

Vortex flow meter

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Preface

Thank you for purchasing vortex flow meter. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- Please use this product in accordance with the explosion-proof characteristics of this product and comply with the requirements of national and regional laws and regulations, and we are not responsible for any problems and losses caused by improper operation or illegal use.

Version

U-SUP-LUGB-SUP-A/B-EN4

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- The following safety signs are used in this manual:



Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.



Warning: Pay special attention to the important information linked to product or particular part in the operation manual.



- Confirm if the supply voltage is consistent with the rated voltage before operation.
- Do not use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzene or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power immediately, otherwise there will be leakage, electric shock or even a

fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.



- Do not use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

Package contents

Table 1

Number	Name	Quantity	Remarks
1	Vortex flow meter	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation. If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

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1 Introduction

1.1 Introduction

Vortex flow meter is on the principle of Karman street, to measure liquid, gas and vapour even turbid liquid including micro grain and impurity. Applications: petroleum, chemical industry, paper making, metallurgy, electric force, environmental protection, food industry and etc.

1.2 Working Principle

Vortex flow meter work on the principle of generated vortex and relation between vortex and flow by theory of Karman and Strouhal, which specialize in measurement of steam, gas and liquid of lower viscosity. As shown in below illustration, medium flows through bluff body and then vortex is generated, vortices are alternately formed on both sides with opposite directions of rotation, Vortices frequency is directly proportional to medium velocity. Through numbers of vortices that is measured by sensor head, medium velocity is calculated, plus flow meter diameter, final volume flow come out.

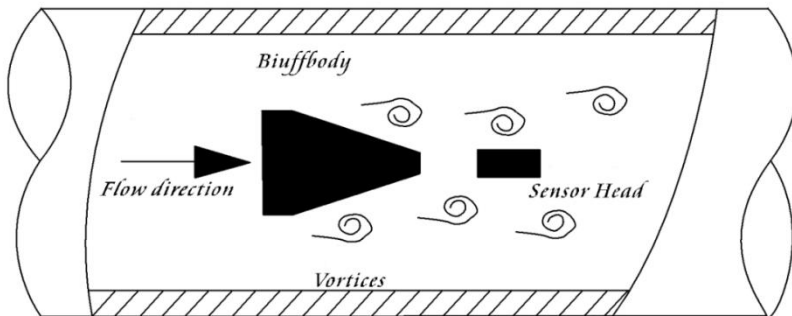


Fig.1

Computational formula as follows:

$$F = St \cdot V / m_d \quad \text{Formula 1}$$

$$Q = 3600 \cdot F / K \quad \text{Formula 2}$$

$$M = Q \cdot \rho \quad \text{Formula 3}$$

Among Formula:

F..... Fluid flow through bluff body generate frequency of vortex (Unit : Hz)

St... Strouhal constant (zero dimension)

V.....Mean velocity of fluid inside the pipeline (Unit : m/s)

m.....The ratio between Lune Circulation area of bluff body at both sides and cross-sectional area (Unit: zero dimension)

d..... Upstream face width of bluff body inside vortex flow meter (Unit : m)

Q..... Instantaneous volume flow (Unit : m^3/h)

K..... Instrument coefficient of vortex flow meter (Unit : pulses / m^3)

M..... Instantaneous mass flow (Unit : kg/ h)

ρ Fluid density (Unit : kg/m^3)

Note: vortex flow meter "K" coefficient is corresponding with one diameter, the exact "K" value

should be calibrated in practice. Viz. one cubic meter fluid through sensor output numbers of pulse under working condition.

2 Technical Parameters

2.1 Technical Parameters

Table.1 Technical parameters of LUGB-A/LUGBC

Medium	Liquid, gas, steam(saturated steam and superheated steam)	
Diameter	Pipeline-version: DN10~DN500 Insertion-version: DN200~DN2000	
Accuracy	Pipeline-version (LUGB-A): 1.0% (0.2% & 0.5% optional) Insertion-version (LUGBC):: 2.5% (1.0%&1.5% optional)	
Range ratio	Gas density:1.2kg/m ³ , Range ratio: 10:1 Liquid density:1000kg/m ³ , Range ratio: 10:1; when the medium density is different, the range ratio will change.	
Flow range	Refer to table 3~8	
Pressure	Pipeline-version wafer connection	DN10-DN500 (priority PN2.5MPa)
	Pipeline-version flange connection	DN10-DN80 (priority PN2.5MPa) DN100-DN200 (priority PN1.6MPa) DN250-DN500 (priority PN1.0MPa)
	Insertion-version attachment flange	DN200-DN2000 (priority PN1.6MPa)
	Note : wafer-version vortex flow meter assemble made-to-order flanges, when flow meter leave factory including companion flanges. We are able to provide GB/T9119-2000, ANSI/ASME, DIN. JIS. KS.... Standard flanges (GB-China standard priority), pressure class recommend priority level.	
Medium temperature	Pipeline-version	-40°C ~ 150°C, -40°C ~ 260°C, -40°C ~ 320°C, -40°C~ 420°C
	Insertion-version:	-40°C ~ 150°C, -40°C~ 200°C
Ambient conditions	-20°C~55°C(normal); -20°C~ 40°C(explosion-proof)	
Relative humidity	5% - 95%	

Atmospheric Pressure	86kPa -106kPa
Electrical Interface	M20*1.5 internal thread (priority).
Power supply	24VDC±5%, lithium battery 3.6VDC
Current output	2-wire (4~20) mA, load resistance $\leq 300 \Omega$ (including wire resistance)
Frequency pulse output	D2/X1 type: Frequency pulse corresponding to instantaneous flow rate under working conditions (low level $\leq 1V$, high level $\geq 6V$) X3-2/E3-2 type: Instantaneous flow rate under working conditions corresponds to frequency pulses (low level $\leq 1V$, high level=power supply voltage (V) -1V - load current (mA) $\times 1k \Omega$, equal pulse width), load current $\leq 9mA$; Equivalent pulse corresponding to instantaneous flow rate under standard conditions (low level $\leq 1V$, high level=power supply voltage (V) -1V - load current (mA) $\times 1k \Omega$, equal pulse width), load current $\leq 9mA$ Note: The frequency input range is 0.01Hz to 10000Hz, the frequency output range is 0.07Hz to 10000Hz, and the equivalent pulse output range is $\leq 100Hz$.
Communication interface	RS485 ; HART
Ingress protection	IP65 (IP67, IP68 optional)
Main body material	Sstainless steel
Pressure loss	$\Delta P \leq 1.2 \rho_{\perp} V^2$ (ΔP unit is Pa, $\rho_{\perp}$ unit is kg/m^3 , V unit is m/s)
Calibration method	All flow meters should be calibrated in the way of lower reaches taking pressure before flow meters leave factory.
Display mode	Intelligent numeric alphabetic display type: twin-row numeric alphabetic LCD (instantaneous flow rate and totalizer)

	Intelligent dot matrix LCD: English 128*64 dot matrix LCD (instantaneous flow rate, totalizer, temperature and pressure under working condition, battery voltage or density under working condition, instantaneous flow rate under working condition, send-out, time, menu modify records, power-off records, etc)
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Table.2 Technical parameters of LUGB

Medium	Liquid, gas, steam(saturated steam and superheated steam)	
Diameter	DN15~DN300	
Accuracy	Gas without compensation	DN15~DN25--1.5%, DN32~DN200--1.0% DN250~DN300: 1.5%
	Liquid without compensation	DN15-DN300 -- 1.0%;
	Temperature and pressure compensation	DN25-DN300 -- 1.5%
Range ratio	Gas density:1.2kg/m ³ , Range ratio: 8:1 Liquid density:1000kg/m ³ , Range ratio: 8:1; when the medium density is different, the range ratio will change.	
Flow range	Refer to table 9~11	
Pressure	Wafer connection	DN15~DN300 PN2.5MPa
	Flange connection	DN15~DN50 PN2.5MPa DN65~DN200 PN1.6MPa DN250~DN300 PN1.0MPa
	Note : Other pressure or other flange standards can be customized	
Medium temperature	(-40~ 150) °C; (-40~ 260) °C; (-40~ 300) °C	
Ambient conditions	-20℃~+55℃	
Relative humidity	5% - 95%RH	
Atmospheric	86kPa -106kPa	

2 Technical Parameters

Pressure	
Electrical Interface	M20*1.5 internal thread (priority).
Power supply	24VDC±5%, lithium battery 3.6VDC
Current output	2-wire (4~20) mA, load resistance $\leq 300 \Omega$ (including wire resistance)
Frequency pulse output	D2/X1 type: Frequency pulse corresponding to instantaneous flow rate under working conditions (low level $\leq 1V$, high level $\geq 6V$) X3-2/E3-2 type: Instantaneous flow rate under working conditions corresponds to frequency pulses (low level $\leq 1V$, high level=power supply voltage (V) -1V - load current (mA) $\times 1k \Omega$, equal pulse width), load current $\leq 9mA$; Equivalent pulse corresponding to instantaneous flow rate under standard conditions (low level $\leq 1V$, high level=power supply voltage (V) -1V - load current (mA) $\times 1k \Omega$, equal pulse width), load current $\leq 9mA$ Note: The frequency input range is 0.01Hz to 10000Hz, the frequency output range is 0.07Hz to 10000Hz, and the equivalent pulse output range is $\leq 100Hz$.
Communication interface	RS485 ; HART
Ingress protection	IP65
Main body material	Sstainless steel
Pressure loss	$\Delta P \leq 1.2 \rho_{\text{working condition}} V^2$ (ΔP unit is Pa, $\rho_{\text{working condition}}$ unit is kg/m ³ , V unit is m/s)
Calibration method	All flow meters should be calibrated in the way of lower reaches taking pressure before flow meters leave factory.
Display mode	Intelligent numeric alphabetic display type: twin-row numeric alphabetic LCD (instantaneous flow rate and totalizer) Intelligent dot matrix LCD: English 128*64 dot matrix LCD (instantaneous flow rate, totalizer, temperature and pressure under working condition, battery voltage or density under

working condition, instantaneous flow rate under working condition, send-out, time, menu modify records, power-off records, etc.)

