HIKMICRO

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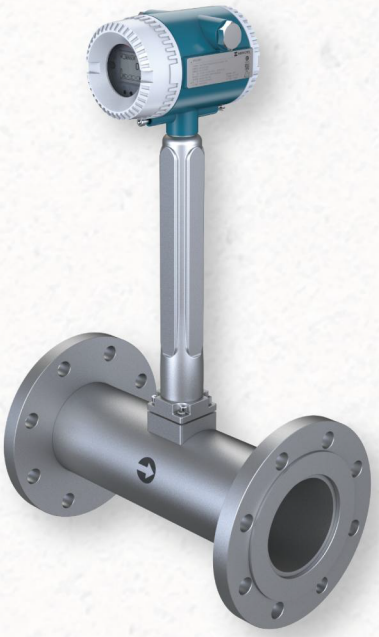
VORTEX FLOW METER



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Features and Benefits

- Wide range of applications and can measure the flow rate of steam, gas, and liquid
- Simple structure, no moving parts inside the measuring tube, high reliability, and stable long-term operation
- Highly corrosion resistant with the body made of stainless steel
- Low pressure loss and a wide dynamic measurement range
- Low power consumption, less than 0.5W
- The on-site LCD display simultaneously shows instantaneous flow rate, cumulative total, percentage, signal frequency, etc

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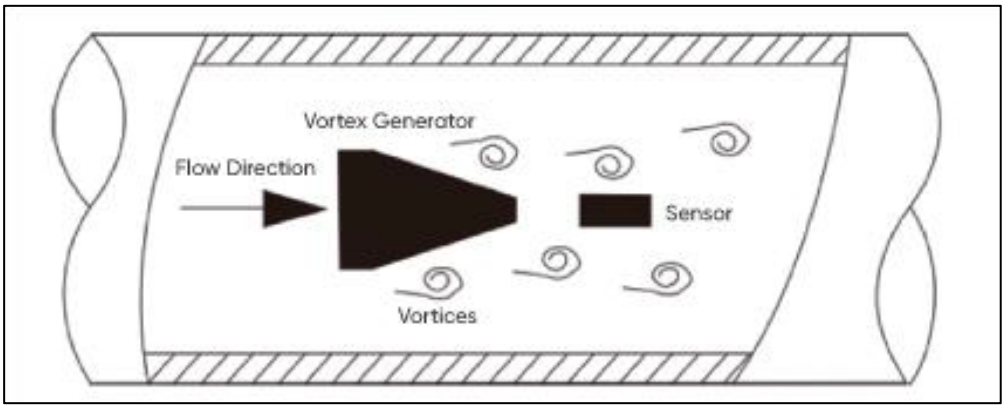
1. Product Introduction

1.1. Application

HIKMICRO FV00 series vortex flow meter is a flow meter that applies the *Karman vortex street* principle. It is used to measure the flow rate of liquids, gases and steam, and can also measure turbid liquids containing small particles and impurities. It is widely used in industries such as petroleum, chemical, pharmaceutical, papermaking, metallurgy, power, environmental protection and food.

1.2. Measuring Principle

When fluid flows past a vortex generator, vortices are alternately formed on both sides with opposite directions of rotation.



Let the vortices generation frequency be f, the average velocity of the incoming medium be V, the width of the vortex generator's upstream face be d , and the diameter of the measuring body be D. According to the *Karman vortex street* principle, the following relationship exists:

$$f = StV / d$$

In the formula:

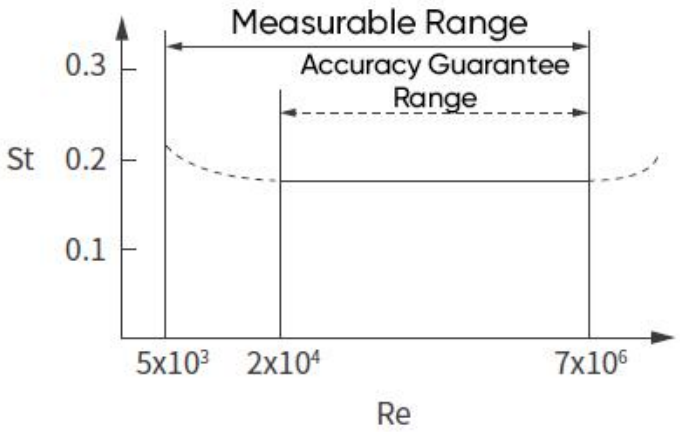
f: Karman vortex frequency generated on one side of the vortex generator

St: Strouhal number (dimensionless number)

V: Average flow velocity of the fluid

d: Width of the vortex generator

Therefore, the instantaneous flow rate can be calculated by measuring the frequency of the Karman vortex street. The Strouhal number (St) is a dimensionless constant, and the relationship between the Strouhal number (St) and the Reynolds number Re is shown in the figure below.



The Strouhal number (St) is linearly related to the Reynolds number (Re), which is the linear measurement range of the vortex flow meter. By detecting the frequency, the velocity of the fluid in the pipe can be determined, and then the volumetric flow rate can be calculated from the velocity. The ratio of the number of pulses output over a period of time to the volume of fluid (the number of pulses corresponding to a unit volume of fluid flowing through) is called the instrument coefficient (K coefficient).

