meter (ANSI150)



Integrated type

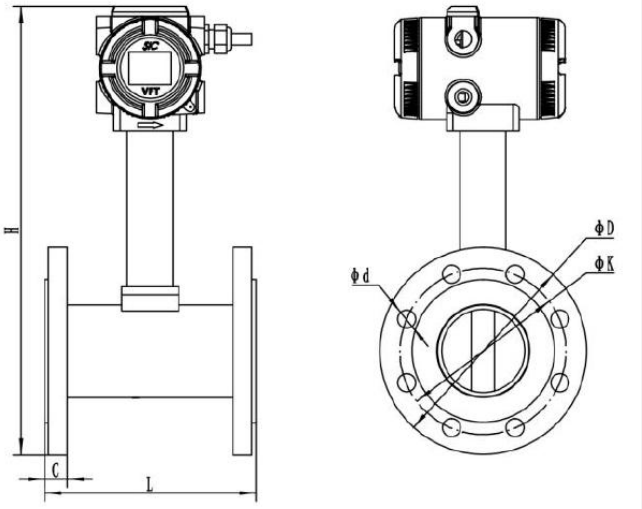


Split type

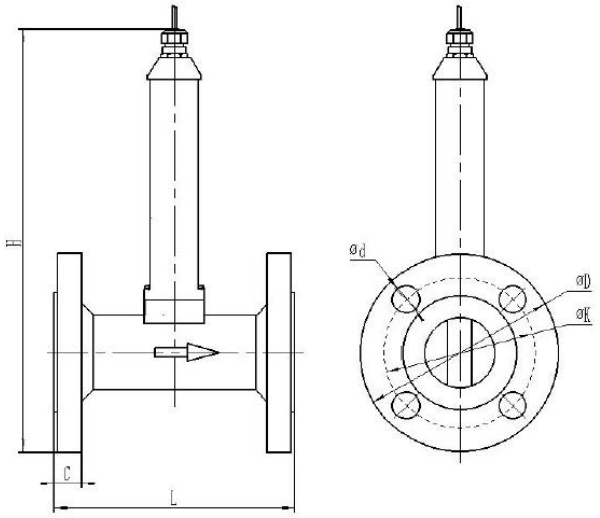
Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
ANSI150	15	160	378	313	15	90	60.3	16	4	11.6	6.7
	20	160	383	318	20	100	69.9	16	4	13.2	7.1
	25	160	389	324	25	110	79.4	16	4	14.7	7.2
	32	170	396	331	32	120	88.9	16	4	16.3	9.0
	40	170	405	340	40	130	98.4	16	4	17.9	8.9
	50	180	423	358	50	150	120.7	18	4	19.5	10.7
	65	180	445	380	65	180	139.7	18	4	22.7	12.7
	80	200	457	392	80	190	152.4	18	4	24.3	16.0
	100	220	488	423	100	230	190.5	18	8	24.3	22.4
	125	220	513	448	125	255	215.9	22	8	24.3	28.9
	150	240	539	474	150	280	241.3	22	8	26	37.5
	200	280	601	536	200	345	298.5	22	8	29	52.5
	250	300	659	594	250	405	362	26	12	30.6	84.0
	300	320	725	660	300	485	431.8	26	12	32.2	113.9

➢ Overall dimensions of VFT flange type vortex flow meter (ANSI300)



Integrated type



Split type

Unit (mm)

Nominal pressure	Nominal diameter	Meter length L	Height of meter body (H)		Inner diameter of meter body d	Flange outer diameter D	Central pitch K	Bolt hole diameter d2	Bolt quantity N	Flange thickness C	Weight Kg
			Integrated type	Split type							
ANSI300	15	160	386	321	15	95	66.7	16	4	14.7	7.2
	20	160	391	326	20	115	82.6	18	4	16.3	7.6
	25	160	397	332	25	125	88.9	18	4	18	7.7
	32	170	405	340	32	135	98.4	18	4	19.5	9.6
	40	170	420	355	40	155	114.3	22	4	21.1	9.5
	50	180	430	365	50	165	127	18	8	22.7	11.4
	65	180	450	385	65	190	149.2	22	8	26	13.6
	80	200	467	402	80	210	168.3	22	8	29	17.0
	100	220	500	435	100	255	200	22	8	32.2	23.9
	125	220	525	460	125	280	235	22	8	35.4	30.8
	150	240	559	494	150	320	269.9	22	12	37	40.0
	200	280	619	554	200	380	330.2	26	12	41.7	56.0
	250	300	680	615	250	445	387.4	30	16	48.1	89.6
	300	320	745	680	300	520	450.8	33	16	51.3	121.5

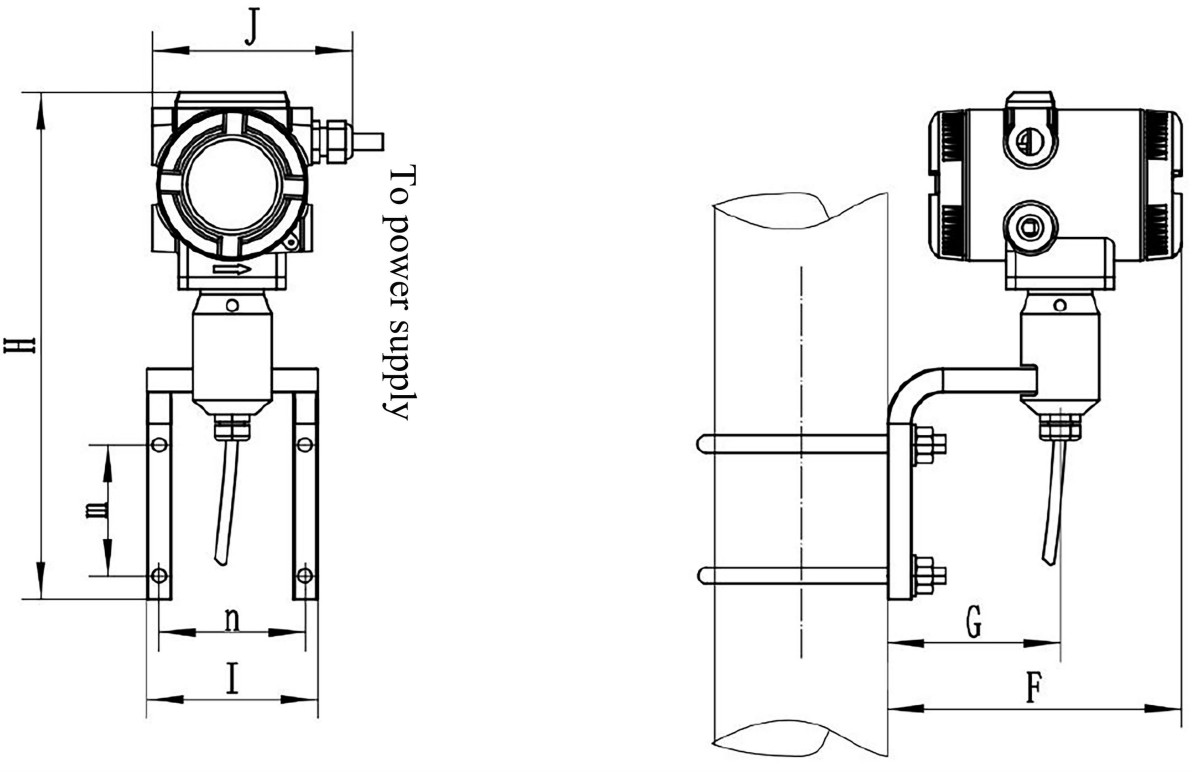
Note: The dimensions in the above table are all conventional contract dimensions. In case of any special dimension requirements, please make an order with the Company.