2.2 LUGB-A pipeline-version vortex flow meter measurable flow range

Notes : when choose vortex flow meter that keep medium flow with dismountable sensor head or vortex flow meter with accuracy is $\pm 0.5\%$, the lower limit of flow range is 1.5 times of corresponding value from table 4~7, upper limit multiplied by 0.8

Table.3 LUGB-A vortex flow meter measurable liquid of different density corresponding with flow range under working condition

ITEM	500 kg/m³	600 kg/m³	700 kg/m³	800 kg/m³	900 kg/m³	1000 kg/m³	1200 kg/m³	1400 kg/m³	1600 kg/m³	1800 kg/m³	Qmax (m³/h)
	Different density of liquid matching its measurable lower imit flow Q-min (unit:m³/h)										
DN10	0.30	0.28	0.24	0.21	0.19	0.15	0.14	0.13	0.12	0.11	2.0
DN15	0.60	0.50	0.47	0.37	0.36	0.35	0.30	0.28	0.26	0.24	4.5
DN20	1.15	1.00	0.98	0.90	0.80	0.60	0.58	0.56	0.54	0.52	8.0
DN25	1.30	1.20	1.10	1.05	1.00	0.90	0.82	0.76	0.71	0.68	12
DN32	1.90	1.80	1.70	1.62	1.56	1.50	1.45	1.35	1.20	1.00	20
DN40	3.50	3.20	3.00	2.80	2.60	2.28	2.20	2.10	2.00	1.90	32
DN50	4.70	4.30	3.9	3.70	3.60	3.50	3.00	2.80	2.60	2.50	50
DN65	7.10	6.50	6.30	6.20	6.10	6.00	5.00	4.50	4.20	4.00	84
DN80	11	10	9.60	9.20	9.10	9.00	8.00	7.60	7.00	6.00	127
DN100	20	18	17	16	15	14	13	12	10	9.00	198
DN125	28	26	25	24	23	22	21	20	18	14	310
DN150	52	50	45	42	36	32	30	28	26	20	445
DN200	99	88	78	70	62	57	53	50	43	35	791
DN250	184	165	150	130	110	89	80	72	68	55	1237
DN300	250	220	200	180	160	128	120	110	98	77	1780
DN350	350	280	250	210	190	173	160	140	120	100	2450
DN400	450	400	360	300	260	226	200	180	160	140	3160
DN450	500	450	400	350	300	286	260	240	210	180	4000
DN500	600	530	480	420	380	355	330	300	260	220	4950

Table.4 LUGB-A Vortex flow meter measure gas of different density corresponding with flow range under standard condition

ITEM	0.50 kg/m³	0.80 kg/m³	1.20 kg/m³	2.40 kg/m³	3.60 kg/m³	4.80 kg/m³	6.00 kg/m³	7.20 kg/m³	8.40 kg/m³	9.60 kg/m³	12.0 kg/m³	20 kg/m³	Qmax (m³/h)
	Different gas density under standard condition, lower limit Q-min (unit: m³/h)												
DN10	2.8	2.0	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	16
DN15	4.8	3.5	3.2	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	38

2 Technical Parameters

DN20	8.2	6.6	5.0	4.8	4.7	4.5	4.3	4.0	3.9	3.8	3.7	3.0	67
DN25	10	9	7.9	7.6	7.2	6.9	6.6	6.2	5.9	5.4	5.0	4.5	100
DN32	26	18	14	13.2	12.8	12.2	12	11.7	11.2	10.9	10.1	9	170
DN40	38	25	20	19	18	17	16	15	14	13	12	10	300
DN50	48	40	31	29	28	26	23	22	21	20	18	12	500
DN65	80	66	53	45	44	42	40	38	35	30	26	18	780
DN80	130	100	80	76	70	66	62	58	50	46	38	28	1200
DN100	180	160	120	110	100	90	80	70	62	56	48	35	2000
DN125	280	250	190	170	156	145	135	120	100	90	76	55	2900
DN150	380	310	280	260	240	220	200	180	160	140	110	85	4100
DN200	800	600	500	480	430	400	380	360	330	300	270	200	7500
DN250	1000	880	790	730	680	620	590	520	480	420	400	300	12500
DN300	1300	1190	1140	1060	980	900	820	760	700	620	580	400	16500
DN350	1800	1600	1550	1400	1300	1200	1100	1000	900	820	720	600	22000
DN400	2200	2160	2000	1800	1650	1500	1400	1300	1200	1100	1000	700	30000
DN450	2700	2580	2500	2300	2100	1900	1700	1600	1500	1400	1200	800	37000
DN500	3500	3200	3100	2900	2600	2400	2200	2000	1800	1600	1300	1000	46000

Conversion formula of gas volume flow under working condition & volume flow under standard condition:

$$Q_W = Q_S \cdot P_S \cdot Z \cdot (273.15 + T_W) / [(P_W + P_L) \cdot (273.15 + T_S)] \text{---FORMULA 4}$$

Among formula :

Q_W --- volume flow under working condition (unit: m^3/h)

P_W --- gas pressure under working condition (unit: MPa)

T_W --- gas temperature under working condition (unit: $^{\circ}\text{C}$)

Z ----- gas relative compressibility $Z = Z_W/Z_S$ (zero dimension)

Q_S --- volume flow under standard condition (unit: m^3/h)

P_S --- Atm press under standard condition (take absolute pressure = 0.101325 MPa)

T_S --- temperature under standard condition (0°C or 20°C)

P_L -- local Atm press (unit: MPa)

Table.5 LUGB-A Vortex flow meter measure saturated steam of different density corresponding with flow range under working condition

MPa	0.10	0.20	0.30	0.40	0.50	0.60	0.80	0.90	1.00	1.20	1.60	2.00	kg/h
℃	120	134	144	152	159	165	175	180	184	192	204	215	
kg/m³	1.12	1.67	2.19	2.68	3.18	3.67	4.62	5.16	5.63	6.67	8.52	10.57	
mm	Range	Different steam density corresponding with its measurable flow range											
10	Qmin	1.55	2.28	2.99	3.68	4.46	5.10	6.48	7.27	7.82	9.11	11.8	14.6
	Qmax	15.5	22.9	30.0	36.9	44.6	51.0	64.8	72.8	78.2	91.1	119	146
15	Qmin	3.50	5.15	6.74	8.29	10.0	11.4	14.5	16.3	17.6	20.5	26.7	32.9
	Qmax	35.0	51.5	67.4	83.0	100	115	146	163	176	205	268	329

MPa	0.10	0.20	0.30	0.40	0.50	0.60	0.80	0.90	1.00	1.20	1.60	2.00
℃	120	134	144	152	159	165	175	180	184	192	204	215
kg/m ³	1.12	1.67	2.19	2.68	3.18	3.67	4.62	5.16	5.63	6.67	8.52	10.57
mm	Range	Different steam density corresponding with its measurable flow range										
20	Qmin	6.22	9.15	11.9	14.7	17.8	20.4	25.9	29.1	31.3	36.4	47.5
	Qmax	62.2	91.6	120	147	178	204	259	291	313	365	476
25	Qmin	9.71	14.3	18.6	23.0	27.9	31.8	40.5	45.4	48.9	56.9	74.3
	Qmax	97.1	143	187	230	279	318	405	454	489	569	743
32	Qmin	15.9	23.3	30.6	37.7	45.7	52.2	66.3	74.5	80.1	93.3	121
	Qmax	159	234	306	378	457	522	664	745	802	933	1218
40	Qmin	23	33	43	53	64	73	93	100	110	130	170
	Qmax	300	440	575	710	860	980	1250	1400	1500	1750	2280
50	Qmin	35	35	52	63	76	88	111	125	130	150	200
	Qmax	550	460	680	845	1020	1170	1480	1670	1800	2100	2730
65	Qmin	59	87	114	137	166	190	240	276	297	345	450
	Qmax	790	1160	1520	1835	2222	2540	3230	3620	3970	4620	6030
80	Qmin	89.5	131	172	212	257	290	370	410	450	520	680
	Qmax	1195	1760	2300	2800	3400	3900	4900	5580	6000	6999	9100
100	Qmin	0.14	0.20	0.27	0.33	0.40	0.46	0.58	0.65	0.70	0.82	1.00
	Qmax	1.87	2.75	3.60	4.43	5.36	6.12	7.78	8.73	9.40	11	14.3
125	Qmin	0.22	0.32	0.42	0.51	0.62	0.71	0.91	1.00	1.10	1.28	1.67
	Qmax	2.91	4.29	5.62	6.91	8.37	9.56	12	13.6	14.7	17	22.3
150	Qmin	0.32	0.46	0.60	0.74	0.90	1.03	1.31	1.47	1.58	1.84	2.40
	Qmax	4.20	6.18	8.09	9.96	12	13.8	17.5	19.6	21.1	24.6	32.1
200	Qmin	0.56	0.82	1.08	1.32	1.60	1.83	2.33	2.61	2.81	3.28	4.28
	Qmax	7.50	11	14.4	17.7	21.4	24.5	31.1	35	37.6	43.7	57.1
250	Qmin	0.87	1.28	1.68	2.0	2.51	2.87	3.64	4.09	4.40	5.10	6.69
	Qmax	11.6	17	22	27.6	33	38	48	54	58.7	68	89
300	Qmin	1.25	1.85	2.42	2.98	3.61	4.13	5.25	5.89	6.34	7.38	9.60
	Qmax	16.7	24.7	32	39	48	55	70	78	84	98	128
350	Qmin	1.71	2.52	3.30	4.06	4.92	5.62	7.15	8.02	8.60	10.0	13
	Qmax	22.8	33.6	44	54	65	74.9	95	106	115	133	174
400	Qmin	2.24	3.29	4.30	5.30	6.40	7.30	9.30	10.5	11.2	13.1	17
	Qmax	29	43.5	57	70	85	97	124	139	150	174	228
450	Qmin	2.83	4.17	5.45	6.72	8.13	9.29	11.8	13.2	14.2	16.6	21.6
	Qmax	37	56	72	89	108	123	157	176	190	221	289
500	Qmin	3.49	5.15	6.74	8.29	12.3	14	17.9	20.1	21.6	25.2	33
	Qmax	46	68	89.8	110	164	188	239	268	289	336	439

Table.6 Superheated steam (unit : kg/m³)

ITEM	130℃	140℃	150℃	160℃	170℃	180℃	190℃	210℃	220℃	250℃	300℃	360℃	420℃
0.10MP	1.10	1.07	1.04	1.02	0.99	0.97	0.95	0.91	0.89	0.83	0.76	0.69	0.63
0.15MP	1.38	1.34	1.34	1.28	1.24	1.21	1.19	1.13	1.11	1.04	0.95	0.86	0.78
0.26MP		1.96	1.90	1.85	1.81	1.76	1.72	1.64	1.61	1.51	1.37	1.24	1.13
0.30MP			2.12	2.067	2.01	1.96	1.92	1.83	1.79	1.68	1.53	1.38	1.26