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2. Technical Parameters

Measuring Medium	Liquids, gases (including natural gas), and steam (saturated steam and superheated steam)
Accuracy level	● Uncompensated Type (Gas) DN15-DN25: 1.5% DN32-DN200: 1% DN250-DN300: 1.5% ● Uncompensated Type (Liquid) DN15-DN300: 1% ● Temperature & pressure Compensated Type DN25-DN300: 1.5%
Reynolds Number (Re)	$2\times10^4 \sim 7\times10^6$
Caliber	DN15-DN300
Pressure Level	0.6 MPa, 1.0 MPa, 1.6 MPa, 2.5 MPa, 4.0 MPa, Class 150, Class 300
Wetted Parts Material	304, 316L, HC
Protection Level	IP65
Explosion-proof Rating	Explosion-proof, Intrinsically Safe
Medium Temperature Range	-40℃ ~ + 80℃, -40℃ ~ +150℃, -40℃ ~ +260℃, -40℃ ~ +300℃;
Ambient Temperature	-20 ℃ to +55 ℃ (standard type); -20 ℃ to +40 ℃ (explosion-proof type);
Power consumption	Less than 0.5W (Recommended power input > 2W)
Range ratio	● When the gas density is 1.2 kg/m³, the range ratio is 8:1 ● When the liquid density is 1000 kg/m³, the range ratio is also 8:1 The range ratio will change when the medium density is different
Working Power Supply	24VDC±5%, lithium battery 3.6VDC (battery lifespan greater than 2 years)
Electrical Interface	M20*1.5 internal thread, 1 /2NPT internal thread
Output Signal	Supports 4-20 mA , pulse, HART , 485 - Modbus. Note: ✓ Instantaneous flow rate corresponds to voltage frequency pulse (low level ≤ 1V, high level ≥ 6V). ✓ Instantaneous flow rate corresponds to 4-20mA output (load resistance ≤750Ω);

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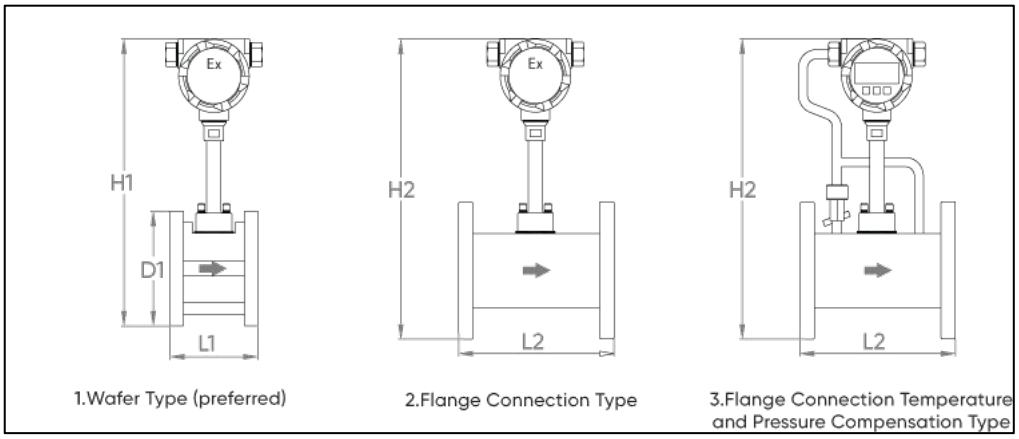
3. Structural Dimensions



1.Wafer Type (preferred)

2.Flange Connection Type

3.Flange Connection Temperature and Pressure Compensation Type

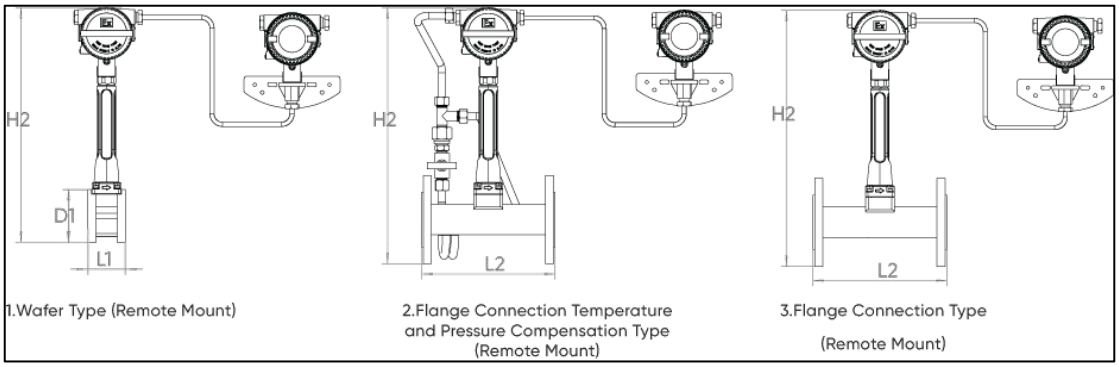
Integral Mount

Size / Caliber	H1 [a] (mm)	H1 [b] (mm)	H1 [c] (mm)	D1 (mm)	L1 (mm)	H2 [a] (mm)	H2 [b] (mm)	H2 [c] (mm)	L2 (mm)
DN15	525	445	355	45	65	540	460	370	170
DN20	531	451	361	58	65	545	465	375	170
DN25	531	451	361	58	65	550	470	380	250
DN32	531	451	361	58	65	563	483	393	250
DN40	529	449	359	85	70	578	498	408	250
DN50	541	461	371	99	70	590	510	420	250
DN65	558	478	388	118	70	612	532	442	250
DN80	573	493	403	132	70	625	545	455	280
DN100	595	515	425	156	70	644	564	474	300
DN125	621	541	451	184	70	674	594	504	350
DN150	647	567	477	211	70	703	623	533	350
DN200	705	625	535	266	98	757	677	587	400

DN250	757	677	587	319	114	810	730	640	450
DN300	808	728	638	370	130	860	780	690	500

Note:

- This product has 3 types of pillars, a, b, and c, with different lengths. Please refer to the H subscript in the table above to view the total height.
- A 150°C sensor head without compensation vortex flow meter uses pillar c; A 150°C sensor head with compensation vortex flow meter uses pillar b.
- A 260°C sensor head vortex flow meter uses pillar b; A 300°C sensor head vortex flow meter uses pillar a.



