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Handbook

ABDT-DYWQ Gas Turbine Flowmeter

Weifang AOBO Instrument Technology Development Co.,Ltd

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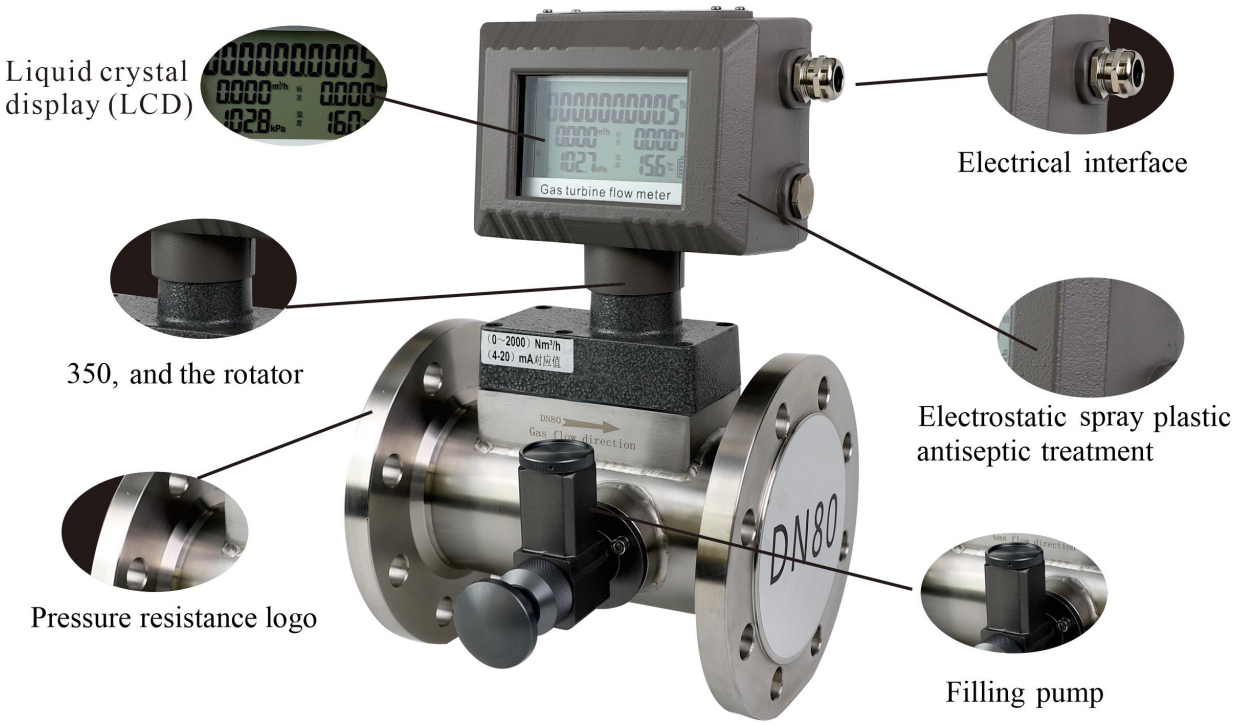


【Section 1】

Installation and Maintenance Instructions of Gas Turbine Flowmeter

I. Product Overview

ABDT-DYWQ series gas turbine flowmeter is a new generation of high-precision and high-reliability gas precision measuring instrument, which is based on the advanced technology of flow meters at home and abroad and has been optimized and designed. It integrates the theories of gas mechanics, fluid mechanics, electromagnetism, etc. and integrates temperature, pressure, flow sensors and intelligent flow totalizer. It has excellent low-pressure and high-pressure metering performance, various signal output modes and low sensitivity to fluid disturbance, and is widely suitable for metering natural gas, coal-based gas, liquefied gas and other gases.