II. Dimensions and weight of split type converter

➢ VFT type



VFT Integrated Type Converter



VFT Split Type Converter

Unit: (mm)

Total height (H)	Total length (J)	Vertical hole spacing (m)	Horizontal hole spacing (n)	Bracket width (I)	Wall spacing (G)	Total width (F)	Weight (MKg)
329	150	85	95	111	112	175	5.5

III. Material

Component	Part	Whether it is wetted	Material	Remarks
Sensor	Sensor meter body	Wetted	304/316L/HC/Special	/
	Generator	Wetted	304/316L/HC/Special	/
	Probe	Not wetted	Stainless steel and nickel-based alloy welding	
	Detector	Wetted	316L/HC	VFT only; When selecting HC material, the meter body and generator must be both HC
	Handle	Not wetted	304	/
	Flange sealing gasket	Not wetted	Graphite (default)/PTFE/316L RJ (ring joint face)	/
Converter	Converter housing	Not wetted	Default: aluminum alloy Special: stainless steel 304/316L	/
	Converter window	Not wetted	Glass	/
Electrical joints	Electrical blind plug	Not wetted	304	/
	Cable connector	Not wetted	General: Nylon Flameproof type: nickel-plated brass (default) /304/316L	/
Split type	Connecting seat	Not wetted	Default: aluminum alloy Special: 304 stainless steel	/
	Converter bracket	Not wetted	304 Stainless Steel	/
	Connecting cable	Not wetted	Single-core shielded cable	/

IV. Flange connection

Flange connection size: PN series complies with HG/T 20592, and ANSI series complies with HG/T 20615. The standard version is subject to the latest release.

The meter sealing surface is a raised face (RF) by default, and a male face (M) can be selected. For high pressure model selections (exceeding 10 MPa), a RJ (ring joint face) can be selected.

Chapter X Operability

I. Operation method

Digital segment code operation menu function

- Commissioning
- Operation

Simple and reliable operation

- For on-site operations, use numbers and characters instead of specific operating languages

II. Language

- The operation menu adopts numbers and characters.

III. On-site operation

Display unit

Segment code LCD screen

The number of decimal places can be set

Allowable ambient temperature of display: -30～+70℃

Operation element

On-site operation is performed by opening the 3 buttons on the converter cover:



VFT operation button

- **S button**: main display interface switching, longitudinal movement of parameter item and parameter modification and confirmation operation
- **+ button**: enter parameter modification and parameter bit increment operation
- **- button**: horizontal movement of parameter item and parameter shift operation

The vortex flow meter mainly includes the main display interface, login interface and parameter modification interface

- **Main display interface**



S/N	Display area	S/N	Display area
①	Menu number display;	④	Instantaneous flow unit display;
②	Range percentage display;	⑤	Total value display;
③	Instantaneous flow value display;	⑥	Total unit display.
Operation steps	1. In the main interface, the meanings of parameters in each display area are shown in ①-⑥; 2. Check the temperature, pressure and density values: In the main interface, press the "S" button, and then press the "S" button to switch the temperature, pressure and density parameter interfaces. At this time, the display area ⑤ displays the temperature value/pressure value/density value and unit; 3. Switch the main interface to the login interface: In the main interface, press the "-" button to enter the login interface.		

- **Login interface**



S/N	Display area	S/N	Display area
①	Menu number display;	④	Instantaneous flow unit display;
②	Range percentage display;	⑤	Password entry area.

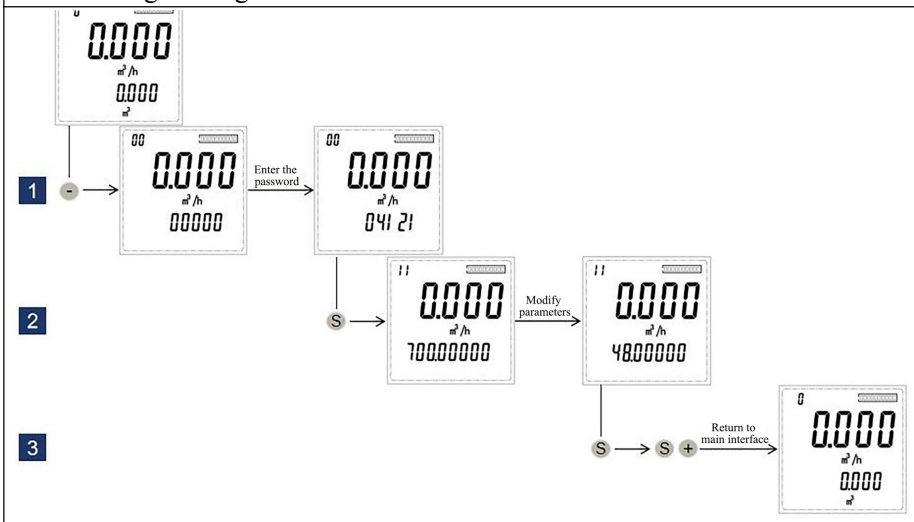
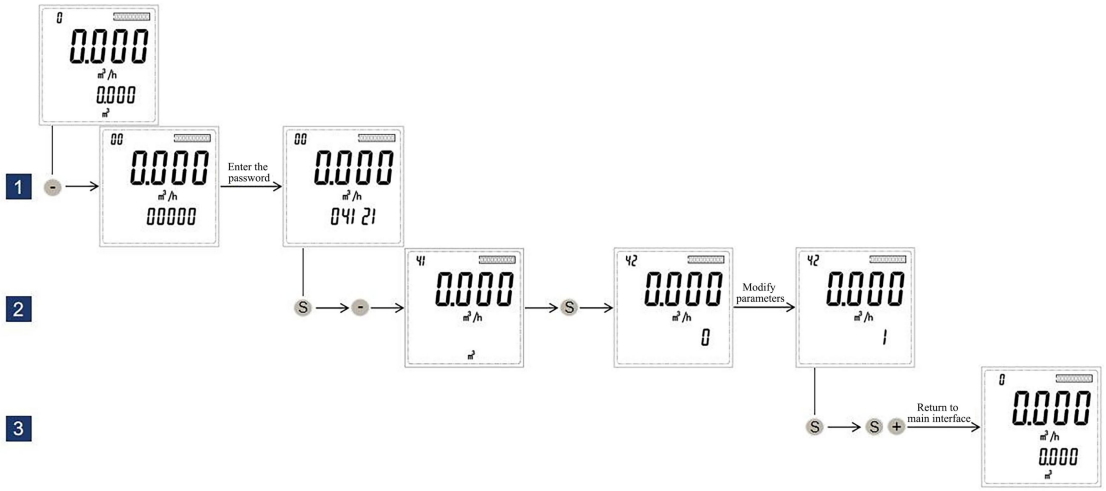
③	Instantaneous flow value display;		
Operation steps	1. In the login interface, the meanings of parameters in each display area are shown in ①-⑤; 2. Meter login password: 23155; 3. Press the "+" button to modify the current position value, and press the "-" button to switch the input position horizontally; 4. Switch the login interface to the parameter modification interface: After entering the password correctly, press the "S" button to confirm and enter the parameter modification interface (if the password is wrong, return to the main interface and re-enter the login interface to enter the password).		

- **Parameter modification interface**



S/N	Display area	S/N	Display area
①	Menu number display;	④	Instantaneous flow unit display;
②	Range percentage display;	⑤	Parameter value.
③	Instantaneous flow value display;		
Operation steps	1. In the parameter modification interface, the meanings of parameters in each display area are shown in ①-⑤; 2. The first digit of the menu number represents the main menu number, and the second digit represents the submenu number. Each menu number corresponds to a parameter, such as menu number "11", which corresponds to the "upper range limit" in the "flow menu". For the corresponding relationship between the menu number and the parameter definition, please refer to Section VI "Parameter definition of vortex flow meter". 3. Switch the main menu horizontally: Press the "-" button to switch the main menu, and press it once to switch one page. For example, under the "11" menu, press the "-" button to switch to the "21" main menu, and then press the "-" button to switch to the "31" main menu, in order. 4. Switch the submenu vertically: Press the "S" button to switch submenus, and press once to switch one page. For example, under the "11" menu, press the "S" button to switch to the "12" submenu, and then press the "S" button to switch to the "13" submenu, in order. 5. Modify parameter value: Switch to the menu number interface of the parameter to be modified. After pressing the "+" button to enter the modification state, press the "+" button to modify the current position value, press the "-" button to switch the input position horizontally, and after the parameter modification is completed, press the "S" button to confirm. 6. Return to the main interface from parameter modification interface: Press and hold the "S" button while pressing the "+" button to return to the main interface.		