1.Wafer Type (Remote Mount)

2.Flange Connection Temperature and Pressure Compensation Type (Remote Mount)

3.Flange Connection Type (Remote Mount)

Remote Mount

Size / Caliber	H1 [a] (mm)	H1 [b] (mm)	H1 [c] (mm)	D1 (mm)	L1 (mm)	H2 [a] (mm)	H2 [b] (mm)	H2 [c] (mm)	L2 (mm)
DN15	525	445	355	45	65	540	460	370	170
DN20	531	451	361	58	65	545	465	375	170
DN25	531	451	361	58	65	550	470	380	250
DN32	531	451	361	58	65	563	483	393	250
DN40	529	449	359	85	70	578	498	408	250
DN50	541	461	371	99	70	590	510	420	250
DN65	558	478	388	118	70	612	532	442	250

DN80	573	493	403	132	70	625	545	455	280
DN100	595	515	425	156	70	644	564	474	300
DN125	621	541	451	184	70	674	594	504	350
DN150	647	567	477	211	70	703	623	533	350
DN200	705	625	535	266	98	757	677	587	400
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Note:

- This product has 3 types of pillars, a, b, and c, with different lengths. Please refer to the H subscript in the table above to view the total height.
- A 150°C sensor head without compensation vortex flow meter uses pillar c; A 150°C sensor head with compensation vortex flow meter uses pillar b.
- A 260°C sensor head vortex flow meter uses pillar b; A 300°C sensor head vortex flow meter uses pillar a.

4. Installation Guide

4.1. Installation Site and Environment Selection

1. Avoid high-voltage equipment, high-frequency frequency conversion equipment, and high-power switching equipment as much as possible;
2. Avoid exposure to high-temperature heat sources and radiant heat sources as much as possible; outdoor installations should be properly shaded and protected from rain.
3. Avoid locations prone to vibration and highly corrosive environments; also consider ease of installation and maintenance.

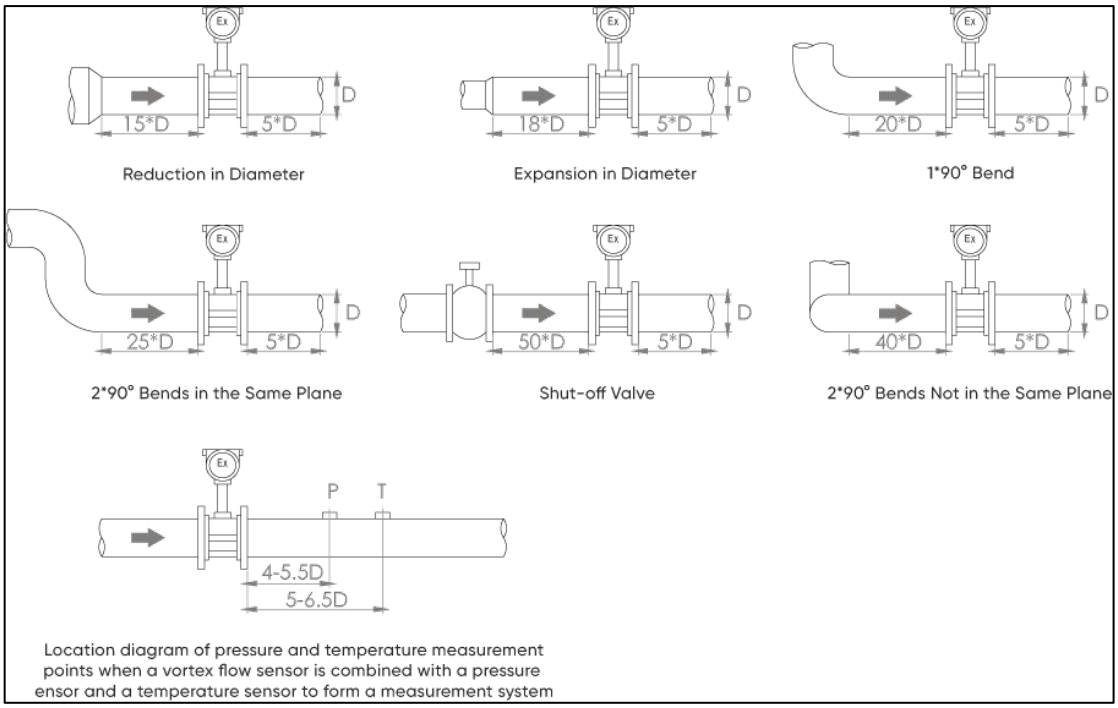
4.2. Reasonable Installation Location

1. Avoid installing on pipes with strong vibrations; otherwise, vibration reduction measures must be taken, such as adding vibration damping sections.
2. The flow meter can be installed horizontally, vertically, or at an angle. When measuring liquids, it is essential to ensure that the fluid flows from a lower to a higher position; when measuring gases, the flow direction is unrestricted; when

measuring steam or high-temperature gases, the meter support should be installed at approximately a 45° angle to the vertical direction.

4.3. Straight Pipe Section Requirements

This choice applies to the following situations: For accurate measurement, there must be sufficient straight pipe sections upstream and downstream of the flow meter, and there should be no components upstream that affect the fluid velocity distribution. The figure below shows the minimum length requirements of the straight pipe sections before and after the flow meter under various pipeline conditions.