The product has passed the inspection by the national explosion-proof product quality inspection department according to GB3836.2000 Electrical Apparatus for Explosive Gas Atmospheres--Part 1: General Requirements, GB3836.2-2000 Electrical Apparatus for Explosive Gas Atmospheres-- Part 2: Flameproof Enclosure “d” and GB3836.4-2000 Electrical Apparatus for Explosive Gas Atmospheres--Part 4: Intrinsic Safety “i”. The anti-explosion signs are Exd Ⅱ BT6 (flameproof enclosure) and Exia Ⅱ CT6 (Intrinsic safety). It is suitable for hazardous sites in Zone 0, Zone 1 and Zone 2 (only intrinsic safety) containing explosive gas mixtures of T1~T4 temperature groups in Class IIA, IIB and IIC.

II. Product Features

- High quality alloy turbine with higher flow stability and corrosion resistance.
- Imported high-quality special bearings with long service life.
- The metering room is isolated from the ventilation room, thus ensuring the safety of the instrument.
- It can detect the temperature, pressure and flow rate of the measured gas, automatically track and compensate the flow rate, and display the gas volume accumulation under the standard state (P_b= 101.325 KPa, T_b=293. 15 K); The temperature and pressure values can be queried in real time.
- Wide flow range (Q_{max} /Q_{min} ⩾20:1), good repeatability, high accuracy (up to grade 1.0), small pressure loss, low initial flow, up to 0.6 m^3/h.
- Multi-point nonlinear correction of intelligent instrument coefficient.
- Built-in pressure and temperature sensor, with high safety performance, compact structure and beautiful appearance.
- The instrument has explosion-proof and protection functions. The explosion-proof marks are Exd Ⅱ BT6 and Exia Ⅱ CT6, and the protection grade is IP65
- The system operates with low power consumption, and a 3.6 V10AH lithium battery can be continuously used for more than one year.
- Instrument coefficient and cumulative flow value will not be lost after power failure for ten years.

III.Technical Indicators

1. Measuring range

Table 1

Nominal diameter (mm)	Standard range(m^3/h)		Conventional withstand voltage rating(MPa)	Special high pressure rating(MPa)	Installation method
DN25	S	5-50	1.6	2.2,4.0	Flange
DN40	S	6-60	1.6	2.2,4.0	Flange
DN50	S1	6-65	1.6	2.2,4.0	Flange
	S2	10- 100			
DN65	S	15-300	1.6	2.2,4.0	Flange
DN80	S1	13-250	1.6	2.2,4.0	Flange
	S2	20-400			Flange
DN100	S1	20-400	1.6	2.5	Flange
	S2	32-650			Flange
DN150	S1	50- 1000	1.6	2.5	Flange
	S2	80- 1600			Flange
DN200	S1	80- 1600	1.6	-	Flange
	S2	125-2500			Flange
DN250	S1	130-2500	1.6	-	Flange
	S2	200-4000			Flange
DN300	S	320-6500	1.6	-	Flange
			1.6		
DN400	S	400-8000	1.6	-	Flange

2. Accuracy grade: 1.0 and 1.5

3. Conditions of use:

Ambient temperature: -20℃~+60℃;

Atmospheric pressure: 86KPa～106KPa;

Medium temperature: -20℃~+80℃;

Relative humidity: 5%～95%

4. Electrical performance index:

Table 2

Model and specification	Display and output mode	Power supply
ABDT-DYWQ-D	Temperature and pressure sensors are installed in ABDT-DYWQ-B (field display type) to automatically compensate and correct the flow under different conditions. The temperature, pressure, battery power and other values can be queried at the same time. It can output high-frequency and low-frequency voltage pulse signals and 4-20mADC two-wire current signals.	a.3.6V10AH lithium battery b.external power DC24V

5. Model table:

Table 3

Specification code		Description
Sign of the factory	ABDT-DYWQ	Factory code
	D	Common type
	F	Precision Type
Media	B	Natural gas
	F	Other
Converter	1	Round header
	2	Square header
Diameter code	2	Diameter 25mm
	4	Diameter 40mm
	5	Diameter 50mm
	6	Diameter 65mm
	8	Diameter 80mm
	10	Diameter 100mm
	15	Diameter 150mm
	20	Diameter 200mm
	25	Diameter 250mm
	30	Diameter 300mm
Table body material	F	Stainless steel 304
	C	Aluminum alloy
Output signal form	A	4-20mA output
	0	Pulse output
Communication interface	1	None
	2	RS485

	3	Special requirements
Working pressure	1	Within 1.0MPA
	2	Within 1.6PMA
	3	Within 2.5MPA
	4	Within 4.0MPA
	5	Above 4.0MPA

6. Outline Dimensions

The appearance of the flowmeter is shown in Figure 1, and the specific dimensions are shown in Table 4.