Parameter configuration demonstration case

Case 1: Range configuration	
	
Operation steps	1. Press the "-" button to enter the login interface and enter the password "23155"; 2. Press the "S" button to confirm, enter the parameter modification interface, find the "Upper range limit" according to the menu number "11", and modify the parameters; 3. Press the "S" button to save the parameters, and then press and hold the "S" button while pressing the "+" button to return to the main interface.
Case 2: Total reset	
	
Operation steps	1. Press the "-" button to enter the login interface and enter the password "23155"; 2. Press the "S" button to confirm, enter the parameter modification interface, find the "Upper range limit" according to the menu number "42" (press the "-" button to turn the page to the total menu interface of the menu number "41", press the "S" button to turn to the submenu "42" upper range limit), and modify the parameters; 3. Press the "S" button to save the parameters, and then press and hold the "S" button while pressing the "+" button to return to the main interface; 4. Press the "+" button on the main interface to reset the total.

Modular menu structure design

➢ Table of Vortex Flow Meter Parameter

Parameter identifier/menu number vertical switching

Parameter identifier/menu number horizontal switching →

Flow menu	Current menu	Frequency menu	Total menu	Temperature and pressure compensation menu	Temperature and pressure calibration menu	Alarm menu	Sensor menu	Test menu	Communication menu	Signal processing menu	Parameter menu	Diagnostic menu
11	21	31	41	51	61	71	81	91	A1	B1	C1	D1
12	22	32	42	52	62	72	82	92	A2	B2	C2	D2
13	23	33	43	53	63	73	83	93	A3	B3	C3	D3
14	24	34	44	54	64	74	84	94	A4	B4		D4
15	25	35	45	55	65	75	85	95	A5	B5		D5
16	26		46	56	66	76	86		A6	B6		D6
	27			57	67	77	87			B7		D7
					68	78	88			B8		D8
					69		89			B9		D9
					6A		8A			BA		DA
					6B		8B			BB		DB
					6C		8C					DC
					6D		8D					
					6E		8E					
					6F		8F					
					6G		8G					
							8H					

Parameter Name and Description

Menu Number	Menu Description	Factory Default Value
Flow menu		
11	Upper limit of flow range, corresponding to the flow when the current output is 20 mA	Set according to the contract
12	Lower limit of range, corresponding to the flow when the current output is 4 mA, usually set to 0	0
13	Flow unit	See "Flow unit" on page 64 of the product manual for details
14	Flow damping, minimum 0.5 seconds	3.2
15	Volume flow under working conditions	Read-only, cannot be set
16	Small flow cutoff. The flow below the set value will be cut off. It can be used to remove noise when there is no flow	0
Current menu		
21	Output current value corresponding to the upper limit of flow (unit: mA)	20
22	Output current value corresponding to the lower limit of flow (unit: mA)	4
23	Current output current value (unit: mA)	Read-only, cannot be set
24	Current output full-scale correction (unit: mA)	Factory calibration
25	Current output zero correction (unit: mA)	Factory calibration
26	Current output enabling. When the current output function is turned off, the meter output current is fixed at 4 mA (0 - turn off the current output function; 1 - turn on the current output function)	1
27	Current output damping coefficient. The closer it is to 0, the slower the current output changes. Set it to 1 to cancel damping	1
Frequency menu		
31	Number of pulses output per unit volume flow (valid when parameter "35" is 0/1/2);	3.6 (equal to the meter K coefficient for polyline correction)
32	Sensor frequency (unit: Hz);	Read-only, cannot be set
33	Upper limit of output frequency (unit: Hz)	5000
34	Current output frequency (unit: Hz);	Read-only, cannot be set
35	Frequency output mode 0: Meter operation frequency output. When no output is present, it maintains a low level; 1: Meter operation frequency output. When no output is present, it maintains a high level; 2: Meter operation pulse output; 3: Sensor frequency output;	3 (0 for polyline correction)
Total menu		
41	Total unit;	See "Flow unit" on page 64 of the product manual for details
42	Total reset enabling. After changing it to 1, press S and + buttons at the same time to return to the main interface, and then press - button to reset the total);	0
43	Total modification password. Enter 12345 and modify the total through parameters 44 - 46;	0

Menu Number	Menu Description	Factory Default Value
44	For the part where the total integer is greater than 108, the total increases by 108 for every increase of 1 in this parameter;	0
45	For the part where the total integer is less than 108, the total increases by 1 for every increase of 1 in this parameter;	0
46	Decimal part of total value;	0
Temperature and pressure compensation menu		
51	Reserved parameters;	/
52	Medium density (unit: kg/m3). When the parameter 57 in temperature and pressure compensation mode is set to 0, 1 or 2, a fixed density can be set for calculating mass flow; when 57 is set to 3, 4, 5, 6 or 7, this value is the medium density automatically calculated by the meter and cannot be modified;	1
53	Temperature under standard conditions. It is used to calculate the volume flow of gas under standard conditions (unit: °C);	20
54	Local atmospheric pressure (unit: kPa);	101.3
55	Temperature/set temperature under working conditions (unit: °C). When a temperature sensor is installed, it displays the currently measured medium temperature. When parameter 61 is set to 0, a fixed temperature is set through this parameter to calculate temperature and pressure compensation;	0
56	Pressure/set pressure under working conditions (unit: kPa). When a pressure sensor is installed, it displays the currently measured medium pressure. When parameter 67 is set to 0, a fixed pressure is set through this parameter to calculate temperature and pressure compensation;	0
57	Temperature and pressure compensation mode: 0: No compensation, output volume flow under working conditions, unit: m3/h; 1: Ideal gas temperature and pressure compensation, output flow under standard conditions. 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 under standard conditions. At this time, set the flow unit as m3/h, and the total unit as m3, displaying as Nm3/h and Nm3; 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;	See "Temperature and pressure compensation" on page 28 of the product manual for details
Temperature and pressure calibration menu		
61	High point standard temperature. When this parameter is set to 0, parameter 55 can be set to a fixed temperature under working conditions;	Factory calibration value
62	High point measured temperature;	Factory calibration value
63	Low point standard temperature;	Factory calibration value
64	Low point measured temperature;	Factory calibration value
65	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. After	0

Menu Number	Menu Description	Factory Default Value
	waiting for 1 minute, when the parameter becomes 0, it means that the reset is completed;	
66	Pressure coefficient;	Factory calibration value
67	Standard pressure at point 1. When this parameter is set to 0, parameter 56 can be set to the fixed pressure under working conditions;	Factory calibration value
68	Measured pressure at point 1;	Factory calibration value
69	Standard pressure at point 2;	Factory calibration value
6A	Measured pressure at point 2;	Factory calibration value
6B	Standard pressure at point 3;	Factory calibration value
6C	Measured pressure at point 3;	Factory calibration value
6D	Standard pressure at point 4;	Factory calibration value
6E	Measured pressure at point 4;	Factory calibration value
6F	Standard pressure at point 5;	Factory calibration value
6G	Measured pressure at point 5;	Factory calibration value
Alarm menu		
71	Upper limit of flow alarm. Once it is higher than the upper limit of flow, the meter will display "Hi". When it is set to 0, the upper limit alarm will be turned off;	0
72	Lower limit of flow alarm. Once it is lower than the lower limit of flow, the meter will display "Lo". When it is set to 0, the lower limit alarm will be turned off;	0
73	Flow alarm hysteresis space (unit: %);	10
74	Temperature and pressure over-limit alarm enabling 0: Alarm off; 1: Temperature over-limit alarm enabling; 2: Pressure over-limit alarm enabling; 3: Temperature and pressure over-limit alarm enabling;	0
75	Upper limit of temperature alarm (unit: ℃)	450
76	Lower limit of temperature alarm	-60
77	Upper limit of pressure alarm (unit: kPa)	4000
78	Lower limit of pressure alarm	-1000
Sensor menu		
81	Meter number;	Set by factory calibration
82	AC amplification coefficient (1-5: 1 is the minimum and 5 is the maximum);	Automatically selected according to configuration
83	Probe type (0: medium temperature probe, 1: high temperature probe). After the probe type is configured, the default signal gain configurations 82 and 85 will change;	Set according to the type of probe used
84	Pipe diameter (unit: mm). After the pipe diameter is configured, the default signal processing configuration will change;	Set according to the contract
85	Capacitance amplification coefficient (1-4: 1 is the minimum and 4 is the maximum);	Automatically selected according to configuration
86	Meter coefficient K/Meter coefficient K at point 0;	Set by factory calibration