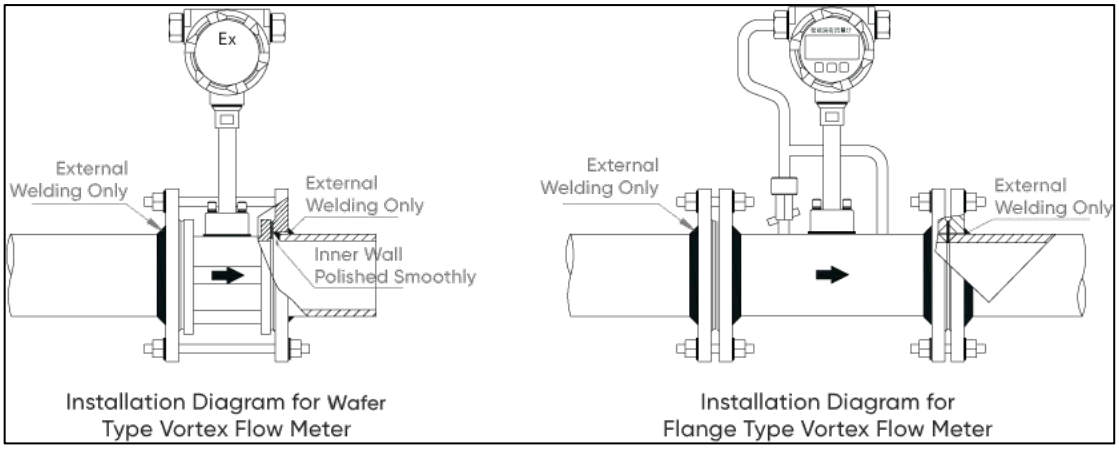
Location diagram of pressure and temperature measurement points when a vortex flow sensor is combined with a pressure ensor and a temperature sensor to form a measurement system

4.4. Grounding Requirements

When installing a flow meter, the meter body should be reliably grounded. If the on-site pipeline does not have grounding conditions, a separate reliable grounding wire should be made and connected to the grounding terminal of the transmitter housing. The grounding resistance from the transmitter housing to the ground should be ⩽5Ω.

4.5. Flow Meter Installation Method and Welding

The inner diameter of the upstream and downstream piping at the vortex flow meter installation point should be consistent with the inner diameter of the meter. The sensor should be concentric with the pipe, and the sealing gasket between the sensor and the flange should not protrude into the pipe. The specific installation method is shown in the figure below.



After the initial assembly of the meter body is completed, the flange bolts should be retightened when the measured medium is steam or other high-temperature medium after the pipeline is filled with the medium. The pipeline should also be insulated to prevent damage to the amplifier due to excessively high ambient temperatures.

Please note: For integral mount temperature and pressure compensated flow meters, to avoid damage to the pressure sensor from high temperatures or water hammer, be sure to close the pressure valve on the meter body before the pipeline is filled with fluid. Once the pipeline is filled with fluid and the operating temperature and pressure are reached, slowly open the valve. For meters installed outdoors, the pressure tapping bend and pressure probe should be insulated.

5. Wiring and Commissioning

5.1. Wiring

For vortex flow meters, it is recommended to use shielded cables of type AVPV2*0.5mm² two- core or AVPV3*0.5mm² three-core. The shielding layer should be reliably grounded at one end or connected to the amplifier housing. When the amplifier housing cannot be reliably grounded, a ground wire should be run from the grounding terminal outside the amplifier housing and reliably connected to the earth to ensure grounding reliability. This is important for the stable operation of the flow meter.

Please note: The external power supply for the amplifier must be 24VDC±5% and the connecting cable should be less than 500 meters. When outputting current, the wire loop resistance should be ⩽50Ω; if the wire loop resistance does not meet this requirement, consider reducing the cable length or increasing the cable cross-sectional area to reduce the wire loop resistance.

5.2.Commissioning

Vortex flow meters undergo rigorous testing and calibration before leaving the factory, and users generally do not need to perform zero-point adjustment when putting them into use. However, if on-site operating conditions (such as vibration, frequency conversion, strong electromagnetic interference) change, causing the zero point to become abnormal, appropriate adjustment of the flow meter's zero point is required. If zero-point adjustment is needed, please contact our company promptly for technical service personnel to guide the operation.

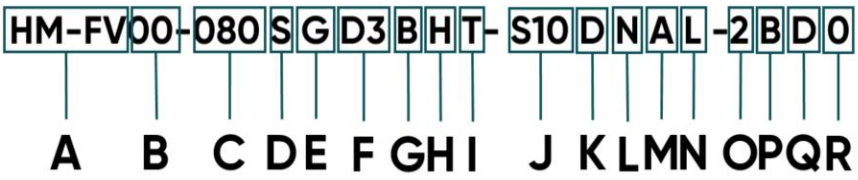
6. Faults and Troubleshooting

Fault Phenomenon	Cause of the Fault	Troubleshooting
After power is turned on, no output signal	1. No medium is flowing in the pipeline or the flow rate is below the lower limit	1. Increase the flow rate of the medium or replace it with a smaller diameter flow meter
	2. The power supply and output cable are not connected correctly	2. Connect the wires correctly
	3. The flow meter itself is damaged	3. Check or replace the flow meter
The flow meter outputs a signal even when there is no flow	1. Poor grounding of the flow meter or other interference	1. Connect the ground wire correctly and eliminate interference
	2. The amplifier's sensitivity is too high or it is experiencing self-oscillation	2. Adjust or replace the amplifier
	3. Unstable power supply or other interference	3. Repair or replace the power supply to eliminate interference
Instantaneous flow Instability is displayed	1. Unstable medium flow rate	1. Wait until the traffic flow stabilizes before testing
	2. There are foreign objects in the pipe	2. Remove foreign objects

	3. The amplifier sensitivity is too high or too low	3. Adjust or replace the amplifier
	4. Poor grounding	4. Check the grounding line to ensure it is functioning properly
	5. Flow rate is below the lower limit	5. Increase flow rate
	6. The sealing ring extends into the pipe, causing disturbance	6. Modify according to installation requirements

7. Ordering Information

The model code of HIKMICRO Vortex Flow Meter is explained below. Each item from A to R must be specified at the time of ordering.