2 Technical Parameters

0.36MP			2.46	2.39	2.33	2.27	2.21	2.11	2.06	1.94	1.76	1.59	1.45
0.40MP				2.61	2.54	2.47	2.41	2.30	2.25	2.11	1.91	1.73	1.57
0.50MP				3.16	3.07	2.99	2.91	2.77	2.71	2.54	2.30	2.07	1.89
0.60MP					3.61	3.51	3.42	3.25	3.18	2.97	2.69	2.42	2.21
0.70MP						4.05	3.94	3.74	3.65	3.41	3.09	2.78	2.53
0.80MP						4.59	4.46	4.23	4.13	3.85	3.48	3.13	2.84
0.90MP						5.15	4.99	4.73	4.61	4.30	3.88	3.48	3.16
1.00MP							5.54	5.23	5.09	4.75	4.28	3.84	3.48
1.15MP							6.37	6.00	5.84	5.43	4.88	4.37	3.97
1.50MP								7.87	7.64	7.05	6.30	5.63	5.10
1.65MP								8.70	8.43	7.76	6.92	6.17	5.59
1.80MP								9.55	9.24	8.48	7.55	6.72	6.08
2.00MP									10.36	9.47	8.39	7.45	6.74
2.20MP									11.51	10.47	9.24	8.20	7.40
2.50MP										12.02	10.55	9.32	8.39

Table.7 Several normal gas of density under standard condition (unit : kg/m³)

Tag	Air	Hydrogen	Oxygen	Nitrogen	Chlorine	Ammonia gas	Semi-watergas
Density	1.293	0.0889	1.43	1.251	3.214	0.77	0.836
Tag	Argon	Acetylene	Methane	Ethane	Propane	Butane	Coke-oven gas
Density	1.79	1.017	0.717	1.357	2.005	2.703	0.4849
Tag	Ethylene	Propylene	Natural gas	Coal gas	CO	CO ₂	
Density	1.264	1.914	0.828	0.802	1.25	1.977	

Notes: standard state is absolute pressure 0.101325MPa and temperature 0℃.

2.3 LUGBC vortex flow meter measurable flow range under working condition and its calculation.

Table.8 LUGBC vortex flow meter measure liquid of different density corresponding with flow range under working condition.

Gas	Density ρ (kg/ m3)	1.0	1.2	2.0	3.0	4.0	6.0	8.0	10	15	20	Vmax(m/s)
	Vmin(m/s)	5.5	5.2	5.0	4.8	4.6	4.2	4.0	3.8	3.6	3.5	55
Liquid	Density ρ (kg/m3)	500	600	700	800	900	1000	1200	1400	1600	1800	Vmax(m/s)

	Vmin(m/s)	0.96	0.8	0.70	0.66	0.62	0.60	0.56	0.52	0.50	0.45	6.0
--	-----------	------	-----	------	------	------	------	------	------	------	------	-----

Notes : table 9 that is accuracy $\pm 2.5\%$ of insertion-version vortex flow meter flow range. When accuracy is better than $\pm 2.5\%$, velocity of flow = lower limit of velocity multiplied by coefficient R(R=2-3), the upper limit multiplied by 0.8.

LUGBC vortex flow meter measurable medium flow range calculation under working condition.

Gas & liquid : min volume flow formula under working condition

$$Q_{\min}=3600 \cdot V_{\min} \cdot (\pi \cdot D^2 / 4) \text{ ----- Formula 5}$$

Gas & liquid : max volume flow formula under working condition

$$Q_{\max}=3600 \cdot V_{\max} \cdot (\pi \cdot D^2 / 4) \text{ ----- Formula 6}$$

Gas : min volume flow formula under standard condition

$$Q_{N\min}=Q_{\min} \cdot [(P_L+P_W) \cdot (273.15+T_s)] / [P_s \cdot Z \cdot (273.15+T_w)] \text{ ---- Formula 7}$$

Gas : max volume flow formula under standard condition

$$Q_{N\max}=Q_{\max} \cdot [(P_L+P_W) \cdot (273.15+T_s)] / [P_s \cdot Z \cdot (273.15+T_w)] \text{ ----- Formula 8}$$

Gas : density formula under working condition

$$\rho=\rho_n[(P_L+P_W) \cdot (273.15+T_s)] / [P_s \cdot Z \cdot (273.15+T_w)] \text{ ----- Formula 9}$$

Among (insertion-version vortex flow meter) :

$Q_{\min}$ -- min volume flow under working condition (unit : m^3/h)

$Q_{\max}$ -- max volume flow under working condition (unit : m^3/h)

$V_{\min}$ -- min velocity under working condition (unit : m/s refer to fig.7)

$V_{\max}$ -- max velocity under working condition (unit : m/s refer to fig.7)

D ----- nominal diameter of insertion-version vortex flow meter (unit : m)

π ----- circumference ratio 3.1415926535898

$Q_{N\min}$ - gas min volume flow under standard condition (unit : m^3/h)

$Q_{N\max}$ - gas max volume flow under standard condition (unit : m^3/h)

T_s --- temperature under standard condition, general is 0°C or 20°C . (unit: $^\circ\text{C}$)

T_w --- measurable gas temperature under working condition (unit: $^\circ\text{C}$)

P_s --- normal atmospheric pressure (=0.101325MPa)

P_w --- measurable gas pressure under working condition (unit : MPa)

Z ----- measurable fluid relative compressibility $Z=Z_w/Z_s$

ρ ----- gas density under working condition (unit : kg/m^3)

ρ_n ---- gas density under standard state (unit: kg/m^3 ; temp is 0°C or 20°C , absolute pressure is 0.101325MPa , among formula 9 the temperature is the same between

T_s and p_n corresponding temp. Several normal gas density under standard state see table 6)

P_L -- local atmospheric pressure (unit : MPa)

LUGBC vortex flow meter Numerical Methods of flow range matching steam measurement:

1. According to steam temperature and pressure refer to table 4 & table 5 then gain exact density " ρ " under working condition.
2. According to steam density " ρ " under working condition, refer to table 7 then gain max/min velocity of flow under working condition " V_{max}/V_{min} " .
3. According to pipe diameter of insertion-version vortex flow meter, through Formula 5 and Formula 6 calculate min volume under working condition or max volume.
4. The final density " ρ " under working condition $\times$ Q_{min} or Q_{max} = mass flow range .

2.4 LUGB vortex flow meter measurable liquid of different density corresponding with flow range under working condition

Table.9 LUGB vortex flow meter measurable liquid of different density corresponding with flow range under working condition

Item	500	600	700	800	900	1000	1200	1400	1600	1800	Qmax m ³ /h
mm	Qmin m3/h										
15	0.7	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	3.2
20	1.3	1.1	1.1	1.0	0.9	0.7	0.7	0.6	0.6	0.6	5.7
25	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.8	8.8
32	2.0	1.9	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.1	19
40	3.8	3.5	3.3	3.1	2.8	2.5	2.4	2.3	2.2	2.1	29
50	5.2	4.8	4.3	4.1	4.0	3.9	3.3	3.1	2.9	2.8	46
65	7.8	7.1	6.9	6.8	6.7	6.6	5.5	4.9	4.6	4.4	78
80	12.2	11.1	10.6	10.2	10.1	9.9	8.8	8.4	7.7	6.6	118
100	22	20	19	18	17	16	14	13	11	10	184
125	31	29	28	26	25	24	23	22	20	15	287
150	57	55	49	46	39	35	33	31	28	22	413

Item	500	600	700	800	900	1000	1200	1400	1600	1800	Qmax m ³ /h
mm	Qmin m ³ /h										
200	108	96	85	76	68	62	58	55	47	38	735
250	201	180	164	142	120	97	87	79	74	60	1148
300	273	240	219	197	175	140	131	120	107	84	1653

Table.10 LUGB Vortex flow meter measure gas of different density corresponding with flow range under working condition

Item	0.5	0.8	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	12	20	Qmax m ³ /h
mm	Qmin m ³ /h												
15	6.7	4.8	3.8	3.6	3.3	3.1	2.9	2.6	2.4	2.1	1.9	1.7	32
20	10.2	7.4	6.8	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.2	57
25	17.4	14.0	10.6	10.2	10.0	9.5	9.1	8.5	8.3	8.1	7.8	6.4	88
32	22.0	19.8	17.4	16.7	15.8	15.2	14.5	13.6	13.0	11.9	11.0	9.9	188
40	50	35	27	26	25	24	23	23	22	21	20	17	294
50	81	53	42	40	38	36	34	32	30	28	25	21	459
65	111	92	72	67	65	60	53	51	49	46	42	28	776
80	164	135	109	92	90	86	82	78	72	61	53	37	1176
100	276	212	170	161	148	140	131	123	106	97	81	59	1837
125	397	353	265	243	221	199	177	155	137	124	106	77	2870
150	562	502	382	341	313	291	271	241	201	181	153	110	4133
200	920	751	678	630	581	533	484	436	388	339	266	206	7348
250	1696	1272	1060	1017	911	848	805	763	699	636	572	424	11481
300	1932	1700	1526	1410	1314	1198	1140	1004	927	811	773	580	16532

Table.11 LUGB Vortex flow meter measure saturated steam of different density
corresponding with flow range under working condition