Menu Number	Menu Description	Factory Default Value
87	Calibrated meter frequency at point 0 (default: 0);	Set by factory calibration
88	Meter coefficient K at point 1 (default: 0);	Set by factory calibration
89	Calibrated meter frequency at point 1 (default: 0);	Set by factory calibration
8A	Meter coefficient K at point 2 (default: 0);	Set by factory calibration
8B	Calibrated meter frequency at point 2 (default: 0);	Set by factory calibration
8C	Meter coefficient K at point 3 (default: 0);	Set by factory calibration
8D	Calibrated meter frequency at point 3 (default: 0);	Set by factory calibration
8E	Meter coefficient K at point 4 (default: 0);	Set by factory calibration
8F	Calibrated meter frequency at point 4 (default: 0);	Set by factory calibration
8G	Meter coefficient K at point 5 (default: 0);	Set by factory calibration
8H	Calibrated meter frequency at point 5 (default: 0);	Set by factory calibration
Test menu		
91	Test mode enabling (1: on, 0: off). After the test mode is turned on, the meter displays the flow at the upper limit of the fixed range by default, and the output current value is 20 mA. The test mode flow can be adjusted through parameter 92	0
92	Test mode flow size;	0
93	Test mode range percentage (unit: %);	Read-only, cannot be set
94	Test mode pulse output (unit: Hz);	Read-only, cannot be set
95	Test mode current output (unit: mA);	Read-only, cannot be set
Communication menu		
A1	Communication mode (0: HART, 1: RS485). According to the installed communication board, the meter can only support one communication protocol at the same time. After the communication board is replaced, when the communication mode is reset, the meter will automatically restart;	Set according to the contract
A2	Write protection (0: write protection off; 1: write protection on). After the write protection mode is turned on, parameters cannot be modified through communication;	0
A3	Number of leading characters required for HART communication response messages & request messages;	5
A4	HART long frame address (0-16777216)	Same as the meter number
A5	HART short frame address (0-15)/Modbus device address (1-254);	0（HART）/1（Modbus）
A6	Modbus communication baud rate setting (0: 4800 bps; 1: 9600 bps, 2: 19200 bps, 3: 38400 bps);	1（9600bps）

Menu Number	Menu Description	Factory Default Value
Signal processing menu		
B1	Signal cutoff amplitude, It can remove the messy interference signals on site. When this value is greater than the value of parameter "B2", the meter will return to zero);	30 (gas) / 60 (liquid)
B2	Signal amplitude, a parameter that measures signal strength	Read-only, cannot be set
B3	Signal variance, a parameter that measures the degree of signal dispersion	Read-only, cannot be set
B4	Medium type (1: liquid, 0: gas/steam, default 0). After configuring the medium type, the default signal processing configuration will also change	Set according to the contract
B5	Sampling frequency (0: 200 Hz, 1: 400 Hz, 2: 800 Hz, 3: 1600 Hz, 4: 3200 Hz, 5: 6400 Hz, 6: 12800 Hz, 7: 25600 Hz);	Automatically selected according to configuration
B6	Judgment range of frequency variance jump	3
B7	Frequency variance threshold. The flow with a variance less than this threshold is removed. If there is a fixed noise flow under empty pipe, you can check the signal variance value B3 at this time and adjust the variance threshold B7 to a variance value higher than the noise to remove interference	0
B8	Insensitive response range (unit: %)	0
B9	Insensitive response time (unit: second)	0
BA	Upper limit of the filter frequency. When the signal frequency is higher than this value, it will be cut off;	Automatically selected according to configuration
BB	Lower limit of the filter frequency. When the signal frequency is lower than this value, it will be cut off;	Automatically selected according to configuration
Parameter menu		
C1	Display the number of decimal places for parameters;	3
C2	Parameter recovery (set to 19 to restore to solidified parameters; set to 55 to restore to default values)	0
C3	Fixation of parameters (sett this parameter to 19, and fix the value, which will automatically return to 1 after completion);	1
Diagnostic menu		
D1	Meter status (0: normal; 1: maintenance request; 3: fault status; 4: out of range; 5: function check)	Read-only, cannot be set
D2	Current alarm enabling (0: turn off the current alarm; 1: turn on the current alarm). After the current alarm is enabled, if the meter is in a fault state, the output current value will be adjusted to ≥21.6 mA;	0
D3	Alarm enabling. Set the corresponding bit to 1 to turn on the alarm function corresponding to this bit	0x00FF
D4	Alarm status. When a fault occurs, the corresponding status bit is set to 1	Read-only, cannot be set
D5	Internal communication diagnosis (0: normal; 1: abnormal)	Read-only, cannot be set
D6	Temperature and pressure sensor diagnosis (0: normal, 1: pressure probe damaged, 2: temperature probe damaged, 3: both temperature and pressure probes damaged)	Read-only, cannot be set
D7	ROM diagnosis (0: normal; 1: abnormal signal CPU; 2: abnormal main CPU; 3: abnormal dual CPU)	Read-only, cannot be set
D8	Reserved parameters	/
D9	Constant current source sampling channel voltage (unit: V)	Read-only, cannot be set

Menu Number	Menu Description	Factory Default Value
DA	Sampling voltage of temperature and pressure diagnosis channel (unit: V)	Read-only, cannot be set
DB	Pressure channel sampling voltage (unit: V)	Read-only, cannot be set
DC	Temperature channel sampling voltage (unit: V)	Read-only, cannot be set

- **Unit description**

➢ **VFT flow unit**

➢ **Flow unit**

Unit	Description	Unit	Description	Unit	Description	Unit	Description
Ltr/s	Liter/second	m^3/h	Cubic meter/hour	kg/s	Kilogram/second	MT/h	Metric ton/hour
Ltr/min	Liter/minute	m^3/D	Cubic meter/day	kg/m	Kilogram/minute	MT/D	Metric ton/day
Ltr/h	Liter/hour	m^3/m	Cubic meter/minute	kg/h	Kilogram/hour		
m^3/s	Cubic meter/second	g/min	Gram/minute	kg/D	Kilogram/day		
m^3/m	Cubic meter/minute	g/h	Gram/hour	MT/min	Metric ton/minute		

➢ **Total unit**

Unit	Description	Unit	Description	Unit	Description	Unit	Description
Ltr	Liter	m^3	Cubic meter	g	Gram	kg	Kilogram
MT	Metric ton						

IV. Remote operation

Modbus

➢ **Overview of MODBUS**

Vortex flow meter provides remote microcomputer (PC, IPC and PLC) to realize the system programming, data acquisition and field monitoring of flow meter via RS-485 digital interface.

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

- ◆ RS-485 digital interface (differential, half-duplex)
- ◆ Electric power pulse output, open-collector optocoupler output
- ◆ Settable communication parameters (address, baud rate and data format)

➢ **Analysis of MODBUS communication protocol:**

The MODBUS protocol is a master-slave point-to-point communication protocol. It is divided into RTU protocol and ASCII protocol. ModBusRTU communication protocol is applied to several kinds of our meters because it allows the data communication between one master and several slaves. In the communication system, the master is microcomputer (PC, IPC or PLC) and the slave is vortex flow meter. In the decentralized communication system, the system is allowed to connect up to 128 meters and the communication distance is 1.2 KM. The communication mode is that a slave responds to the request of a master. That is to say, the master makes a command request and slaves receive and analyze the data in response to the request. If the data meets the requirement of

the communication protocol, slaves make a data response.

In the communication between the master and slaves, every data frame sent by the master contains the following information (hexadecimal)

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. It indicates that the slave with a user-set address will receive information sent by the master. Each slave must have a unique address code. 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.

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

Points (holding register) can be read with communication commands. 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 meter supports word address rather than byte address.