A. Base Model-Vortex Flow Meter
B. Series
C. Nominal Diameter
D. Medium Type
E. Process Connection Standard
F. Pressure Standard
G. Sealing Surface
H. Accuracy
I. Temp. Range
J. Structure Type
K. Power Supply
L. Explosion-proof
M. Sensor Protection Rating
N. Wetted Parts Material
O. Output Signal
P. Electrical Connection
Q. Temperature / Pressure Compensation
R. Pressure Sensor Range

7.1. Model Code Description

Model Code Position	Model Code	Description
Base Model- Vortex Flow Meter		
A	HM-FV	Product Category
Series		
B	00	Product Series
Nominal Diameter		
C	025	DN25

C	032	DN32
C	040	DN40
C	050	DN50
C	065	DN65
C	080	DN80
C	100	DN100
C	125	DN125
C	150	DN150
C	200	DN200
Medium Type		
D	G	Gas
D	S	Steam (saturated steam, superheated steam)
D	L	Liquid
Process Connection Standard		
E	A	ASME B16.5(A)
E	B	GB/T9124.2 (A)
E	E	EN1092-1 (E)
E	G	GB/T9124.1 (E)
E	H	HG/T20615(A)
E	K	Wafer (Flangeless)
E	M	HG/T20592 (E)
Pressure Standard		
F	D1	PN06
F	D2	PN10
F	D3	PN16
F	D4	PN25
F	D5	PN40
F	D6	PN63

F	C1	Class 150
F	C2	Class 300
Sealing Surface		
G	A	FF (Flat Face)
G	B	RF (Raised Face)
G	N	Not involved
Accuracy		
H	H	1.5%
H	G	1%
Temp. Range		
I	S	-40℃~260℃
I	T	-40℃~300℃
I	R	-40℃~150℃
Structure Type		
J	E00	Integral Mount
J	S10	Remote mount with 10m signal line length
J	S15	Remote mount with 15m signal line length
Power Supply		
K	D	24V DC
K	L	3.6V Lithium Battery
K	S	3.6V Lithium Battery + 24V DC
Explosion-proof		
L	A	Intrinsic Safety (Gas, Zone 0, 1, 2 + Dust, Zone 20, 21, 22)
L	D	Explosion-proof
L	N	Non-explosion-proof
Sensor Protection Rating		
M	A	IP65
Wetted Parts Material		
N	H	HC (Hastelloy C)
N	K	316L Stainless Steel
N	L	304 Stainless Steel
Output Signal		

O	0	No output
O	1	Pulse + Modbus
O	2	4~20mA + HART
O	3	Pulse Only
O	4	4~20mA
Electrical Connection		
P	B	M20x1.5 stainless steel explosion-proof cable gland
P	C	M20x1.5 nylon cable gland
P	D	1/2NPT explosion-proof cable gland
P	E	1/2NPT nylon cable gland
P	F	G1/2 internal thread
P	G	G1/2 external thread
Temperature / Pressure Compensation		
Q	D	Temperature and Pressure Compensation
Q	E	Pressure Compensation
Q	F	Temperature Compensation
Q	N	No Compensation
Pressure Sensor Range		
R	0	Consistent with nominal pressure
R	A	⩽0.1MPa
R	B	⩽0.35MPa
R	C	⩽1MPa
R	D	⩽1.6MPa
R	E	⩽2.5MPa
R	F	⩽4MPa

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7.2. Selection Table

VORTEX FLOW METER

X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X

Base Model- Vortex Flow Meter

Product Category HM-FV

Series

Product Series 0

Nominal Diameter

DN25	25
DN32	32
DN40	40
DN50	50
DN65	65
DN80	80
DN100	100
DN125	125
DN150	150
DN200	200

Medium Type

Gas	G
Steam (saturated steam, superheated steam)	S
Liquid	L

Process Connection Standard

ASME B16.5(A)	A
GB/T9124.2 (A)	B
EN1092-1 (E)	E
GB/T9124.1 (E)	G
HG/T20615(A)	H
Wafer (Flangeless)	K
HG/T20592 (E)	M

Pressure Standard

PN06	D1
PN10	D2
PN16	D3
PN25	D4
PN40	D5
PN63	D6
Class 150	C1
Class 300	C2

Sealing Surface

FF (Flat Face)	A
RF (Raised Face)	B
Not involved	N

Accuracy

1.50%	H
1%	G

Temp. Range

-40℃~260℃	S
-40℃~300℃	T
-40℃~150℃	R

Structure Type

E00	Integral Mount
S10	Remote mount with 10m signal line length
S15	Remote mount with 15m signal line length

Power Supply

D	24V DC
L	3.6V Lithium Battery
S	3.6V Lithium Battery + 24V DC

Explosion-proof

A	Intrinsic Safety (Gas, Zone 0, 1, 2 + Dust, Zone 20, 21, 22)
D	Explosion-proof
N	Non-explosion-proof

Sensor Protection Rating

A	IP65

Wetted Parts Material

H	HC (Hastelloy C)
K	316L Stainless Steel
L	304 Stainless Steel

Output Signal

0	No output
1	Pulse + Modbus
2	4~20mA + HART
3	Pulse Only
4	4~20mA

Electrical Connection

B	M20x1.5 stainless steel explosion-proof cable gland
C	M20x1.5 nylon cable gland
D	1/2NPT explosion-proof cable gland
E	1/2NPT nylon cable gland
F	G1/2 internal thread
G	G1/2 external thread

Temperature / Pressure Compensation

D	Temperature and Pressure Compensation
E	Pressure Compensation
F	Temperature Compensation
N	No Compensation