MPa	0.10	0.20	0.30	0.40	0.50	0.60	0.80	0.90	1.00	1.20	1.60	2.00	
℃	120	134	144	152	159	165	175	180	184	192	204	215	
kg/m3	1.12	1.67	2.19	2.68	3.18	3.67	4.62	5.16	5.63	6.67	8.52	10.57	
mm	Range	Different steam density corresponding with its measurable flow range											
15	Qmin	4.49	6.22	7.92	9.44	10.9	12.2	14.5	15.6	16.5	18.2	20.1	21.7
	Qmax	35.6	53.1	69.6	85.2	101	117	147	164	179	212	271	336
20	Qmin	7.74	10.8	13.3	15.8	18.4	21.0	25.6	28.1	30.2	34.6	41.4	48.4
	Qmax	63.3	94.4	124	151	180	207	261	292	318	377	482	597
25	Qmin	12.6	17.4	22.4	27.1	31.9	36.5	44.4	48.6	52.0	58.4	70.2	84.2
	Qmax	98.9	147	193	237	281	324	408	456	497	589	752	933
32	Qmin	20.0	28.6	36.8	44.2	51.3	57.9	70.5	77.2	82.8	93.5	110	122
	Qmax	211	314	412	504	598	690	869	971	1059	1255	1603	1988
40	Qmin	32.1	44.3	56.6	68.1	79.7	90.8	110	121	132	153	184	217
	Qmax	329	491	644	788	935	1079	1358	1517	1655	1960	2504	3107
50	Qmin	49.9	69.4	89.0	107	124	140	168	183	195	218	251	282
	Qmax	514	767	1006	1231	1460	1685	2122	2370	2585	3063	3913	4854
65	Qmin	84.9	117	149	178	208	236	281	299	311	346	412	469
	Qmax	869	1296	1700	2080	2468	2848	3586	4005	4369	5177	6612	8203
80	Qmin	128	171	208	246	289	330	400	437	468	531	602	614
	Qmax	1317	1963	2575	3151	3738	4315	5431	6066	6619	7841	10016	12426
100	Qmin	0.20	0.28	0.36	0.42	0.49	0.54	0.65	0.71	0.75	0.84	0.90	0.96
	Qmax	2.06	3.07	4.02	4.92	5.84	6.74	8.49	9.48	10.3	12.3	15.7	19.4
125	Qmin	0.32	0.43	0.54	0.64	0.73	0.81	0.93	0.99	1.03	1.10	1.15	1.23
	Qmax	3.21	4.79	6.29	7.69	9.13	10.5	13.3	14.8	16.2	19.1	24.5	30.3
150	Qmin	0.45	0.61	0.76	0.90	1.03	1.14	1.36	1.47	1.56	1.70	1.69	1.79
	Qmax	4.63	6.90	9.05	11.1	13.1	15.2	19.1	21.3	23.3	27.6	35.2	43.7
200	Qmin	0.78	1.10	1.40	1.66	1.90	2.12	2.50	2.67	2.81	3.05	3.26	3.27
	Qmax	8.23	12.3	16.1	19.7	23.4	27.0	33.9	37.9	41.4	49.0	62.6	77.7
250	Qmin	1.23	1.74	2.24	2.66	3.02	3.33	3.96	4.31	4.61	5.21	5.91	6.45
	Qmax	12.9	19.2	25.1	30.8	36.5	42.1	53.0	59.2	64.6	76.6	97.8	121
300	Qmin	1.75	2.47	3.13	3.72	4.28	4.80	5.61	6.09	6.52	7.10	7.80	8.41
	Qmax	18.5	27.6	36.2	44.3	52.6	60.7	76.4	85.3	93.1	110	141	175

3 Product Dimension

3.1 LUGB Vortex flow meter dimension

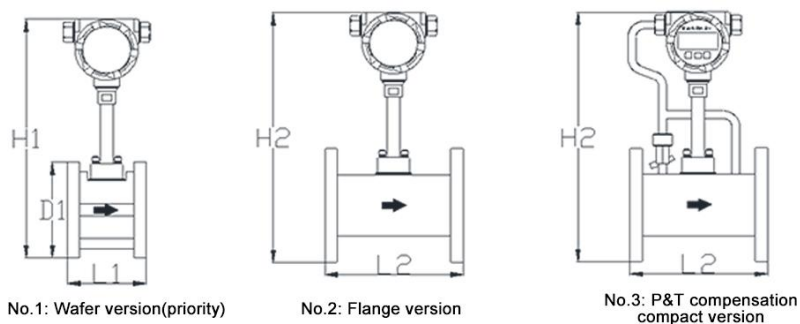


Fig.2 LUGB Vortex flow meter max configuration size

Table.12

Size DN	H1 ^a	H1 ^b	H1 ^c	D1	L1	H2 ^a	H2 ^b	H2 ^c	L2
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 three kinds of pillars a, b, c, different lengths, you can check the height of the entire table corresponding to the H mark on the table above.

150℃ sensor head without compensation vortex, use pillar c; 150℃ sensor head

with compensation vortex, use pillar b;
For 260°C sensor head vortex, use pillar b; for 300°C sensor head vortex, use pillar a.

3.2 LUGB-A/LUGBC Vortex flow meter dimension

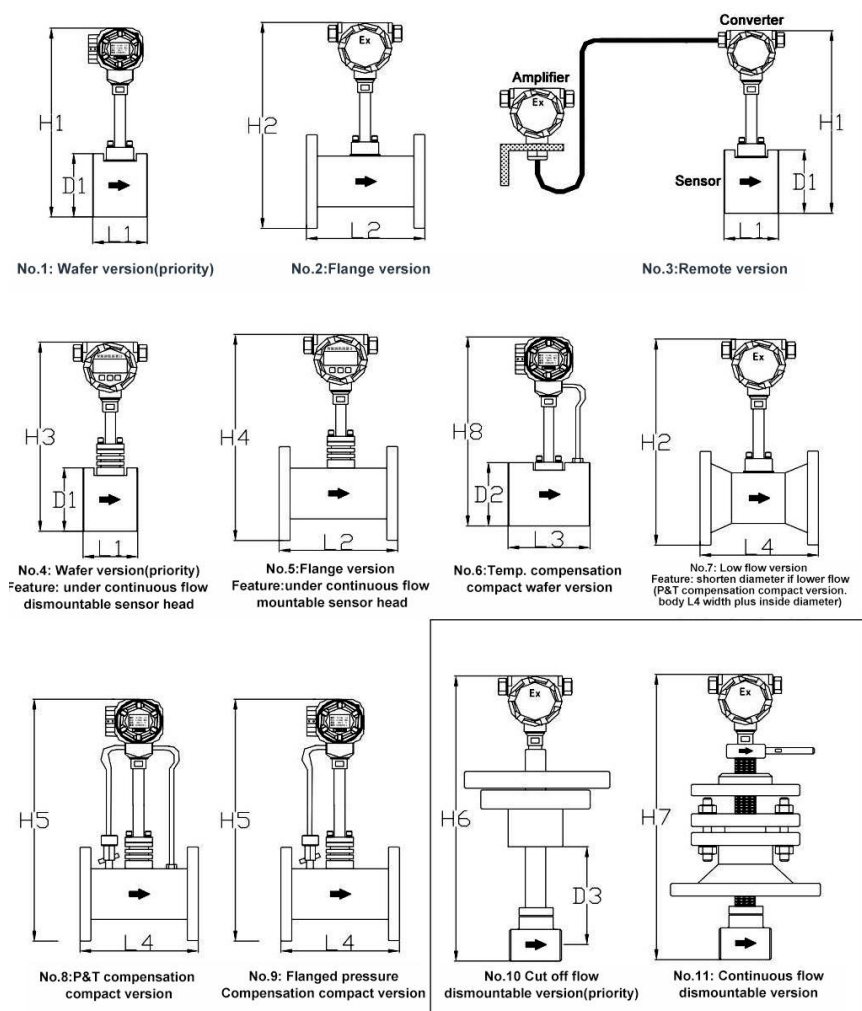


Fig.3 LUGB-A Vortex flow meter max configuration size fig. 3 (unit: mm)

Table.13 LUGB-A/LUGBC Vortex flow meter max configuration size (unit: mm)

DN	H1 ^a	H1 ^b	H1 ^c	H2 ^a	H2 ^b	H2 ^c	H3 ^a	H3 ^b	H3 ^c	H4 ^a	H4 ^b	H4 ^c	H5 ^b	H5 ^c
10		441		338	428	508								
15		445		340	430	510								
20		450		345	435	515								
25		451		350	440	520							468	548
32		456		362	452	532							481	561
40	345	435	515	378	468	548	400	490	570	428	518	598	518	598
50	348	438	518	390	480	560	407	497	577	441	531	611	531	611
65	363	453	533	412	502	582	418	508	588	458	548	628	548	628
80	386	476	556	425	515	595	442	532	612	473	563	643	563	643
100	409	499	579	444	534	614	466	556	636	494	584	664	584	664
125	430	520	600	474	564	644	483	573	653	522	612	692	612	692
150	455	545	625	503	593	673	508	598	678	554	644	724	644	724
200	505	595	675	557	647	727	558	648	728	605	695	775	695	775
250	555	645	725	610	700	780	608	698	778	658	748	828	748	828
300	605	695	775	660	750	830	658	748	828	708	798	878	798	878
350	655	745	825	715	805	885	708	798	878	763	853	933	853	933
400	705	795	875	771	861	941	758	848	928	818	908	988	908	988
450	855	845	925	820	910	990	808	898	978	868	958	1038	958	1038
500	805	895	975	875	965	1045	858	948	1028	921	1011	1091	1011	1091

Table.14 : (unit: mm)

DN	H6	H7	H8 ^b	H8 ^c	D1	D2	D3	L1	L2	L3	L4
10					90			54	200		
15					95			54	200		
20					100			54	200		
25			428		100	60		54	200		275
32			432		105	65		54	200		275
40			477	557	92	92		78	200	112	275
50			484	564	98	98		78	200	112	275
65			495	575	110	110		78	200	112	275
80			519	599	134	134		90	225	112	300
100			543	623	158	158		78	250	112	350
125			560	640	175	175		78	275	112	375
150			585	665	200	200		100	300	140	400
200	530	1150	635	715	250	250	100	120	350	160	450
250	530	1150	685	765	300	300	125	140	400	180	500
300	580	1200	735	815	350	350	150	160	450	200	550
350	580	1200	785	865	400	400	175	165	500	220	600
400	630	1250	835	915	450	450	200	185	550	240	650
450	630	1250	885	965	500	500	225	205	600	260	700
500	680	1300	935	1015	550	550	250	225	650	280	750

Note:

Note: This product has three kinds of pillars a, b, c, different lengths, you can check the height of the entire table corresponding to the H mark on the table above.

Clamp installation without compensation cut-off type (H1): 150 °C sensing head, height a; 260 °C sensor head, height b; 320 °C sensing head, height c;

Flange installation uncompensated cut-off type (H2): 150 °C sensing head, height a; 260 °C sensor head, height b; 320 °C sensing head, height c;

Clamp installation without compensation for continuous flow (H3): 150 °C sensing head, height a; 260 °C sensor head, height b; 320 °C and 420 °C sensing heads, height c;

Flange installation without compensation for continuous flow (H4): 150 °C sensing head, height a; 260 °C sensor head, height b; 320 °C and 420 °C sensing heads, height c;

Flange installation compensation type (H5):

Steam compensation type: height c;

Non steam compensation type: maximum medium temperature < 80 °C, height b;

Maximum medium temperature ≥ 80 °C, height c;

Side compensation type: 150 °C, 260 °C sensing head, height b; 320 °C and 420 °C sensing heads, height c;

Clamp installation temperature compensation type (H8):

Steam type: height c;

Non steam type: 150 °C, 260 °C sensing heads, height b; 320 °C and 420 °C sensing heads, height c.

4 Installation

- Installation Place and Environment Selection
 1. Try to avoid strong power equipment, high-frequency equipment and strong power switchgear.
 2. Try to avoid high-temp thermal source and source of radiant heating; outdoor installation should do some measures of sun-shading and rain shelter.
 3. Try to avoid shock places and corrosion environment; meanwhile, easy maintenance should be considered.