➢ **Application of digital interfaces**

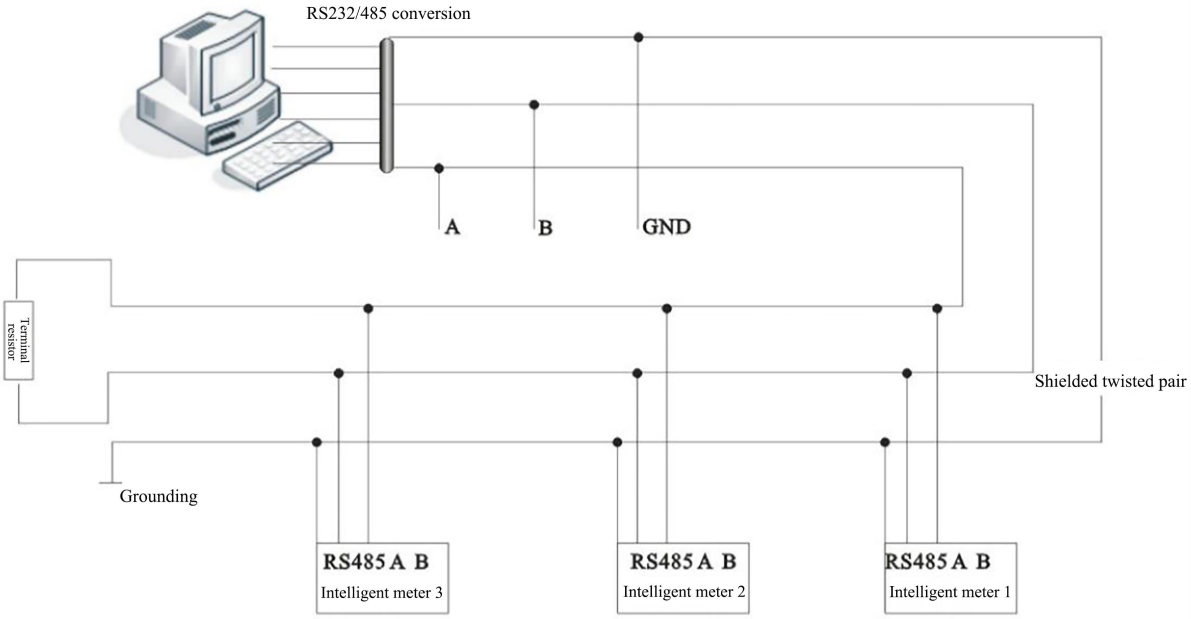
① Setting of communication parameter: The following communication parameters can be set from the programmable keyboard on the meter.

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

Communication speed: Set the communication speed in the communication network to 4800 bps (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 meter.



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 meter programming and data acquisition) can be realized after connecting communication interfaces (RS232/485), communication lines and meter, running the test software ModScan/ModbusPoll, and setting the parameters correctly.

④ Message 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 Examples:

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

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

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

Answer from the slave:02H 03H 08H BYTE1 BYTE2 BYTE3 BYTE4 BYTE5 CRC16

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 velocity (BYTE1, BYTE2, BYTE3, and BYTE4) and flow (BYTE5, BYTE6, BYTE7, and BYTE8). Its meaning meets the requirements of the data specification for float 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
Float number content	S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

Where: S: sign bit, 0: +, 1: -. E is an exponent, which occupies an 8-bit binary number and is stored in two bytes. Note: The value of exponent E is the exponent of 2 plus an offset (127). The purpose is to avoid a negative value of exponent, but the exponent can be either positive or negative. The normal range of exponent E is 1~254, but the actual range is -126 to +127. M is the decimal part of the mantissa, represented by a 23-bit binary number and stored in three bytes. The integer part of the mantissa is always 1, so it will not be stored, but it exists implicitly. The decimal point is preceded by the implicit integer bit "1". The numerical range of a float 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 velocity 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 meter No. 1 and flow velocity address starting from 0, that is, flow velocity 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 velocity is calculated by IEEE-754 =-12.5.

⑧ Modbus parameter table:

Vortex flow meter (MODBUS)					
PLC Address	CYAC Protocol Address	Name of variable Parameter name	Operation	Nature	Function Description

40001	0x00	Read Density	c, r	Float	Density
40003	0x02	Read Flow	c, r	Float	Flow
40005	0x04	Read Total	c, r	Float	Total quantity
40007	0x06	Read Pressure	c, r	Float	Pressure
40009	0x08	Read Temperature	c, r	Float	Temperature
40011	0x0A	Read Percent	c, r	Float	Flow percentage
40013	0x0C	Read Current	c, r	Float	Current
40015	0x0E	Read Pulse	c, r	Float	Frequency

⑨ Communication Control Baud Rate Setting Table:

Communication control (baud rate)	Baud rate selection
0	4800
1 (default)	9600
2	19200
3	38400 (contract remarks)

Chapter XI Certificates and Certification

I. Explosion-proof certification

CMExC

Applicable Region	Explosion-proof type	Type of vortex flow meter
Zone 0/1/2	Ex ia lI C T6 Ga	VFT type
Zone 20/21/22	Ex ia IIIC T200 80° C Da	VFT type
Zone 1/2	Ex db IIC T6 Gb	VFT type
Zone 21/22	Ex tb IIIC T80° C Db	VFT type

II. FF certification

The vortex flow meter has successfully passed the certification of the field communication organization. The measurement system meets all requirements of the following standards:

- FF communication H1 certification
- Interoperability testing (ITK)
- Physical layer conformance testing
- The meter can be used with certified equipment produced by other suppliers (interoperability)

III. Quality certification

The flow meter is subjected to a pressure test according to JB/T9249 before leaving the factory. The test pressure is 1.5 times the nominal pressure and the test time is 5 minutes. There is no damage or leakage during and after the test.

Optional. The fillet welds of the flow meter sensor housing are subject to visual inspection and non-destructive testing. Non-destructive testing requires 100% penetration testing and Class II standard. The testing standard shall comply with NB/T47013-2015.

Optional. The flow meter sensor housing flange butt weld is subject to non-destructive testing. The non-destructive testing requires 100% radiographic testing of the flange welding and Class I standard. The testing standard shall comply with NB/T47013-2015. This item needs to be clarified for ordering again. The structural type requires flange butt welding before radiographic flaw detection can be performed.

Optional. The flow meter sensor housing is subject to TS inspection during the manufacturing. The statutory inspection shall be carried out in accordance with the provisions of TSGD7006-2020 *Pressure Pipe Supervision Inspection Regulation*, and the entrusted inspection shall be performed according to this standard.

IV. Other standards and guidelines

- JB/T9249 Vortex Shedding Flowmeters
- GB/T 4208 Degrees of Protection Provided by Enclosure (IP Code)
- GB/T 17626.2 Electromagnetic Compatibility (EMC) - Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
- GB/T 17626.3 Electromagnetic Compatibility - Testing and Measurement Techniques - Radiated, Radio-frequency, Electromagnetic Field Immunity Test
- GB/T 17626.4 Electromagnetic Compatibility - Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test

- GB/T 17626.5 Electromagnetic Compatibility - Testing and Measurement Techniques - Surge Immunity Test
- GB/T 17626.8 Electromagnetic Compatibility - Testing and Measurement Techniques - Power Frequency Magnetic Field Immunity Test
- GB/T 17626.11 Electromagnetic Compatibility - Testing and Measurement Techniques - Voltage Dips, Short Interruptions and Voltage Variations Immunity Test
- JJG1029 Verification Regulation of Vortex-shedding Flowmeter
- JB/T9234 Values of Nominal Size for Industrial Process Measurement and Control Instruments
- HG/T 20592~20635, Steel Pipe Flanges, Gaskets and Bolting

The above standards shall be implemented in accordance with the latest published version.

Chapter XII Accessories

Our company provides a variety of meter accessories to meet the needs of different users. Accessories can be ordered with the meter or separately. Detailed ordering information for accessories can be obtained through local sales outlets, or by contacting our company through the ordering information.