Pressure Sensor Range

0	Consistent with nominal pressure
A	≤0.1MPa
B	≤0.35MPa
C	≤1MPa
D	≤1.6MPa
E	≤2.5MPa
F	≤4MPa

Appendix 1: Saturated Steam Density-Pressure Table

The pressures in the table are absolute pressures			The pressures in the table are absolute pressures			The pressures in the table are absolute pressures		
Temperature (℃)	Pressure (MPa)	Density (kg/m³)	Temperature (℃)	Pressure (MPa)	Density (kg/m³)	Temperature (℃)	Pressure (MPa)	Density (kg/m³)
100	0.1013	0.5977	150	0.476	2.548	200	1.5548	7.864
101	0.105	0.618	151	0.4888	2.613	201	1.5876	8.025
102	0.1088	0.6388	152	0.5021	2.679	202	1.621	8.188
103	0.1127	0.6601	153	0.5155	2.747	203	1.6548	8.354
104	0.1167	0.6821	154	0.5292	2.816	204	1.6892	8.522
105	0.1208	0.7046	155	0.5433	2.886	205	1.7242	8.694
106	0.125	0.7277	156	0.5577	2.958	206	1.7597	8.868
107	0.1294	0.7515	157	0.5723	3.032	207	1.7959	9.045
108	0.1339	0.7758	158	0.5872	3.106	208	1.8326	9.225
109	0.1385	0.8008	159	0.6025	3.182	209	1.8699	9.408
110	0.1433	0.8265	160	0.6181	3.26	210	1.9077	9.593
111	0.1481	0.8528	161	0.6339	3.339	211	1.9462	9.782
112	0.1532	0.8798	162	0.6502	3.42	212	1.9852	9.974
113	0.1583	0.9075	163	0.6666	3.502	213	2.0248	10.17
114	0.1636	0.9359	164	0.6835	3.586	214	2.065	10.37
115	0.1691	0.965	165	0.7008	3.671	215	2.1059	10.57
116	0.1746	0.9948	166	0.7183	3.758	216	2.1474	10.77
117	0.1804	1.025	167	0.7362	3.847	217	2.1896	10.98
118	0.1863	1.057	168	0.7544	3.937	218	2.2323	11.19
119	0.1923	1.089	169	0.773	4.029	219	2.2757	11.41
120	0.1985	1.122	170	0.792	4.123	220	2.3198	11.62
121	0.2049	1.155	171	0.8114	4.218	221	2.3645	11.84
122	0.2114	1.19	172	0.831	4.316	222	2.4098	12.07
123	0.2182	1.225	173	0.8511	4.415	223	2.4559	12.3
124	0.225	1.261	174	0.8716	4.515	224	2.5026	12.53
125	0.2321	1.298	175	0.8924	4.618	225	2.55	12.76
126	0.2393	1.336	176	0.9137	4.723	226	2.5981	13
127	0.2467	1.375	177	0.9353	4.829	227	2.6469	13.24
128	0.2543	1.415	178	0.9573	4.937	228	2.6963	13.49
129	0.2621	1.455	179	0.9797	5.048	229	2.7466	13.74
130	0.2701	1.497	180	1.0197	5.16	230	2.7975	14
131	0.2783	1.539	181	1.0259	5.274	231	2.8491	14.25
132	0.2867	1.583	182	1.0496	5.391	232	2.901	14.52
133	0.2953	1.627	183	1.0737	5.509	233	2.9546	14.78
134	0.3041	1.672	184	1.0983	5.629	234	3.0085	15.05
135	0.313	1.719	185	1.1233	5.752	235	3.0631	15.33
136	0.3222	1.766	186	1.1487	5.877	236	3.1185	15.61
137	0.3317	1.815	187	1.1746	6.003	237	3.1746	15.89
138	0.3414	1.864	188	1.201	6.131	238	3.2316	16.18
139	0.3513	1.915	189	1.2278	6.264	239	3.2892	16.47
140	0.3614	1.967	190	1.2551	6.397	240	3.3477	16.76
141	0.3718	2.019	191	1.2829	6.553	241	3.407	17.06
142	0.3823	2.073	192	1.3111	6.671	242	3.467	17.37
143	0.3931	2.129	193	1.3397	6.812	243	3.5279	17.68
144	0.4042	2.185	194	1.369	6.955	244	3.5897	17.99
145	0.4155	2.242	195	1.3987	7.1	245	3.6522	18.31
146	0.4271	2.301	196	1.4289	7.248	246	3.7155	18.64
147	0.4389	2.361	197	1.4596	7.398	247	3.7797	18.97
148	0.451	2.422	198	1.4909	7.551	248	3.8448	19.3
149	0.4633	2.484	199	1.5225	7.706	249	3.9107	19.64

Appendix 2: Table of Superheated Steam Density

Pressure (MPa)	Temperature (℃) The pressures in the table are absolute pressures. When referring to the table, the pressure should be the instrument reading + atmospheric pressure. Density is measured in kg/m³							
	150	170	190	210	230	250	270	290
0.1	0.5164	0.4925	0.4707	0.4507	0.4323	0.4156	0.4001	0.3857
0.15	0.7781	0.7412	0.7079	0.6777	0.65	0.6246	0.601	0.5795
0.2	1.0423	0.9918	0.9466	0.9056	0.8684	0.8342	0.8027	0.7736
0.25	1.3089	1.2444	1.1869	1.1349	1.0849	1.0445	1.0048	0.9682
0.3	1.5783	1.499	1.4287	1.3653	1.3079	1.254	1.2077	1.1634
0.4	2.1237	2.0141	1.9166	1.8297	1.7513	1.678	1.6152	1.5554
0.5	2.6658	2.538	2.4121	2.2997	2.1992	2.1081	2.0255	1.9495
0.8	4.3966	4.1676	3.935	3.74	3.5374	3.411	3.2718	3.1453
1.1	6.1313	5.8332	5.5342	5.2356	4.981	4.746	4.5445	4.3612
1.4	7.8785	7.5163	7.154	6.7913	6.4288	6.1147	5.8437	5.5945
1.7	9.8464	9.3688	9.2473	8.413	7.9352	7.5219	7.183	6.8607
2	11.6295	11.0985	10.5676	10.0366	9.5054	8.9744	8.535	8.1447
2.5	15.189	14.4516	13.715	12.9776	12.2406	11.5036	10.8794	10.35
3	18.4168	17.5709	16.7243	15.8776	15.0367	14.1842	13.3377	12.6359
3.5	22.7008	21.5713	20.4427	19.3131	18.2266	17.053	15.9243	15.0163
4	27.164	25.747	24.3303	22.9129	21.4954	20.0778	18.6603	17.4997
4.5	30.3852	28.9163	27.4475	25.9784	24.5096	23.0407	21.5717	20.1028
5	35.4243	33.6293	31.8342	30.0384	28.2433	26.4483	24.6532	22.858
6	43.8954	41.7475	39.5988	37.4508	35.302	33.1541	31.0062	28.8574
7	56.7201	53.6991	50.678	47.6561	44.6352	41.6133	38.5922	35.5704
8	65.4713	62.18	58.8883	55.5968	52.3061	49.0145	45.7231	42.4316
9	84.5457	79.8261	75.1061	70.3863	65.6665	60.9465	56.21	51.5077
10	108.625	102.0289	95.4346	88.8412	82.2486	75.6543	65.7699	62.4676
12.5	158.3464	148.7516	139.1578	129.5629	119.9781	110.3842	95.7769	91.1964
15	206.4175	194.4276	182.4477	170.4577	158.4766	146.4967	127.682	122.5268
17.5	250.3934	236.691	222.8603	209.1592	195.4568	181.6261	163.428	154.2312
20	327.8165	309.9521	291.2953	273.4409	255.5786	236.9271	219.0574	201.2031
21.5	384.6647	363.2975	341.9027	320.5455	299.188	277.7931	256.426	235.0688