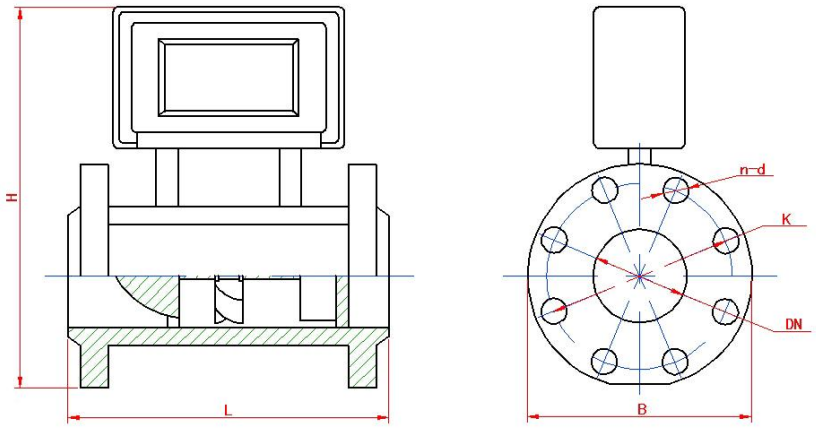


Figure 1

Note: Figure 1 shows the appearance of temperature and pressure compensation instrument.

The sensor parts of all types of instruments with the same caliber and the height dimensions of the whole machine are consistent.

Table 4

Model	Diameter (mm)	L	B	H	K	n	d	Bolt specifications	Conventional withstand voltage(MPa)
ABDT-DYWQ-25	25	200	115	335	85	4	Φ14	M12×50	1.6
ABDT-DYWQ-40	40	200	150	365	110	4	Φ18	M16×55	
ABDT-DYWQ-50	50	200	165	365	125	4	Φ18	M16×60	
ABDT-DYWQ-65	65	240	185	395	145	4	Φ18	M16×65	1.6
ABDT-DYWQ-80	80	240	200	395	160	8	Φ18	M16×70	
ABDT-DYWQ-100	100	300	220	415	180	8	Φ18	M16×80	
ABDT-DYWQ-150	150	450	285	495	240	8	Φ22	M20×80	1.6
ABDT-DYWQ-200	200	600	340	528	295	12	Φ22	M20×90	

ABDT-DYWQ-250	250	300	403	585	355	12	Φ26	M24×90
ABDT-DYWQ-300	300	350	460	668	410	12	Φ26	M24×100
ABDT-DYWQ-400	400	600	580	1000	525	16	Φ30	M27×150

IV. Selection of Flowmeter

1. When selecting the type, the user should reasonably select the type and specification of the flowmeter according to the nominal pressure of the pipeline, the highest pressure of the medium, the temperature of the medium, the composition of the medium, the flow range and the signal output requirements.

2. In order to optimize the service performance of the flowmeter, the flow rate range of the flowmeter should be within (20%~80%) Q_{max}.

3. The signal output mode of flowmeter when leaving the factory: working condition pulse signal output (three-wire system), standard flow signal (IC card) output or RS-485 communication output. If other output functions are required, please explain them when ordering.

4. Examples of type selection

It is known that the actual working pressure of a certain gas supply pipeline is (gauge pressure) 0.8 MPa~ 1.2 MPa, the medium temperature range is -5 ℃ ~ +40 ℃ , and the gas supply volume is 3000~8000Nm^3/h (standard flow rate). Without considering the natural gas composition, it is required to determine the specification and model of the flowmeter.

Analysis: The flow range given in Table 1 of the instruction is the working condition flow range, while the flow range given in this example is the standard condition flow range. Therefore, the standard condition flow must be converted into the working condition flow according to the gaseous equation before selecting the appropriate caliber.