I. Special accessories for equipment

<table>
<tr><th>Parameter</th><th colspan="4">Form</th><th>Code</th><th>Remarks</th></tr>
<tr><td rowspan="6">Matching flange</td><td>Material</td><td>Flange type</td><td>Sealing surface</td><td>Series</td><td rowspan="6">Example: F0002 (indicated as 304 steel PL (plate-type flat welding) raised face (RF) 2 series matching flange)</td><td rowspan="6">1) Only the RF (raised face) can be selected for PL (plate-type flat welding);
3) FF (flat face) is limited to pressure ratings of 1.0 MPa/1.6 MPa/ANSI150;
4) It is recommended to select FM (female face) for the matching flange of MFM (male-female face), and the default meter sealing surface is M (male face);
5) The RJ (ring joint face) can only be used for WN (welding neck);</td></tr>
<tr><td>0: 304 steel</td><td>0: PL (plate-type flat welding) (standard configuration)</td><td>0: RF (raised face) (standard configuration)</td><td>0: System I</td></tr>
<tr><td>1: 316L steel</td><td>1: SO (slip-on)</td><td>1: FF (flat face)</td><td>1: Series II (standard configuration)</td></tr>
<tr><td>2: Carb on Steel</td><td>2: WN (welding neck)</td><td>2: FM (female face)</td><td></td></tr>
<tr><td>S: Other</td><td>3: SW (socket welding)</td><td>3: M (male face)</td><td></td></tr>
<tr><td></td><td></td><td>4: RJ (ring joint face)</td><td></td></tr>
<tr><td rowspan="8">Surface preparation</td><td colspan="4">0: Copper-zinc content of wetted materials ≤0.1%</td><td>S0</td><td>Limited to non-TS products</td></tr>
<tr><td colspan="4">1: Copper-zinc content of wetted materials ≤0.5%</td><td>S1</td><td>For sensors</td></tr>
<tr><td colspan="4">2: Copper-zinc content of wetted materials ≤1%</td><td>S2</td><td></td></tr>
<tr><td colspan="4">3: Wetted material finish Ra0.8</td><td>S3</td><td></td></tr>
<tr><td colspan="4">4: Wetted material finish Ra1.6</td><td>S4</td><td></td></tr>
<tr><td colspan="4">5: C3 anti-salt spray paint</td><td>S5</td><td>For converters</td></tr>
<tr><td colspan="4">6: C5 heavy protective paint</td><td>S6</td><td>For converters</td></tr>
<tr><td colspan="4">7: No oil and degreasing</td><td>S7</td><td></td></tr>
<tr><td rowspan="2">Cable</td><td colspan="4">1: 20 m</td><td>D1</td><td rowspan="2">VFT type only</td></tr>
<tr><td colspan="4">2: 30 meters</td><td>D2</td></tr>
<tr><td rowspan="3">Temperature sensor</td><td colspan="4">0: External ordinary temperature sensor</td><td>N0</td><td rowspan="3">304 stainless steel mounting base as standard configuration</td></tr>
<tr><td colspan="4">1: External intrinsically safe temperature sensor</td><td>N1</td></tr>
<tr><td colspan="4">2: External flameproof temperature sensor</td><td>N2</td></tr>
<tr><td rowspan="4">Pressure transmitter</td><td colspan="4">0: External ordinary pressure transmitter</td><td>C0</td><td rowspan="4">304 stainless steel mounting base as standard configuration</td></tr>
<tr><td colspan="4">1: External intrinsically safe pressure transmitter</td><td>C1</td></tr>
<tr><td colspan="4">2: External flameproof pressure transmitter</td><td>C2</td></tr>
<tr><td colspan="4">3: External dust flameproof pressure transmitter</td><td>C3</td></tr>
<tr><td rowspan="2">Integrator</td><td colspan="4">0: Integrator CMF1 (220VAC power supply)</td><td>Y0</td><td>Input: flow 4~20 mA or pulse, temperature: PT100, pressure: 4~20 mA;
Output: 4~20 mA; power supply: 100~240 VAC;</td></tr>
<tr><td colspan="4">1: Integrator CMF1 (power supply: 24 VDC)</td><td>Y1</td><td>Input: flow 4~20 mA or pulse,</td></tr>
</table>

Parameter	Form	Code	Remarks
			temperature: PT100, pressure: 4~20 mA; Output: 4~20 mA; power supply: 12~30 VDC;
	2: Integrator CMF4 (power supply: 220 VAC)	Y2	Input: flow 4~20 mA or pulse, temperature: PT100, pressure: 4~20 mA; Output: 4~20 mA, RS485; power supply: 100~240 VAC;
	3: Integrator CMF4 (power supply: 24 VDC)	Y3	Input: flow 4~20 mA or pulse, temperature: PT100, pressure: 4~20 mA; Output: 4~20 mA, RS485; power supply: 12~30 VDC;
	4: Other integrators	Y4	
Product Accessories	1: 316L Tag No. plate	P1	
	2: Customized nameplate	P2	
	3: 316L converter housing	P3	
	4: Wireless RTU-4G	P4	The meter itself must have RS485 communication
	5: Surge protector	P5	
	6: Metal graphite spiral wound gasket	P6	
	7: PTFE gasket	P7	Only for nominal pressure ≤1.6MPa or ANSI150 and the medium temperature at (-40~100)°C
	8: Metal PTFE spiral wound gasket	P8	Only for temperature ≤150°C
	9: Pressure tapping valve	P9	VFT type only
	10: 304 blind plug	PA	
	11: Concentric reducer of carbon steel (one pair)	PB	It is necessary to determine the specific size of the on-site process pipeline (outer diameter × wall thickness)
	12: 304 concentric reducer (one pair)	PC	
	13: 316L concentric reducer (one pair)	PD	
	14: Carbon steel matching straight pipe section assembly (front 15D and rear 5D long straight pipes, with flanges and concentric reducers)	PE	
	15: 304 matching straight pipe section assembly (front 15D and rear 5D long straight pipes, with flanges and concentric reducers)	PF	
	16: 316L matching straight pipe section assembly (front 15D and rear 5D long straight pipes, with flanges and concentric reducers)	PG	
	17: Converter sunshade	PH	VFT type only
Rectifier	0: 304 rectifier	Z0	Diameter ≤DN100
	1: 316L rectifier	Z1	
	2: HC rectifier	Z2	
Explosion-proof cable gland	0: 304 explosion-proof cable gland	E0	The default material of explosion-proof cable gland is nickel plated brass
	1: 316L explosion-proof cable gland	E1	
Product	0: Verification certificate (in the name of customer)	A0	VFT series does not support

Parameter	Form	Code	Remarks
Certification	1: Verification certificate (in the name of Chuanyi)	A1	A5, A6, A7, A8, A9, AA
	2: Calibration certificate (in the name of customer)	A2	
	3: Calibration certificate (in the name of Chuanyi)	A3	
	4: TS Certification	A4	
	5: PAC certification	A5	
	6: EAC certification (CU-TR012 explosion-proof)	A6	
	7: EAC certification (CU-TR020 electromagnetic compatibility)	A7	
	8: EAC certification (CU-TR032 pressure)	A8	
	9: CE certification	A9	
	10: SIL3	AA	
Handover data	0: Calibration certificates, qualification certificates and nameplates in Chinese and English, with instructions in Chinese as standard configuration	Not selected for standard configuration	The nameplate is in Chinese and English by default, and any Russian nameplate needs to be specially customized
	1: Calibration certificates, qualification certificates and nameplates in Russian, with instructions in Russian as standard configuration	H1	
	2: Calibration certificates, qualification certificates and nameplates in English, with instructions in English as standard configuration	H2	
	3: National standard wetted material report (meter body)	H3	
	4: National standard wetted material report (meter body + generator)	H4	
	5: National standard wetted material report (meter body + generator + flange)	H5	
	6: National standard wetted material report (meter body + generator + flange + probe base)	H6	
	7: National standard wetted material report (meter body + generator + flange + probe base + pressure tapping pipe)	H7	
	8: EN10204-3.1 wetted material report (meter body)	H8	
	9: EN10204-3.1 wetted material report (meter body + generator)	H9	
	10: EN10204-3.1 wetted material report (meter body + generator + flange)	HA	
	11: EN10204-3.1 wetted material report (meter body + generator + flange + probe base)	HB	
	12: EN10204-3.1 wetted material report (meter body + generator + flange + Probe base + pressure tapping pipe)	HC	
	13: Pressure Test Report	HD	
	14: Technical passport	HE	With English and Russian bilingual as standard configuration
	15: PVC first inspection certificate	HF	
	16: Weld penetrant flaw detection report	HG	
	17: Finished product inspection report	HH	

Parameter	Form	Code	Remarks
	18: 2D Overall Dimension Drawing	HI	
	19: 3D Overall Dimension Drawing	HJ	
Current alarm	The output signal rises when a fault occurs in accordance with NAMURNE43 (output signal ≥ 21.6 mA when an alarm occurs)	GA	VFT type only
Quality assurance level	0: QA1	Q1	
	1: QA2	Q2	
	2: QA3	Q3	
	3: QNC	Q4	
Export packing	0: Plywood export packing	B0	
	1: Fumigated wooden box export packing	B1	
	2: Carton export packing	B2	
	3: Unmarked export packing	B3	

When there is a need to purchase only parts or additional items, the main product model must be indicated in front of the part or additional item. Example:

Only VFT flange type sensors with DN100 diameter, 1.6 MPa, 304 material and liquid measurement are purchased.