Pressure (MPa)	Temperature (℃) The pressures in the table are absolute pressures. When referring to the table, the pressure should be the instrument reading + atmospheric pressure. Density is measured in kg/m³							
	310	330	350	370	390	410	430	450
0.1	0.3724	0.36	0.3484	0.3375	0.3272	0.3176	0.3086	0.3
0.15	0.5594	0.5404	0.523	0.5066	0.4912	0.4767	0.4631	0.4502
0.2	0.7465	0.7214	0.698	0.6759	0.6553	0.636	0.6178	0.6005
0.25	0.9343	0.9027	0.8732	0.8456	0.8198	0.7955	0.7726	0.7507
0.3	1.1224	1.0844	1.0488	1.0156	0.9845	0.9552	0.9277	0.8989
0.4	1.5	1.449	1.401	1.3563	1.3144	1.2753	1.2377	1.2035
0.5	1.8802	1.8147	1.7545	1.6983	1.6456	1.5961	1.5498	1.5036
0.8	3.0283	2.9215	2.8227	2.7305	2.644	2.5595	2.4884	2.4171
1.1	4.1943	4.041	3.903	3.77	3.6512	3.5384	3.4335	3.3345
1.4	5.3794	5.1777	4.9945	4.829	4.6673	4.522	4.3857	4.2575
1.7	6.5815	6.3309	6.0998	5.7779	5.6936	5.512	5.3441	5.1863
2	7.8061	7.4955	7.2186	6.9619	6.729	6.5117	6.313	6.1203
2.5	9.8888	9.4806	9.1139	8.7802	8.475	8.1938	7.9332	7.6777
3	11.9979	11.5143	11.0494	10.6308	10.2493	9.9	9.5775	9.2642
3.5	14.2565	13.8501	13.0286	12.6162	12.0528	11.6308	11.2425	10.8842
4	16.5527	15.749	15.0539	14.4392	13.8862	13.3077	12.9991	12.5087
4.5	18.9333	17.9308	17.1279	16.4018	15.7527	15.1451	14.6679	14.1507
5	21.4221	20.2508	19.2627	18.4108	17.6565	16.9827	16.3719	15.8139

Pressure (MPa)	Temperature (℃) The pressures in the table are absolute pressures. When referring to the table, the pressure should be the instrument reading + atmospheric pressure. Density is measured in kg/m³							
	310	330	350	370	390	410	430	450
6	26.7091	25.0502	23.7006	22.557	21.5629	20.69	19.9062	19.1981
7	32.5488	30.2231	28.4037	27.01	25.633	24.5224	23.4021	22.6635
8	39.1399	35.8485	33.4179	31.4825	29.8698	28.4969	27.2913	26.017
9	46.7877	42.068	38.8083	36.3217	34.3044	32.2947	31.1593	29.8733
10	59.6648	49.2802	44.756	41.5274	39.0006	36.9344	35.1684	33.6447
12.5	81.6034	72.0105	62.4178	56.1496	51.8212	48.5015	45.8023	43.5431
15	110.5369	98.5531	86.5688	74.584	66.8341	61.553	57.5137	54.2497
17.5	140.3919	126.6895	116.3142	100.8176	85.3228	76.6185	70.5711	65.9331
20	182.5462	164.6839	151.12	137.7965	108.543	94.4945	85.3276	78.7759
21.5	213.6739	192.3164	171.8651	150.0074	128.1614	106.636	95.1366	87.0939