The gaseous equation is as follows:

$$Q_b = Q \cdot \frac{P \cdot T_b}{P_b \cdot T} \cdot \frac{Z_b}{Z_g} = Q \cdot C \cdot F_z^2$$

Where: Q_b —— standard condition flow,m^3/h;

Q —— working condition flow,m^3/h;

C_* —— conversion factor;(Look up Table a. The data in the table are only for reference during selection and conversion)

$F_z = \sqrt{\frac{Z_b}{Z_g}}$ ——The gas compression factor is calculated according to SY/T 6143-1996 standard of China National Petroleum Corporation.

The data in Table b are for reference only. The data are calculated according to the true relative density of natural gas Gr=0.600 and the molar fractions of nitrogen and carbon dioxide are both 0.00. When the medium pressure is lower than 0.5MPa, they can be estimated according to Z_b/Z_g= 1. 00.

Calculation: ① When the medium pressure is the lowest (0.8MPa) and the temperature is the highest (+40℃) (in the peak period of gas supply), it shall have the maximum standard volume flow rate (FZ can be temporarily ignored when selecting the type, and the local atmospheric pressure is 101.325 kPa):

that is, $Q_{\max} = Q_{b\,max}\frac{P_b}{p}\cdot\frac{T}{T_b} = 8000 \times \frac{101.325}{101.325+800} \times \frac{273.15+40}{293.15} = 965.472$ m³/h

Or use the following formula for estimation (where, C_* is the conversion factor, see Appendix Table a):

$$Q_{\max} = \frac{Q_{bmax}}{C} = \frac{8000}{8.33} = 960.38 \text{ m}^3/\text{h}$$

② When the medium pressure is the highest (1.2MPa) and the temperature is the lowest (-5℃) (at the bottom of gas supply), it shall have the minimum standard volume flow rate:

that is, $Q_{\min} = 3000 \times \frac{101.325}{101.325+1200} \times \frac{273.155}{293.15} = 213.51$ m³/h or use the following formula to estimate: $Q_{\min} = \frac{Q_{bmin}}{C} = \frac{3000}{14.0} = 241.3$ m³/h

Selection: From the above estimation results, it is known that the flow range of the flowmeter to be selected is (213.5~965.472) m³/h. According to Table 1, the flowmeter model to be selected is ABDT-DYWQ- 150.

The value of conversion coefficient C* calculated according to the gaseous equation