The model is: VFT10113123A00;

Only VFT converters with M20×1.5 outgoing line seal, 4~20mA.DC output, non-explosion-proof and IP65 grade are purchased. The model is: VFT3VH1211111; only 1 set of 20m long VFT cable (additional item) is purchased. The model is: VFT/D1

II. Troubleshooting for Common Faults

S/N	Symptom	Cause Analysis	Inspection Method	Solutions
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 line or replace the power supply.
		Mainboard damp	Visually observe whether there is obvious dampness on the mainboard.	Dry the mainboard.
		Insulation of temperature sensor decreased	The insulation resistance of the temperature sensor signal line to the ground tested by an insulation meter at 100 VDC is not less than 100 MΩ	Replace the temperature sensor.
2	The black screen has no character display and no current output.	Power supply voltage insufficient	Use a multimeter to check whether the power supply voltage is within the range of (21~42) VDC	Replace the power supply.
		Power supply not connected	Check whether the wiring is correct and whether the line is unblocked	Carry out connection again or check the cable.
		Mainboard fault	Check whether the mainboard is normal or not. Refer to the Converter Detection Procedure for the test method.	Replace the mainboard.
		Pin connecting the	Visually observe whether the	Replace the pin.

		front cavity and the back cavity abnormal	pins are bent or lacking	
3	The black screen has no character display but current output.	Display not connected to the mainboard normally	Check whether the pins between the display and the mainboard are damaged or misaligned	Replace the mainboard.
		Display model not matching the mainboard driver	Check the display model and program version number.	Replace the display or rewrite the mainboard driver.
4	Abnormal 4~20 mA current output	Power supply voltage insufficient	Use a multimeter to check whether the power supply voltage is within the range of (21-42)V DC. If the voltage is lower than 21 V, the output of 20 mA current will be affected.	Replace the power supply.
5	There is flow in the pipeline but no flow in the meter.	Flow too small to enter the measurement range of the meter	Increase the flow to see the display.	The flow needs to reach the measurement range of the meter.
		Flow reaching the lower limit of the meter, but meter magnification not enough	Enter the menu to view parameters 82 (range 1~5) and 85 (range 1~4)	Increase the values of parameters 82 and 85
		Probe (signal probe) fault	Use a multimeter to detect the resistance between the signal line of the signal probe and the ground and between the two signal lines: if the resistance is greater than 10 MΩ, 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.
		Sensor 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 meter.	50Hz power frequency interference	Enter the menu to check whether the value of parameter 34 is 50	Choose shielded cable and ensure that the shielded wire is well grounded; if the 50 Hz interference is not within the signal frequency range, the parameter BB can be set to 55
		High-frequency interference caused by high-voltage equipment near the	Check whether there is such equipment around.	Ensure that the meter is reliably grounded and consider changing the installation location

		meter		
		Pipeline strong vibration	Check the pipeline vibration.	Reinforce the pipeline of meter installation part.
		Meter magnification setting value too large	Enter the menu to view parameters 82 (range 1~5) and 85 (range 1~4)	Decrease the values of parameters 82 and 85, and increase the cutoff amplitude B1
7	The flow is unstable and fluctuates greatly (the meter is installed reversely, and the signal line is wrongly connected).	Straight pipe section not enough and the flow field unstable	Check whether the straight pipe section meets the installation requirements.	Replace the installation position or lengthen the straight pipe section.
		Pipeline strong vibration	Check the pipeline vibration.	Reinforce the pipeline of meter installation part.
		Inner diameter of the meter and the inner diameter of the pipeline not concentric	Check the concentricity of meter inner diameter and pipeline inner diameter.	Reinstall the meter.
		Sealing ring extending into the pipeline to affect the flow field	Check the installation of sealing ring.	Adjust the sealing ring and reinstall the meter.
		Pipe not full of fluid	Check the fluid condition and the installation position of the meter. When measuring the liquid, the fluid flow direction should be from bottom to top	Reinstall the meter.
8	The flow does not match the actual flow.	Cavitation existing in the fluid	Check the fluid condition.	Install a valve downstream of the meter to increase the back pressure.
		Flow below the lower limit or above the upper limit	Check whether the flow under its actual working conditions is within the measurable flow range of the meter.	Re-select the meter according to the flow under actual working conditions.
		Flow low and fluid viscosity high	Check the flow rate and fluid viscosity.	Re-select the meter according to the flow under actual working conditions.
		Mainboard signal processing circuit fault	Replace the normal mainboard and observe whether the flow is stable.	Replace the mainboard.
		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 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 meter, but the actual temperature and pressure do not match	Enter the temperature and pressure compensation menu to view the relevant parameters	Reset related parameters of temperature and pressure compensation menu.

		the set value.		
		Steam neither saturated nor superheated	Check the steam process flow.	Change process conditions, which is beneficial to meter compensation
		Incorrect compensation mode of flow integrator	Enter the flow integrator menu to check the temperature and pressure compensation mode.	Design the correct compensation mode according to the actual working conditions.
		Meter full-scale value inconsistent with the system full-scale value	Enter the menu to check whether the value of parameter 11 is consistent with the system full-scale value	Reset the parameter 11
9	Field 485 communication is abnormal.	No 485 communication board	Check whether 485 communication board is included	Install 485 communication board
		Wrong vortex software version	VFT: Check whether the vortex software version is 3.5 series (The lower right corner after powering on displays 3.5X, where X is the serial number for different versions)	VFT: Replace the mainboard with one from the 3.5 series
		Baud rate or address mismatches.	Check whether the vortex baud rate (A6) and address (A5) match the system	The vortex street is consistent with the address and baud rate of the system.
		Meter address conflicts on bus.	Check whether the meter addresses on the bus are consistent.	Change meter 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 meter 485 communication connection mode.	Change the connection mode to serial connection, and reliably ground the 485 bus (shielded wire) at a single point

III. Converter detection procedure

S/N	Inspection Content	Inspection Method	Inspection Means
1	Power supply	When the converter is not connected to the user power supply, refer to the power supply voltage section and use a multimeter to test whether the user power supply voltage meets the requirements.	Multimeter
2	Display buttons	After powering on, check whether the display is working properly. The characters must be displayed clearly without garbled characters. Test whether the buttons are normal.	Visual inspection

3	4~20mA Current output	Set the test mode parameter (91) to 1 to start the test mode, set the test flow parameter (92) to full-scale flow, and check whether the loop current is 20 mA. Set the test flow parameter (92) to 0, and check whether the loop current is 4 mA.	Multimeter
4	HART communication	Use a HART manual operator to check whether the HART communication is normal. (Only for meters with HART communication)	HART manual operator
5	Signal detection	On the meter body near the probe mounting seat, use a screwdriver to knock on the sensor housing and watch whether the display shows flow. If there is a flow display, the mainboard signal processing is normal; otherwise, it is abnormal;	Visual inspection
Note: This converter detection procedure is for VFT series converters			

IV. Density of Common Gas Media under Standard Conditions

Gas name	Density (kg/m^2)	Gas name	Density (kg/m^2)
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

Chapter XIII Solution of Water Hammer

I. Introduction to water hammer

Water hammer: It 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 "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.

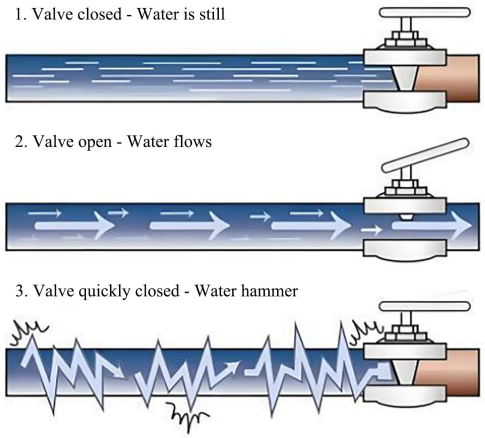
Of course, the water hammer will occur not only in the water system, but also in the steam system. When it occurs in a steam system, a water hammer is sometimes called a "steam hammer".