- Reasonable and correct installation position.
 1. Installation position should avoid strong shock pipeline, or take some measures of shock absorption.
 2. Horizontal, vertical and slanting installation. Liquid measuring ensure flow direction from low to high. Gas measuring, direction no required. When measuring vapor or high-temp gas, flow meter body pillar should be at an angle of 45 Deg with vertical direction.

- Grounding requirement.

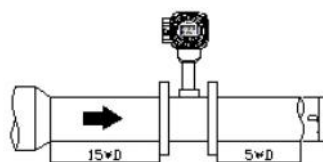
When pipelines without available grounding conditions, a ground-wire is essential between housing and earth.

- Required lengths of straight pipe

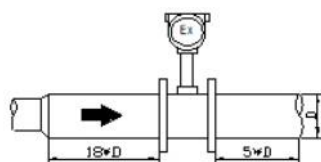
In order to correct measurement, upstream or downstream of flow meter should obligate enough straight length.

No components to effect fluid velocity in upstream of flow meter. All types of straight length installation reference:

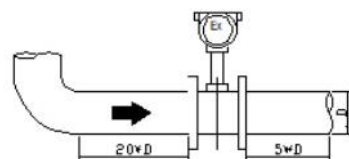
Vortex flow meter required lengths of straight pipe fig.3



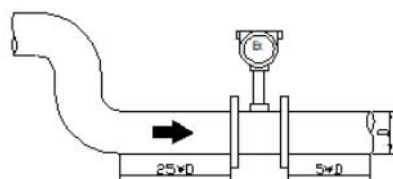
Swaged version



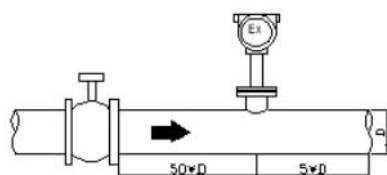
Enlarged diameter version



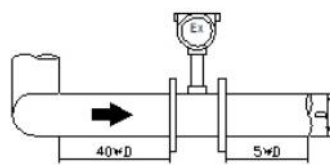
1*90° conduit elbow



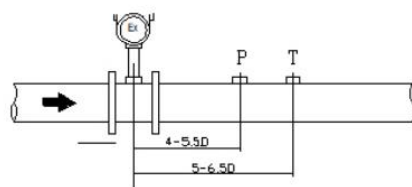
Isoplanar 2*90° conduit elbow



Shutoff valve



**Noncoplanar 2*90°
conduit elbow**



**Position of temperature sensor
and pressure sensor**

Installation and welding of flow meter

LUGB Vortex diameter is accordant to upstream and downstream tubing diameter at installation point; sensor is concentric with pipeline; prohibit gaskets between sensor and flanges bulge out into pipeline. Make sure that the connection end face of insertion-version vortex flow meter parallel to the pipe axis. Details as per fig.4.

After initial installation, when medium is steam or other high-temp medium, flanges & bolts should be re-tightened when medium full of pipeline. Do heat reservation measures for pipeline in order to protect amplifier. Fig.4

LUGB model

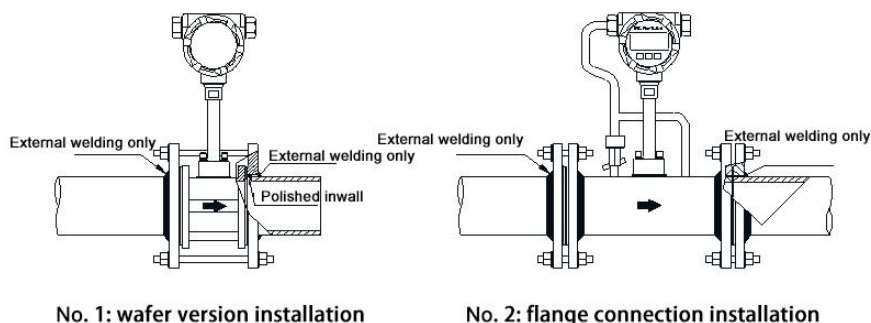


Fig.4

LUGB-A model

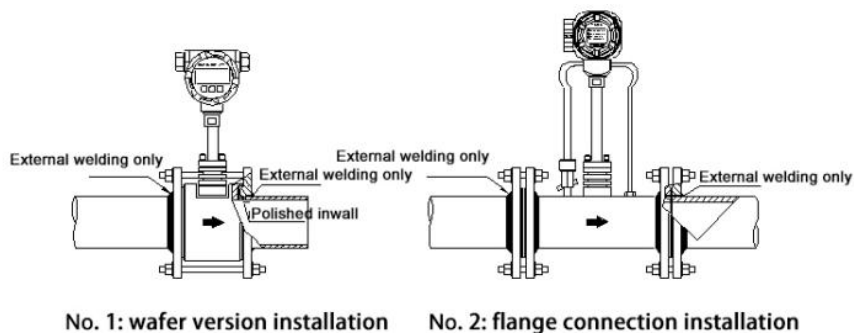


Fig.5

LUGBC model

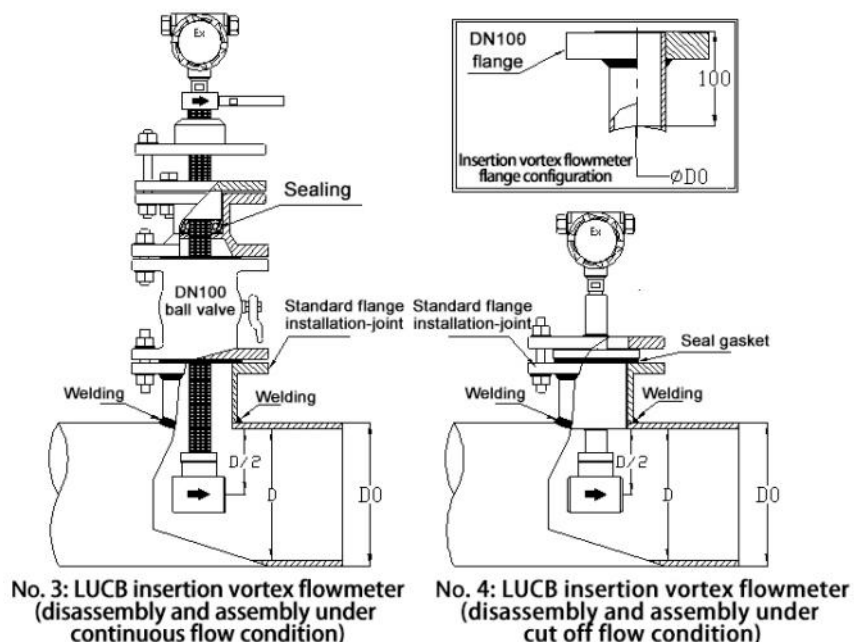


Fig.6

Be attention: concerning P/T compensation integrated vortex flow meter, to avoid high-temp or liner shock damage pressure transmitter, Pressure control valve must be closed before medium is full of pipeline. When medium full of pipeline meanwhile approaching working temperature and pressure, slowly turn on control valve. Pressure tapping and pressure detector should be done heat reservation if flow meter outdoor installation.

5 Wiring

The connecting wire should select AVPV2*0.5mm² two-core or AVPV3*0.5mm² three- core shielded cable produced by the regular manufacturer. When the cable is connected with the terminal, it is needed to be ensure that the connection is reliable. When the amplifier housing is not grounded, the measurement will not be stable and accurate.

Note: The external power supply of the intelligent amplifier must be 24VDC±5%

The wire circuit resistance is ≤50Ω current output; if the wire loop resistance does not meet this requirement, the cable length or the cable cross sectional area should be considered to reduce the wire loop resistance.

The connection terminals of various amplifiers of vortex flow meters are described as follows:

5.1 Non-display pulse output type (three-wire voltage pulse) wiring

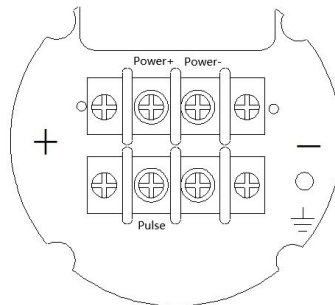


Fig.7

Table.15

Power+: power supply 24VDC+	Note: The Fo on the back circuit board is an internal pull-up resistor switch, which is short circuited by default at the factory and is an active pulse output. When 0C gate output is required, Fo needs to be disconnected. When the negative pole of the working power supply and the negative pole of the pulse output are not grounded together, they should be short-circuited.
Power-: power supply 24VDC-	
Pulse: pulse output	

5.2 Non-display current output type (2-wire 4-20mA) wiring

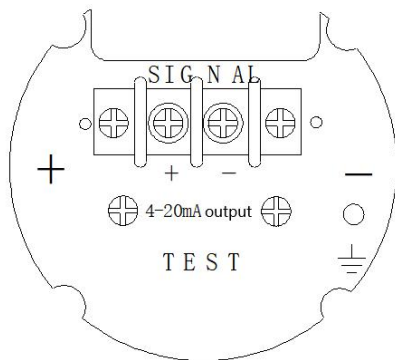


Fig.8

Table.16

Power+: power supply 24VDC +	Note: K5 on the back circuit board is a short-circuit plug between the negative pole of the power supply and the ground. The factory default is the short-circuit state. When the external signal receiving system has a separate "ground", K5 needs to be disconnected, otherwise it will cause inaccurate measurement.
Power-: 4-20mA output	

5.3 Local display pulse output type (3-wire ,pulse)

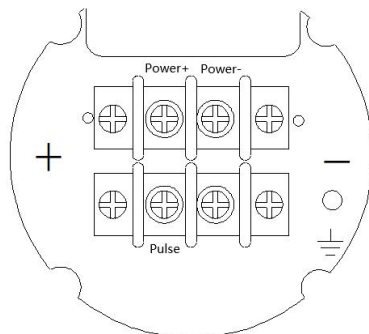


Fig.9

Table.17

Power+: power supply 24VDC+	Note: When the negative pole of the external power supply and negative pole of the pulse input do not share "ground", they should be short-circuited. This type of amplifier always requires battery power to work properly, so after the external power supply is turned on, you still need to turn the battery switch to the "ON" position to use it normally.
Power-: power supply 24VDC-	
Pulse: pulse output	