Pressure (MPa)	Temperature (℃) The pressures in the table are absolute pressures. When referring to the table, the pressure should be the instrument reading + atmospheric pressure. Density is measured in kg/m³						
	470	490	510	530	550	570	590
0.1	0.2919	0.2842	0.2769	0.27	0.2634	0.2571	0.2512
0.15	0.4381	0.427	0.4156	0.4052	0.3953	0.386	0.3768
0.2	0.5842	0.5688	0.55	0.54	0.5271	0.5146	0.5026
0.25	0.7316	0.7113	0.6925	0.6757	0.6591	0.644	0.6284
0.3	0.8856	0.854	0.832	0.8108	0.7913	0.7724	0.754
0.4	1.1708	1.1396	1.1102	1.0821	1.0556	1.0303	1.0062
0.5	1.4648	1.4258	1.3888	1.3537	1.3204	1.2887	1.2585
0.8	2.35	2.2869	2.2274	2.172	2.1164	2.029	2.0168
1.1	3.2402	3.1529	3.071	2.9902	2.917	2.8449	2.7774
1.4	4.3496	4.2291	3.9157	3.8143	3.7183	3.6271	3.5401
1.7	5.0374	4.8972	4.7665	4.6408	4.523	4.4116	4.3056
2	5.9419	5.7811	5.6204	5.4725	5.3322	5.1989	5.0745
2.5	7.4937	7.281	7.0799	6.8637	6.6858	6.5177	6.3582
3	8.856	8.602	8.361	8.133	8.0486	7.8437	7.6498
3.5	10.5512	10.25	9.9499	9.6776	9.4197	9.1777	8.948
4	12.1835	11.757	11.4169	11.0994	10.8003	105191	10.2533
4.5	13.7009	13.288	12.895	12.5315	12.1894	11.8683	11.565
5	15.3017	14.8021	14.3859	13.9749	13.5885	13.2267	12.885
6	18.5495	17.956	17.4029	16.8912	16.4119	15.9657	15.544
7	21.8675	21.146	20.4699	19.8506	19.2745	18.735	18.2314
8	25.264	24.395	23.5905	22.8573	22.1742	21.54	20.95
9	28.4637	27.71	26.7676	25.9068	25.1124	24.3771	23.6949
10	32.3002	31.096	30.0116	29.0164	28.1	27.2557	26.4738
12.5	41.5884	39.88	38.3537	36.9936	35.7414	34.6072	33.5541
15	51.5265	49.194	47.1249	45.3087	43.668	42.1936	40.8349
17.5	62.1807	59.052	56.3427	53.9875	51.8985	50.0237	48.3269
20	73.6858	69.601	66.0602	63.0674	60.4493	58.1253	56.0402
21.5	81.0184	76.1667	72.1376	68.7108	65.737	63.1132	60.7719

Appendix 3: Table of Measurable Flow Range of Vortex Flow Meters for Liquid

	Volumetric Flow Rate Range (Liquid)										Maximum Flow Rate Qmax (m^3/h)
Density(kg/m3)	500	600	700	800	900	1000	1200	1400	1600	1800	
Nominal Diameter (mm)	Minimum Flow Rate Qmin (m^3/h)										
15	0.54	0.49	0.46	0.43	0.40	0.38	0.35	0.32	0.30	0.28	3.18
20	0.96	0.88	0.81	0.76	0.71	0.68	0.62	0.57	0.54	0.51	5.65
25	1.50	1.37	1.27	1.18	1.12	1.06	0.97	0.90	0.84	0.79	8.83
32	2.25	2.05	1.90	1.78	1.68	1.59	1.45	1.35	1.26	1.19	18.81
40	3.52	3.21	2.97	2.78	2.62	2.49	2.27	2.10	1.97	1.85	29.39
50	5.50	5.02	4.64	4.34	4.10	3.89	3.55	3.28	3.07	2.90	45.92
65	9.29	8.48	7.85	7.34	6.92	6.57	5.99	5.55	5.19	4.89	77.61
80	14.07	12.84	11.89	11.12	10.49	9.95	9.08	8.41	7.86	7.41	117.56
100	21.98	20.07	18.58	17.38	16.38	15.54	14.19	13.14	12.29	11.59	183.69
125	34.35	31.35	29.03	27.15	25.60	24.29	22.17	20.53	19.20	18.10	287.02
150	49.46	45.15	41.80	39.10	36.86	34.97	31.92	29.56	27.65	26.07	413.30
200	87.92	80.26	74.31	69.51	65.54	62.17	56.76	52.54	49.15	46.34	734.76
250	137.38	125.41	116.11	108.61	102.40	97.14	88.68	82.10	76.80	72.41	1148.06
300	197.83	180.59	167.20	156.40	147.45	139.89	127.70	118.23	110.59	104.27	1653.21

Appendix 4: Table of Measurable Flow Range of Vortex Flow Meters for Gas & Steam

	Volumetric Flow Rate Range (Gas & Steam)												Maximum Flow Rate Qmax (m^3/h)
Density(kg/m3)	0.5	0.8	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	12	20	
Nominal Diameter (mm)	Minimum Flow Rate Qmin (m^3/h)												
15	5.9	4.7	3.8	2.7	2.2	1.9	1.7	1.6	1.4	1.3	1.2	0.9	31.8
20	10.5	8.3	6.8	4.8	3.9	3.4	3.0	2.8	2.6	2.4	2.1	1.7	56.5
25	16.4	13.0	10.6	7.5	6.1	5.3	4.7	4.3	4.0	3.7	3.4	2.6	88.3
32	26.9	21.3	17.4	12.3	10.0	8.7	7.8	7.1	6.6	6.1	5.5	4.3	188.1
40	42.0	33.2	27.1	19.2	15.7	13.6	12.1	11.1	10.3	9.6	8.6	6.6	293.9
50	65.7	51.9	42.4	30.0	24.5	21.2	19.0	17.3	16.0	15.0	13.4	10.4	459.2
65	111.0	87.7	71.6	50.7	41.4	35.8	32.0	29.2	27.1	25.3	22.7	17.5	776.1
80	168.1	132.9	108.5	76.7	62.7	54.3	48.5	44.3	41.0	38.4	34.3	26.6	1175.6
100	262.7	207.7	169.6	119.9	97.9	84.8	75.8	69.2	64.1	59.9	53.6	41.5	1836.9
125	410.4	324.5	264.9	187.3	153.0	132.5	118.5	108.2	100.1	93.7	83.8	64.9	2870.2
150	591.0	467.3	381.5	269.8	220.3	190.8	170.6	155.8	144.2	134.9	120.6	93.5	4133.0
200	1050.7	830.7	678.2	479.6	391.6	339.1	303.3	276.9	256.4	239.8	214.5	166.1	7347.6
250	1641.8	1297.9	1059.8	749.4	611.8	529.9	473.9	432.6	400.5	374.7	335.1	259.6	11480.6
300	2364.1	1869.0	1526.0	1079.1	881.1	763.0	682.5	623.0	576.8	539.5	482.6	373.8	16532.1

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442 738 3918 contacto@ingframex.com www.ingframex.com

Hikmicro Industrial hikmicro_industrial HIKMICRO Industrial
HIKMICRO www.hikmicrotech.com info@hikmicrotech.com