Table a

C* PRE / TEMP		MPa													
		0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
TEMP (℃)	-20	1.27	1.70	2.30	2.87	3.34	4.02	4.59	5.16	5.73	6.30	6.87	7.44	8.02	8.59
	-15	1.25	1.70	2.26	2.82	3.38	3.94	4.50	5.06	5.62	6.18	6.74	7.30	7.86	8.42
	-10	1.22	1.66	2.21	2.76	3.31	3.86	4.41	4.96	5.51	6.60	6.61	7.16	7.71	8.26
	-5	1.20	1.63	2.17	2.71	3.25	3.79	4.33	4.87	5.41	5.95	6.49	7.03	7.57	8.11
	0	1.18	1.60	2.13	2.66	3.19	3.72	4.25	4.78	5.31	5.84	6.37	6.90	7.43	7.96
	5	1.16	1.57	2.09	2.61	3.13	3.65	4.17	4.69	5.21	5.73	6.25	6.77	7.29	7.81
	10	1.14	1.55	2.06	2.57	3.08	3.59	4.10	4.61	5.12	5.63	6.14	6.66	7.17	7.68
	15	1.12	1.52	2.02	2.52	3.03	3.53	4.03	4.53	5.03	5.54	6.04	6.54	7.04	7.54
	20	1.10	1.49	1.99	2.48	2.97	3.47	3.96	4.45	4.95	5.44	5.93	6.43	6.92	7.42
	25	1.08	1.47	1.95	2.44	2.92	3.41	3.89	4.38	4.86	5.35	5.84	6.32	6.81	7.29
	30	1.06	1.44	1.92	2.40	2.88	3.35	3.83	4.31	4.78	5.26	5.74	6.22	6.69	7.17
	35	1.05	1.42	1.89	2.36	2.83	3.30	3.77	4.24	4.71	5.18	5.65	6.12	6.58	7.05
	40	1.03	1.40	1.86	2.32	2.78	3.25	3.71	4.17	4.63	5.09	5.56	6.02	6.48	6.94
	45	1.01	1.38	1.83	2.29	2.74	3.19	3.65	4.10	4.56	5.01	5.47	5.92	6.38	6.83
	50	1.00	1.35	1.80	2.25	2.70	3.15	3.59	4.04	4.49	4.94	5.38	5.83	6.28	6.73
C* PRE / TEMP		MPa													
		0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.20	1.40	1.60	2.00	2.50	3.00	4.00
	-20	9.16	9.73	10.3	10.9	11.4	12.0	12.6	14.9	17.2	19.4	24.0	29.7	35.4	46.9
	-15	8.98	9.54	10.1	10.7	11.2	11.8	12.3	14.6	16.8	19.1	23.6	29.1	34.8	46.0
	-10	8.81	9.36	9.91	10.5	11.0	11.6	12.1	14.3	16.5	18.7	23.1	28.6	34.1	45.1
	-5	8.65	9.19	9.72	10.3	10.8	11.3	11.9	14.0	16.2	18.4	22.7	28.1	34.5	44.3
TEMP (℃)	0	8.49	9.20	9.55	10.1	10.6	11.1	11.7	13.8	15.9	18.0	22.3	27.6	32.9	43.4
	5	8.33	8.86	9.38	9.90	10.4	10.9	11.5	13.5	15.6	17.7	21.9	27.1	32.3	42.1
	10	8.19	8.70	9.21	9.72	10.2	10.7	11.3	13.3	15.3	17.4	21.5	26.6	31.7	41.9
	15	8.05	8.55	9.05	9.55	10.1	10.6	11.1	13.1	15.1	17.1	21.1	26.1	31.1	41.2
	20	7.91	8.40	8.90	9.39	9.88	10.4	10.9	12.8	14.8	16.8	20.7	25.7	30.6	40.5
	25	7.78	8.26	8.75	9.23	9.72	10.2	10.7	12.6	14.6	16.5	20.4	25.2	30.6	39.8
	30	7.65	8.12	8.60	9.08	9.56	10.0	10.5	12.4	14.3	16.2	20.1	24.8	30.1	39.1
	35	7.52	7.99	8.46	8.93	9.40	9.87	10.3	12.2	14.1	16.0	19.7	24.4	29.6	38.5
	40	7.40	7.87	8.33	8.79	9.25	9.71	10.3	12.0	13.9	15.7	19.4	24.0	29.1	37.9
	45	7.29	7.47	8.20	8.65	9.11	9.56	10.3	11.8	13.7	15.5	19.1	23.7	28.6	37.3
	50	7.17	7.62	8.07	8.52	8.96	9.11	9.86	11.7	13.4	15.2	18.8	23.3	27.8	36.7

Note:

1. The values in the table are calculated based on the local atmospheric pressure of 101.325KPa;

2. Pressure is gauge pressure

F_z value of gas compression factor

Table b

P \ TEMP (Fz)	30	35	40	45	50	55	60	65	70	75
0.50	1.0048	1.0046	1.0043	1.0041	1.0039	1.0036	1.0034	1.0032	1.0031	1.0029
1.00	1.0097	1.0092	1.0087	1.0082	1.0077	1.0073	1.0069	1.0065	1.0061	1.0058
1.50	1.0147	1.0138	1.0130	1.0123	1.0116	1.0109	1.0103	1.0097	1.0091	1.0086
2.00	1.0197	1.0185	1.0174	1.0164	1.0154	1.0145	1.0137	1.0129	1.0121	1.0114
2.50	1.0247	1.0231	1.0217	1.0204	1.0192	1.0181	1.0170	1.0160	1.0151	1.0142
3.00	1.0297	1.0278	1.0261	1.0245	1.0230	1.0216	1.0203	1.0191	1.0180	1.0169
3.50	1.0347	1.0325	1.0305	1.0286	1.0268	1.0252	1.0236	1.0222	1.0208	1.0196
4.00	1.0397	1.0372	1.0348	1.0326	1.0305	1.0286	1.0269	1.0252	1.0236	1.0222
4.50	1.0447	1.0418	1.0391	1.0366	1.0343	1.0321	1.0301	1.0282	1.0264	1.0247
5.00	1.0497	1.0464	1.0434	1.0405	1.0379	1.0355	1.0332	1.0311	1.0291	1.0272
5.50	1.0547	1.0510	1.0476	1.0444	1.0415	1.0388	1.0363	1.0339	1.0317	1.0297
6.00	1.0596	1.0555	1.0517	1.0483	1.0450	1.0420	1.0393	1.0367	1.0343	1.0320
6.50	1.0644	1.0599	1.0558	1.0520	1.0485	1.0452	1.0422	1.0394	1.0368	1.0343
7.00	1.0692	1.0643	1.0598	1.0557	1.0519	1.0483	1.0451	1.0420	1.0392	1.0365
7.50	1.0738	1.0686	1.0637	1.0593	1.0552	1.0514	1.0478	1.0446	1.0415	1.0387
8.00	1.0748	1.0727	1.0675	1.0627	1.0583	1.0543	1.0505	1.0470	1.0438	1.0407

P \ TEMP (Fz)	-20	-15	-10	-5	0	5	10	15	20	25
0.50	1.0088	1.0083	1.0078	1.0073	1.0069	1.0065	1.0061	1.0058	1.0054	1.0051
1.00	1.0180	1.0169	1.0159	1.0149	1.0140	1.0132	1.0124	1.0117	1.0110	1.0103
1.50	1.0276	1.0258	1.0242	1.0227	1.0213	1.0200	1.0188	1.0176	1.0166	1.0156
2.00	1.0375	1.0351	1.0328	1.0307	1.0287	1.0269	1.0252	1.0237	1.0222	1.0209
2.50	1.0479	1.0446	1.0416	1.0389	1.0363	1.0340	1.0318	1.0298	1.0280	1.0263
3.00	1.0587	1.0546	1.0508	1.0473	1.0441	1.0412	1.0385	1.0360	1.0337	1.0316
3.50	1.0700	1.0649	1.0602	1.0560	1.0521	1.0485	1.0453	1.0423	1.0396	1.0370
4.00	1.0818	1.0756	1.0699	1.0648	1.0602	1.0506	1.0521	1.0486	1.0454	1.0425
4.50	1.0941	1.0866	1.0799	1.0739	1.0685	1.0635	1.0591	1.0550	1.0513	1.0479
5.00	1.1069	1.0980	1.0902	1.0831	1.0768	1.0712	1.0660	1.0614	1.0571	1.0533
5.50	1.1201	1.1089	1.1006	1.0926	1.0853	1.0789	1.0730	1.0678	1.0630	1.0587
6.00	1.0339	1.1218	1.1113	1.1021	1.0939	1.0866	1.0800	1.0741	1.0688	1.0640
6.50	1.0480	1.1342	1.1222	1.1117	1.1025	1.0943	1.0870	1.0805	1.0746	1.0693
7.00	1.1624	1.1467	1.1332	1.1214	1.1111	1.1020	1.0943	1.0867	1.0803	1.0745
7.50	1.1770	1.1593	1.1442	1.1311	1.1197	1.1097	1.1008	1.0929	1.0859	1.0796
8.00	1.1917	1.1719	1.1551	1.1407	1.1282	1.1172	1.1075	1.0990	1.0913	1.0845

V. Installation and Use

5.1 Installation of flowmeter

● Before installation, the pipeline shall be purged clean to prevent residual iron filings from affecting the normal operation of the flowmeter.

● Before installation, when the turbine is blown with tiny air flow, if the turbine can rotate flexibly without irregular noise, the flowmeter can be installed and used.

● When installing the flowmeter, a sealing gasket shall be added between the flange and the pipeline flange.