5.4 Local display current output type (2-wire , 4-20mA)

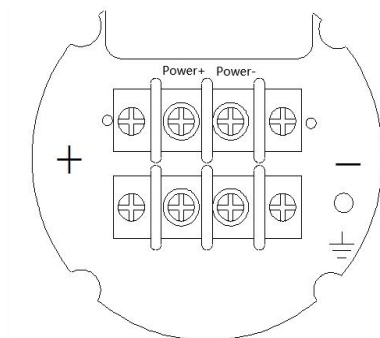


Fig.10

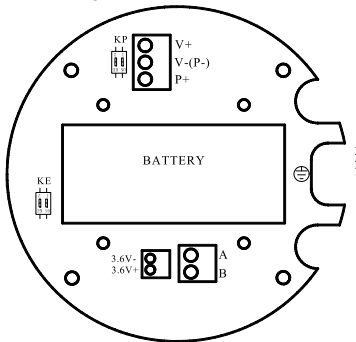
Table.18

Power+: power supply 24VDC+	Note: When the external signal receiving system has a separate "ground", the "pulse (secondary meter)" plug on the back circuit board needs to be disconnected, otherwise the measurement will be inaccurate. This type of amplifier always requires battery power to work properly, so after the external power supply is turned on, you still need to turn the battery switch to the "ON" position to use it normally.
Power-: 4-20mA output	

5.5 Intelligent display type

(1) Wiring schematic diagram:

X3-2 type:



E3-2 type:

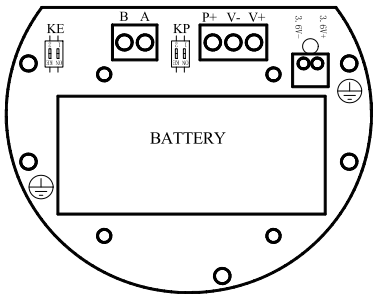


Fig.11

(2) Sampling schematic diagram:

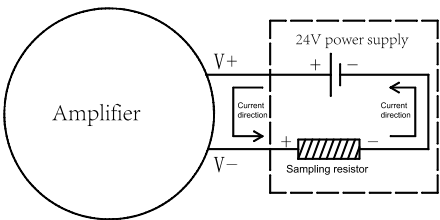


Fig.12 Negative sampling

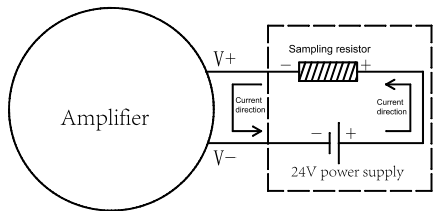


Fig.13 Positive sampling

Table.19 definition

Project	Terminal		Definition	
Pulse output	V+		Power supply 24VDC+	
	V-(P-)		power supply 24VDC-(Pulse input-)	
	P+		Pulse output +	
Current output	Negative sampling (first choice) Refer to Fig.12	V+	Power supply 24VDC+	Power supply 24VDC- and sampling current - short circuiting
		V-(P-)	Sampling (4~20) mA current +	
	Positive sampling Refer to Fig.13	V+	Sampling (4~20) mA current -	Power supply 24VDC+ and sampling current + short circuiting
		V-(P-)	Power supply 24VDC-	
Battery	3.6V+		3.6V battery +	
	3.6V-		3.6V battery -	
Communication	A		RS485 A	
	B		RS485 B	
Wwitch	KP		Switch to the 0N end for active pulse output, otherwise it is the 0C gate	
	KE		Turn the ground switch to the ON end to connect the working ground of the amplifier board to the outer shell	

6 Operation - Local display type

6.1 Display and Operation Unit

- **Button Description**

The function key Z, the number increase key ↑, and the shift key → work together to complete the task, but in the end, the Z key must be repeatedly pressed until "END" is displayed. Press Z to confirm before the setting changes can take effect.

- **Interface Description**

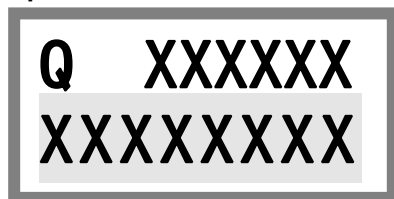


Fig.14 Display interface

The first line: Q represents the instantaneous flow rate, and its value is displayed as a six digit floating point number. Display range 0~999999.

The second line: displays the accumulated flow, which is displayed as an eight digit floating point decimal with a range of 0 ~ 99999999.

6.2 Setting

The vortex flowmeter completes various parameter settings before leaving the factory, and generally does not need to be reset after leaving the factory. Only when the instrument coefficient or range needs to be modified on site (referring only to the (4~20) mA output type), will parameter settings need to be reset.

- **Instrument coefficient K setting (unit: number of pulses/cubic meter)**

Pressing the function key Z first displays the following symbol:



Fig.15

Then the instrument coefficient K value is displayed as follows:



Fig.16

You can use the number increase key $\uparrow$, shift key $\rightarrow$ modify, and set the instrument coefficient to a maximum of six integers and two decimals. After confirming that the input is correct, press the function key Z to set the parameters. At this time, the flow unit is m^3/h . The instrument coefficient is set within the range of 0.00-999999.99.

Note: If you want the flow unit to be kg/h or t/h , the instrument coefficient should be calculated as follows:

Set coefficient $K' = \text{original instrument coefficient } K / \text{medium density } \rho$

- (1) When the unit of ρ is kg/m^3 , the unit of instantaneous and cumulative flow is kg/h .
 - (2) When the unit of ρ is t/m^3 , the unit of instantaneous and cumulative flow is t/h .
 - (3) After the instrument coefficient is changed, the cumulative flow rate will also change accordingly.
- **Small signal cutoff setting (unit corresponds to instantaneous flow rate)**

Press the function key Z twice to continuously display the following symbol:



Fig.17

Then display the small signal cut-off value:



Fig.18

You can use the number increase key $\uparrow$, shift key $\rightarrow$ to modify or set four digit integers and two digit decimal small signals to remove numerical values. After confirming that the input is correct, press the function key Z to set the parameters. The minimum resection value is 0.01.

- **(4~20) mA output corresponds to the upper limit setting of full-scale flow (unit is the same as the instantaneous flow unit)**

Press the function key Z three times to continuously display the following symbols:



Fig.19

Then display the maximum traffic limit value at full capacity:



Fig.20

You can use the number increase key $\uparrow$, shift key $\rightarrow$ to modify and set the maximum flow limit value to six integers and two decimals. After confirming that the input is correct, press the function key Z to set the parameters. When there is pulse output or no current output, this parameter can be omitted.

- **Sampling time setting**

Press the function key Z until the flashing display symbol is as follows:



Fig.21

Press the Z key, the $\uparrow$ key, and the $\rightarrow$ key simultaneously for 3 seconds before stopping. The LCD screen will display the following symbols in a loop:

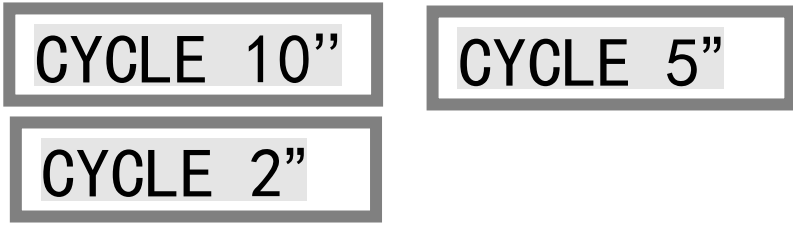


Fig.22

They represent sampling times of 10 seconds, 5 seconds, and 2 seconds, respectively. After selecting the appropriate sampling time, press the function key Z to confirm. The shorter the sampling time, the shorter the battery life. So in general, the maximum sampling time of 10 seconds should be selected.

- **Accumulated traffic reset setting**

Press the function key Z until the flashing display indicates the following:



Fig.23

Press key Z and key → for 5 seconds at the same time, then release them. The LCD screen will display the accumulated flow value as follows:



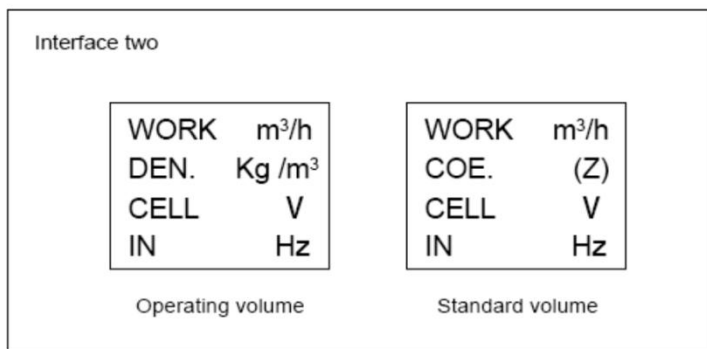
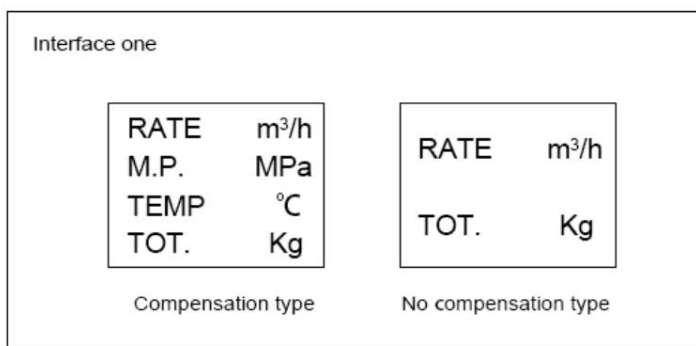
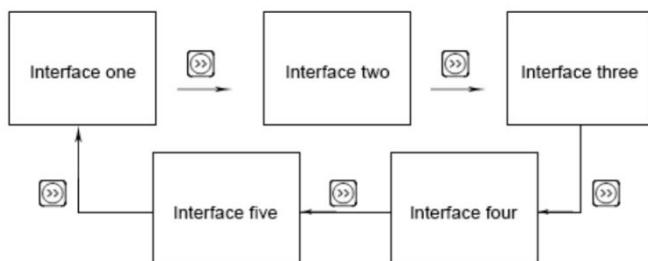
Fig.24