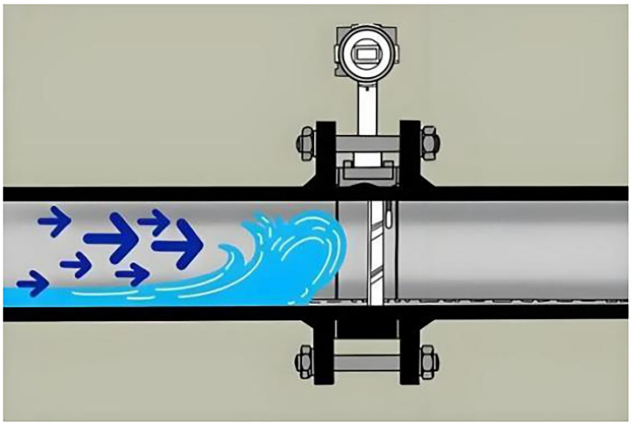
II. Hazard of water hammer

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 use sites.

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 detector of the flow meter in serious conditions.

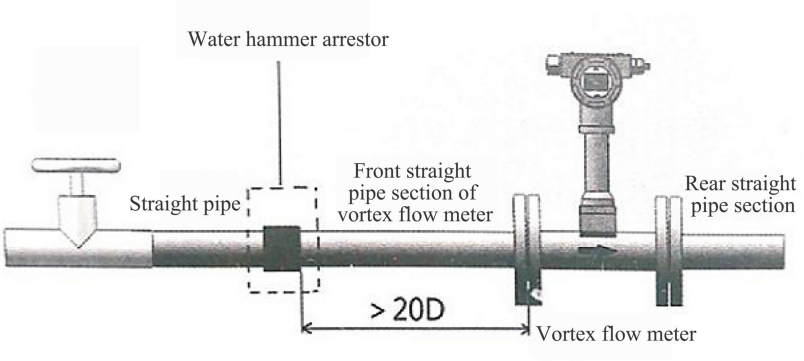
III. Causes to water hammer





- The collision of high-speed condensed water in the pipe produces a water hammer
- When steam rapidly condenses and collides with each other, water hammer occurs.

IV. Solution of water hammer



In case of the following process, it is recommended to add a water hammer arrestor to protect the flow meter from damage:

1. Rapid opening or closing of the valve;
2. Sudden shutdown or startup of the water pump unit;
3. Single-pipe water conveyance to a high place (with water supply elevation difference of above 20m);
4. High water pump total head (or working pressure);
5. Too high water flow velocity in water delivery pipe;
6. Too long water delivery pipe, and great terrain change.

Chapter XIV VFT Vortex Flow Meter Spectrum

Selection Table of VFT Type Vortex Flow Meter

Main designation	Sensor								Converter								
VFT	XXX	X	X	X	X	X	X	X	X	XX	X	X	X	X	X	X	X

Main name

Diameter: DN15-DN300

Three digits: the first and second digits of diameter and the number of zeros following the first two digits (unit: mm).

Note: DN125 is special and is indicated as 121

Nominal pressure

1: 1.6MPa 2: 2.5MPa 3: 1.0MPa

4: ANSI150 5: 4.0MPa 6: ANSI300

Note: The maximum nominal pressure for temperature and pressure compensation is 4.0 MPa

Structure material

Material combination sequence: body - generator - detector

1: 304-304-304 2: HC-HC-HC

3: 304-304-316L 4: 304-316L-316L

6: 316L-316L-316L 9: Other

A: 2205-2205-2205 B: T12-T12-T12

Note: Option "A" is only applicable when the medium temperature is within 260°C

Measuring medium

1: Liquid 2: Gas 3: Steam

Working environment

1: General place -40°C ≤ ambient temperature ≤ 70°C
-40°C≤ medium temperature ≤ 260°C

2: General place -40°C ≤ ambient temperature ≤ 70°C
-40°C ≤ medium temperature ≤ 400°C

3: Explosion-proof place -40°C ≤ ambient temperature ≤ 60°C
-40°C ≤ medium temperature ≤ 260°C

4: Explosion-proof place -40°C ≤ medium temperature ≤ 60°C
-40°C ≤ ambient temperature ≤ 400°C

Connection method

1: Clamped connection

3: Flange type

4: Reducing type (one-level) (limited to non-temperature and pressure compensation flange connection)

7: Dual sensor (limited to ≥ DN50 flange connection)

8: Clamp type (limited to DN15-DN50)

Accuracy class

A: Class 1.0 B: Class 0.75 (liquid only) E: Special

Temperature and pressure compensation

0: N/A 1: 1.6 MPa pressure + PT100 temperature 2: 4.0 MPa pressure + PT100 temperature

Note: Only for flange type with temperature and pressure compensation. The temperature and pressure selection pressure shall be ≥ the nominal pressure of the meter. For split type, only option "0" can be selected

Electrical interface

1: G1/2" internal thread 2: 1/2" NPT internal thread 3: M20X1.5

Type

VH: Integrated type VR: Split type (cable length defaults to 10m, and other lengths must be selected in additional options)

Power supply

1: 24V DC

Display assembly

2: With display

Output signal

1: Two-wire system, 4~20 mA. DC output 2: Pulse output +4~20 mA. DC output 3: Pulse output +4~20 mA. DC output +HART communication

4: Pulse output + Modbus RS-485 communication 5: Pulse output + FF communication

Note: ModbusRS-485 communication or FF communication is not compatible with 4-20 mA. DC output

Explosion-proof requirements

1: Non-explosion-proof 2: Intrinsically safe 3: Flameproof 4: Intrinsically safe dust 5: Flameproof dust 6: Combined explosion-proof

Note: For combined explosion-proof, the explosion-proof grade must be specified in the contract.

Display direction

1: Standard direction 2: 90° counterclockwise 3: 90° clockwise 4: 180° clockwise

Language

1: English

Protection rating

0: IP55 1: IP65 2: IP66 3: IP67

Notes:

1. When measuring flammable and explosive gases such as oxygen and natural gas, be sure the sensor is degreased first to avoid accidents.
2. The connecting flange is provided with a flexible graphite gasket. Flange type vortex flow meter is not provided with pipe flanges and bolts in delivery, which can be machined by users themselves or purchased directly from us (please state the requirement when ordering)
3. The temperature compensation sensor and pressure compensation transmitter used for integrator, gas and steam measurement are non-standard factory accessories, and we can provide them on behalf of users according to their needs. Please explain when ordering.
4. Protection rating is IP65 by default.
5. Temperature and pressure can only be compensated for gas or steam. Temperature is compensated by default for saturated steam when leaving the factory, and temperature and pressure are compensated for gas and superheated steam by default when leaving the factory.
6. Additional options: /XX (See the additional option table)
7. When the temperature of the selected medium is lower than 260°C, the flow meter has no valve for pressure measurement. If you need to perform online maintenance on the pressure sensor by closing the valve, please select the additional option /P9. When the temperature of the selected medium is higher than 260°C, the flow meter is equipped with a pressure tapping valve as standard, and there is no need to select the additional option /P9.

Chapter XV Order Consultation Sheet

Customer:			Date:		
Name:			Department:		
Tel:			Fax:		
Output signal type of meter:					
Measuring medium:	Steam □		Gas □	Liquid □	
Medium composition:					
Flow Maximum: Minimum: Operating point:	Unit: m³/h□		kg/h□	t/h□	Standard state □ Working state □
Density Maximum: Minimum: Operating point:	Unit: kg/m³				Standard state □ Working state □
Viscosity Maximum: Minimum: Operating point:	Unit: cst				
Medium temperature Maximum: Minimum: Operating point:	Unit: °C				
Ambient temperature:	Unit: °C				
Medium pressure Maximum: Minimum: Operating point:	Unit: MPa				Absolute pressure □ Gauge pressure □
Explosion-proof requirements:	Intrinsically safe □	Flameproof □	Intrinsically safe dust □	Flameproof dust □	
Temperature and pressure compensation:	Temperature compensation □		Pressure compensation □	Temperature and pressure compensation □	Not required □
Actual inner diameter of pipe: mm					
Actual outer diameter of pipe: mm					
Other requirements:					

Chapter XVI Ordering Information

You can consult and order through local sales outlets, or contact our company in the following ways. The detailed ordering information is as follows:

- Sales hotline:023-67032678
- Tel.:023-67032666
- Technical support:023-67032695 023-67032667
- Fax:023-67032676
- Website: www.cqcy.com
- Email: flowmaster@sicc.com.cn/flowmaster@sicflow.com.cn

***The warranty period of vortex flow meter is one year (since the delivery date of the product)**

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

Product development may lead to changes in technical indicators without notice.
In the event of any printing error, the Company reserves the right of interpretation.

Caution for safety:

⚠ For correct and safe use of our products, be sure to read this *Operation Manual* before use.