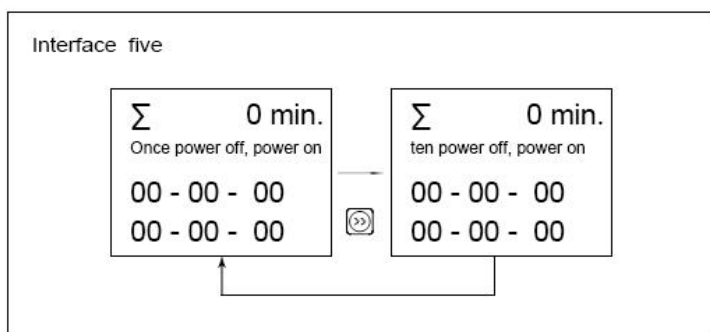
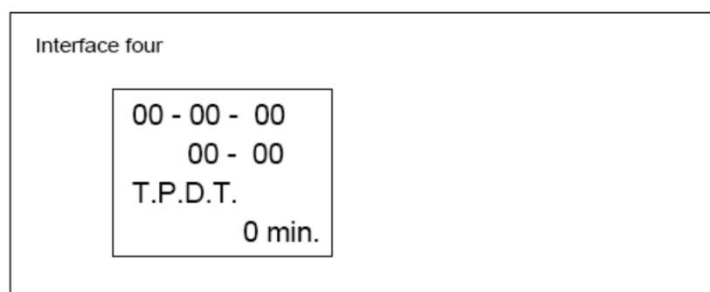
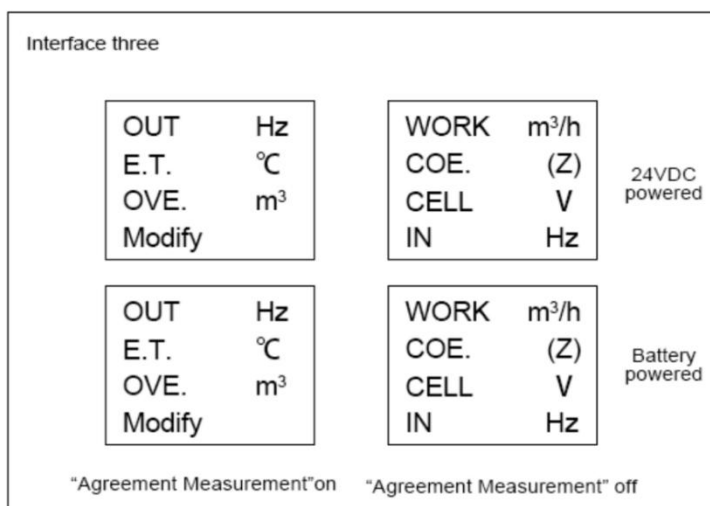
Press function key Z to confirm zeroing. If you don't want to reset, press the shift key → return

7 Operation - Intelligent display type

7.1 Main display

Connect the 24VDC power supply or turn on the battery switch to display the main interface, which is divided into 5 pages and can be switched by pressing the  key (K2).





Note: Interface display instructions (marked ◇ Unique features of the first edition of

digital filter type, annotations ☆ Unique features of the second edition of digital filter type, annotations ※ Unique features of battery powered type)

- Instantaneous / cumulative display range:
Instantaneous flow display range 0.0-999999999;
Cumulative flow display range 0.0-999999999 (battery powered type cumulative flow display range 0.0-999999999) ;
 - a) The "instantaneous" flow unit can be set through the menu, the "cumulative" flow unit the same as the instantaneous flow unit;
 - b) When the cumulative amount accumulates to 100000000 (accumulated to 1000000000 by battery-powered type), all will be cleared and re-accumulated;
 - c) When the flow unit is changed, the accumulated flow value still keeps the original value. At this time, please record the original accumulated amount, then reset it to zero, and re-accumulate.
- Temperature, pressure display range:
Temperature display range -50.0~+430.0℃ ;
Pressure display range -0.10—+20.0MPa;
 - A. In manual compensation mode, if the upper and lower limits of temperature and pressure are set to the same value, the "temperature" and "pressure" on the interface will display the set fixed values;
 - B. Automatic compensation mode:
 - a) In the "temperature and pressure compensation" mode, the temperature and pressure display values are actual measured values;
 - b) In "saturated steam temperature compensation" mode, the temperature is the actual measured value, and the pressure is calculated by the software;
 - c) In "saturated steam pressure compensation" mode, the pressure is the actual measured value, and the temperature is calculated by the software;

"Frequency", "Current": display the corresponding frequency or current output value according to the setting of "Output Type" in the menu:

- A. "Working condition pulse" mode: display the corresponding working condition pulse frequency value, display range: 0.0-9999.9Hz;
 - B. "Standard pulse" mode: display the corresponding standard pulse frequency value, display range: 0.0-9000.0Hz;
 - C. "Current" mode: display the current value corresponding to the upper and lower limits of the flow rate, display range: 4.00-20.80mA;
 - D. ※ "Current percentage" mode: display the flow percentage corresponding to the upper and lower limits of the output, display range: 0.00-105.00%;
- "Density": display range: 0.000-99999999kg/m³
 - A. When the "flow unit" is set to mass flow (ie kg/h, t/h, etc.), the "density" item in the second interface displays the density of the measured medium;
 - B. When the "flow unit" is set to volume flow (ie m³/h, km³/h, etc.), the "density" item is displayed as NULL (the first version of digital filter type is displayed as "-");
- "Amplifier temperature": The "amplifier temperature" item in the second interface displays the internal temperature of the amplifier housing, and the display range: -99.9-+99.9℃ ;
- "Input": The "input" item in the second interface displays the actual measured frequency value of the sensor, and the display range: 0.0-9999.9Hz;
- "Working condition": display instantaneous working condition volume flow, display range: 0.000-99999999m³/h;
 - "Coefficient": When the "flow unit" is set to the standard condition volume flow (ie Nm³/h, etc.), the medium working condition compression factor is displayed, and the display range: 0.000000-9.999999;
 - "Battery": Display battery voltage, display range 0.00-9.99V, when battery voltage is lower than 3.2V, display 
 - "Overrun": When the "protocol measurement" function is on, the cumulative flow exceeding the upper limit is displayed, display range: 0.000-999999999. The "overrun" flow unit is the same as the "cumulative" flow unit;
- Note: When the over-limit flow accumulates to 1000000000, all will be cleared and re-accumulated.

- "Menu modification": display the number of menu modification, display range 0-9999, when added to 10000, clear and re-record;
- System clock display: displays the current time, the total number of minutes of power down, and displays when the "system clock" is on;
- Incoming power outage record: can save the time of the last 10 outages; display when "system clock" is on;
Description of power failure time interface:
 - A. The first line: total power-off time, display range 0-999999999 minutes;
 - B. The second line: display the time sequence, "first power-off, power-on" is the last time, "second power-off, power-on" is the last time, and so on;
 - C. The third line: display the power outage time of this time;
 - D. The fourth line: display the incoming call time.
- Special display of the first version of digital filtering: if the value of all the displayed items is wrong or the value exceeds the limit, it will be displayed as "-8888888";
- Digital filter second edition, battery-powered special display instructions:
 - A. NULL ---- Do not display this data;
 - B. ERROR ---- The data is wrong. At this time, please check the menu settings;

7.2 Key

The setting of parameters and debugging information is completed through the cooperation of 4 buttons on the display panel.

- a)  (K1) : Enter the setting state and confirm the setting value;
- b)  (K2) : Cycle the cursor position to the next digit;
- c)  (K3) : add 1 to the value of the cursor or select the function;
- d)  (K4) : Return to the previous menu item.

7.3 Menu

In the main interface state, press the  (K1) key to enter the main menu.

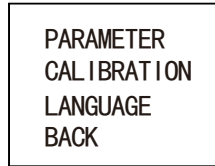


Fig.25 Main menu

Press the  (K2) key to cycle through various menus, and press the  (K1) key to enter.

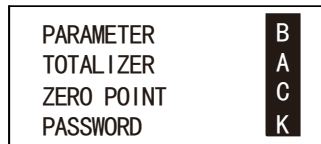


Fig.26 Parameter setting interface

Press the  (K1) key to enter the password verification interface. After entering the correct password, you can set various parameters.

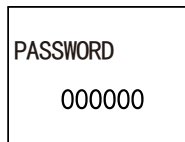


Fig.27 Password verification interface

Note: If there are no buttons in the main menu for 16 seconds and no buttons in the final menu for 30 seconds, the system will automatically exit the "Settings" state. At this time, the set parameter values are invalid and must be stored and exited before the set parameter values can take ef

7.4 Parameter Setting

Parameter modification menu initial password: **000000**, set directory as shown in the table below.

Table.20 Parameter setting menu

Menu name	Menu contents	Description
Load default	Yes, No	Select "yes" and press the setting button. LED displays

Menu name	Menu contents	Description
		“please waiting”. Next, it will show “recovery is completed”. Select “no” and enter the lower menu. It is defaulted as “no”.
Application	Liquid , Gas, Gas+s+P Heat Steam+P+T, Sat.Steam+T,Sat.Steam+P Water+P+T, Oil+P+T Natural Gas+P+T Mixed Gas+P+T	
Size	0000-9999mm	
Factor unit	1/m ³ , 1/L	
Flow curve	Average instrument factor	
	Linear	
	Linear correction factor	Frequency I
		Frequency I
		Frequency II
		Frequency II
		
		Frequency X
		Frequency X
Flow unit	m ³ /h, km ³ /h, L/min, kg/h, t/h, kg/min, (Nm ³ /h, Nkm ³ /h, NI/min, Nm ³ /min, Nkm ³ /min)	m ³ /h, km ³ /h, l/min is Volume flow unit for working conditions; kg/h, t/h, kg/min is Mass flow unit; Nm ³ /h, Nkm ³ /h, NI/min, Nm ³ /min, Nkm ³ /min are Volume unit of flow for gas gauge.
Output	4-20mA (2-wire) Current percent Unscale pulse COMP.pulse	

Menu name	Menu contents	Description
Equivalent factor	0.000000 ~ 99999999	The equivalent factor is only meaningful when the “equivalent pulse” is output. Unit: cumulative value/pulse; An appropriate equivalent factor should be selected according to the flow, and the output frequency should generally be not greater than 100Hz.
Max. output	0.000000 ~ 99999999	The Max. and Min. output is only meaningful when the output form is “two-wire current” and “current percentage”.
Min. output	0.000000 ~ 99999999	
Damping factor	01-10	“The default value of “damping factor” is 01 The timing setting of vortex flowmeter is valid.
Critical pressure	0.000000MPa~99999999 MPa	Parameter setting of “temperature and pressure compensation of gas”. The
Critical temperature	0.000000K-99999999K	

Menu name	Menu contents	Description
Compressibility factor	0.000000~99999999	values of “critical pressure” and “critical temperature” should be set according to the gas type; When the “critical pressure” and “critical temperature” are both set to 0, in order to set a fixed compressibility factor, the “compressibility factor” is valid at this time.
Temperature I	-9999℃~99999℃	“Parameter setting of “sectional compensation of liquid temperature”. See 7.7 for the setting method.
Density I	0.000000kg/m ³ ~99999999 kg/m ³	
Temperature II	-9999℃~99999℃	
Density II	0.000000kg/m ³ ~99999999 kg/m ³	
.....		
Temperature X	-9999℃~99999℃	
Density X	0.000000kg/m ³ ~99999999 kg/m ³	Parameter setting of “temperature and pressure compensation of natural gas”.
CO ₂ mole fraction	0.000000-99999999	
H ₂ mole fraction	0.000000-99999999	
Relative density	0.000000-99999999	

Menu name	Menu contents	Description
Higher calorific value	0.000000MJ/m ³ ~9999999 9MJ/m ³	The default value of “CO ₂ mole fraction” is 0.006; The default value of “H ₂ mole fraction” is 0; The default value of “relative density” is 0.6; The default value of “higher calorific value” is 40.66MJ/m ³ .
Max. temperature	-50℃~430℃	When the temperature signal needs to be received, the Max. temperature must be set to 430℃ and the Min. temperature set to 0℃. When the Max. and Min. temperatures are equal, a fixed temperature is set.
Min. temperature	-50℃~430℃	
Pressure type	Gauge pressure, absolute pressure	
Max. gauge (absolute) pressure	-0.1MPa~20MPa	When the pressure signal needs to be received, the Max. pressure must be set according to the factory settings, and the Min. pressure must be 0. When the Max. and Min. pressures are equal, a fixed pressure is set.
Min. gauge (absolute) pressure	-0.1MPa~+20MPa	
Local atmospheric pressure	0.000000MPa~99999999 MPa	The default value of “local atmospheric pressure” is 0.101325MPa.
Temperature under	00℃~99℃	“The default value of

Menu name	Menu contents	Description
standard condition		"temperature under standard condition" is 20°C.
Medium density	0.000000kg/m ³ ~99999999 kg/m ³	Non-compensation mode: medium density under working condition is set; Temperature and pressure compensation of gas: the density at 0.101325 MPa and temperature under standard condition is set; Temperature and pressure compensation of petroleum: the density of petroleum at absolute pressure of 0.101325 MPa and temperature of 20°C is set.
Flow cutoff unit	Hz, flow unit	
Cutoff data	0.000000-99999999	
Date	No, yes	
Time	MM/DD/YY 00:00	When the system clock is set to "no", it is not displayed
Communication	No 485	
Communication bit number	001~255	The default value of "Communication bit number" is 001.
Baud rate	9600、4800、2400、1200	The default value of "Baud rate" is 9600.
Parity check	None Odd parity check Even parity check	The default value of "Parity check" is "None".
Stop bit	1st bit, 2nd bit	The default value of "Stop bit" is "1st bit"
Contrast	1~5	The display gradually

Menu name	Menu contents	Description
		deepens, default : 3
Backlight mode	Auto, Off, On,	
Save	Yes, no	Press  for 2-3 seconds to exit from "parameter setting" menu. Select "yes" and the screen will display "success in parameter storage" and return to main menu.

Note:

1. The table lists all the menu items in the software, which are not all displayed in general; Depending on the function and settings, certain menu items are blocked;
2. When you enter the menu, you may find that a value is different from the original setting. It is normal that LED display has not been refreshed. Press K2 button to recover to normal.

7.5 Totality zero

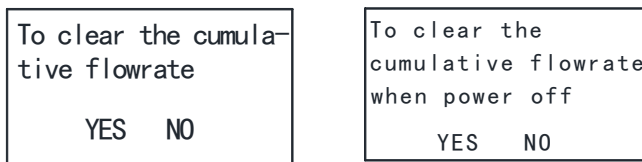


Fig.28

The "Accumulated Zero" menu can clear accumulated traffic and power outage records.

7.6 Zero point settings

Parameter modification menu initial password: **000000**, set directory as shown in the table below.

Table.21 Zero settings

Menu name	Menu contents	Description
Trigger sensitivity	0~7	Please refer to the zero point setting method for usage introduction.
Filter settings	NO, Yes	Select "Yes" to enable anti-interference mode.

Menu name	Menu contents	Description
Parameter storage	NO, Yes	Press  for 2-3 seconds, Exit the zero point setting menu Select "Yes" and the screen will display "Parameter Storage Successful".

Note: When the anti-interference mode is turned on, the response time for the flow display from zero to zero and from zero to zero is slightly longer.

Zeroing method:

(1) Manual zeroing: Enter the menu, modify the zeroing value according to the value of "Input frequency" (the larger the value, the less the sensitivity), and then save it

Input frequency Hz
 50.000
 Trigger sensitivity
 3

Fig.29

(2) Automatic zeroing: In the main interface, long pressure the  button till the ZERO indicator lamp comes on to enter the automatic zeroing state. When the indicator lamp flashes and goes out, the zeroing ends.

Note: When verifying zero point, ensure that the pipeline flowrate is zero.

8 Setting Of Signal Output

1. Digital filter first version signal output setting method
 - 1) Working condition pulse or communication: DIP switch 3 is turned on, and the rest are closed; the software selects "working condition pulse";
 - 2) Standard condition pulse: DIP switch 3 is turned on, and the rest are closed; the software selects "standard condition pulse";
 - 3) Two-wire 4-20mA current: DIP switches 1, 2 are on, the rest are off; the software selects "current";

2. Digital filter second edition signal output setting method
 - 1) Two-wire current: DIP switches 1, 2 are on, and the rest are off; the software selects "two-wire current";
 - 2) Three-wire current: DIP switches 1, 2, and 8 are off, and the rest are on; the software selects "three-wire current";
 - 3) Pulse output: DIP switches 1, 2, 8 are closed, and the rest are open; the software selects the corresponding pulse output form;
 - 4) RS485 communication: DIP switches 1, 2 are closed, and the rest are open; the software selects "485" (in the case of 485 communication, "two-wire current" cannot be selected);

3. Setting method of battery-powered signal output (the DIP switch is located on the motherboard)
 - 1) Working condition frequency: the menu selects "working condition frequency"; DIP switches 1, 3, 4 are on, the rest are off, J1 'F0' sign
 - 2) Short-circuit the terminal; when the OC gate is output, the J1 'OC' terminal is short-circuited;
 - 3) Equivalent pulse: the menu selects "equivalent pulse"; DIP switches 1, 3, 4 are turned on, the rest are closed, and J1 'F0' sign
 - 4) Short-circuit the terminal; when the OC gate is output, the J1 'OC' terminal is short-circuited;
 - 5) Two-wire current: the menu selects "two-wire current" or "current percentage"; DIP switch 4 is turned on, and the rest are turned off;
 - 6) Communication output: select "485" in the menu "Communication Type";

the DIP switches 2, 3, 4 are on, and the rest are off;

- 7) Simultaneous output of communication and frequency: the menu is set correspondingly as described above; DIP switches 1, 2, 3, and 4 are opened, and the J1 'F0' terminal is short-circuited; when the OC gate is output, the J1 'OC' terminal is short-circuited.

9 Troubleshooting

No	Malfunctions	Cause	Troubleshooting
1	No signal output	1. There is no medium flow in the pipeline or the flow rate is lower than the lower limit flow rate; 2. The power supply and output cable are not connected correctly; 3. The device is damaged;	1. Increase the flow rate of the medium or use a small diameter flow meter; 2. Correct wiring; 3. Check or replace the flow meter.
2	With signal output when there is no flow	1. The flow meter is not grounded or other interference; 2. The amplifier sensitivity is too high or self-excited; 3. The power supply is unstable;	1. Connect the ground wire correctly to eliminate interference; 2. Adjust or replace the amplifier; 3. Repair and replace the power supply to eliminate interference.
3	Instantaneous flow rate display is unstable	1. Medium flow is unstable; 2. There is debris in the pipeline; 3. The sensitivity of the amplifier is too high or too low; 4. Not grounded; 5. The flow rate is lower than the lower limit; 6. The sealing ring extends into the pipeline, forming a disturbance.	1. Test again after the flow is stable; 2. Eliminate debris; 3. Adjust or replace the amplifier; 4. Check the grounding circuit 5. Increase flow; 6. Change according to installation requirements.

10 Communication

The instrument is provided with standard RS485 series communication interface, in accordance with international universal standard MODBUS-RTU communication protocol.

Start bit: 1 bit	Data bit: 8 bits	Parity check bit: setting
Stop bit: setting	Baud rate: setting	Collection interval: $\geq 1s$

Table.22 Register Address

Register Address	Name	Data length (word)	Data type	Definition
0000H	Instantaneous flow	2	float	
0002H	Cumulative flow v	2	float	
0004H	Working condition temperature	2	float	No compensation model; , 0.000
0006H	Working condition pressure	2	float	
0008H	Operating volume flow rate	2	float	
000AH	Working condition density;	2	float	
000CH	Coefficient of compressibility	2	float	Nonstandard unit of volume, 0.0000
000EH	Input frequency	2	float	
0010H	Working	2	float	

Register Address	Name	Data length (word)	Data type	Definition
	frequency output			Not output, 0.000
0012H	Equivalent pulse output	2	float	
0014H	Current output	2	float	
0016H	Current percentage	2	float	
0018H	Gauge temperature	2	float	
001AH	Transfinite cumulative flow	2	float	when the protocol metering is off, it is 0.0000
001CH	Total power loss time	2	float	when the system clock is off, it is 0.0000
001EH	Menu modification times	2	float	
0020H	Battery voltage	2	float	
0030H	Accumulated traffic (integer part)	2	long int	
0032H	Accumulated traffic (integer part)	2	float	
0034H	Overlimit cumulative traffic (integer part)	2	long int	
0036H	Exceeding limit cumulative flow (decimal part)	2	float	

Special transmission data(Digital Filter type(Second Edition) and battery-powered type only)Transmission data when liquid crystal displays the following information::

- 1) NULL: Transmit data is 0;
- 2) ERROR: Transmit data is -1234;
- 3) OVERRUN: Transmit data is-8888;

11 Warranty & After-sales Service

We promise to the customer that the hardware accessories provided during the supply of the instrument have no defects in material and manufacturing process.

From the date of the purchase, if the user's notice of such defects is received during the warranty period, the company will unconditionally maintain or replace the defective products without charge, and all non customized products are guaranteed to be returned and replaced within 7 days.

Disclaimers:

- During the warranty period, product faults caused by the following reasons are not in the scope of Three Guarantees service
- Product faults caused by improper use by customers.
- Product faults caused by disassembling, repairing and refitting the product.

After-sales service commitment:

- We promise to deal with the customer's technical questions within 2 hours.
- For the instruments returned to the factory for maintenance, we promise to issue the test results within 3 working days and the maintenance results within 7 working days after receiving them.