● A filter should be installed in front of the flowmeter. It is strictly prohibited to directly connect the filter with the flowmeter.

● Flange ball valves shall be added before and after the flowmeter is installed.

● There should be no protrusions at the inner diameter of the pipe at the flange joint.

● During the installation of the flowmeter, it is strictly prohibited to directly carry out electric welding at the inlet and outlet flanges to avoid burning out the internal parts of the flowmeter.

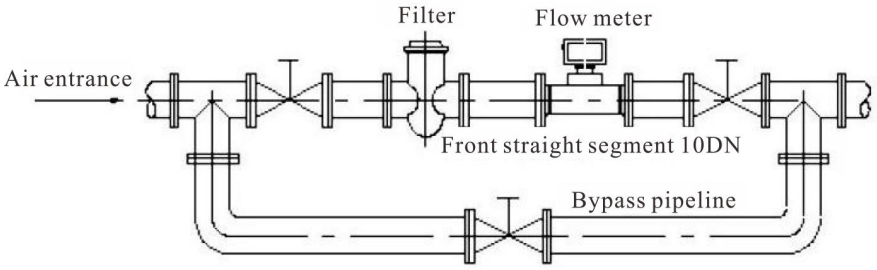
● The flowmeter shall be installed in a place that is convenient for maintenance and free from strong electromagnetic field interference, mechanical vibration and thermal radiation.

● Flowmeters should not be used in occasions where flow is frequently interrupted and there is strong pulsating flow or pressure pulsation.

● When the flowmeter is installed outdoors, the upper part shall have a cover to prevent rainwater immersion and sun exposure from affecting the service life of the flowmeter.

● The flowmeter must be installed horizontally, and the direction of fluid flow should be consistent with the direction marked on the shell. There should be a straight pipe section of not less than 10DN upstream of the flowmeter and a straight pipe section of not less than 5DN behind the meter.

● In order not to affect the normal delivery of fluid, it is recommended to install the bypass pipe as shown in Figure 2, and the bypass pipe valve must be closed during normal use.



● During pipeline construction, telescopic pipes or bellows should be installed to avoid serious stretching or fracture of flowmeter.

● It is required to ensure that the connection between the pipeline and the inlet and outlet of the flowmeter is coaxial, and prevent washers and welds from protruding into the pipeline,otherwise the flow profile will be disturbed;

● When external power supply is used, the flowmeter must have reliable grounding, but it shall not share the ground line with the strong power system. During pipeline installation or maintenance, the ground wire of the electric welding system shall not be overlapped with the flowmeter.

● When the pipeline is installed and the sealing pressure test is carried out, attention should be paid to the maximum pressure that the flowmeter pressure sensor can bear (i.e. the maximum pressure of the medium on the verification certificate) so as not to damage the pressure sensor.

5.2 Use of Flowmeter

5.2.1 Precautions

● Maximum leak detection pressure of medium and low pressure meters: ⩽1.0MPa, and the leak detection pressure of temperature and pressure compensation shall not exceed 3 times of the upper limit value of the pressure sensor. The high-pressure case shall be checked for leakage at 1.2 times the rated flow rate.

● The following provisions shall be observed during leak detection after installation and during installation and use:

① Close the outlet valve and the intake valve first.

② Slightly open the air outlet valve, then slowly open the air inlet valve to make the meter start slowly, and then slowly open the air outlet valve to reach the normal operation state, to prevent sudden start and damage to the meter core.

③ When stopping gas, the outlet valve shall be closed, and then the intake valve shall be closed. The above regulations shall be observed every time the gas is started.

● After the flowmeter is installed and used, fasteners such as bolts, screws and nuts shall not be touched at will to avoid risks such as air leakage and damage.

VI. Common Fault Handling

<table>
<tr><th>No.</th><th>Fault description</th><th colspan="2">Causes</th><th>Solution</th></tr>
<tr><td>1</td><td>No display of the smart header</td><td colspan="2">Dead battery</td><td>Replace the battery</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Only cumulative flow is displayed in the smart header,but no instantaneous flow is displayed
Judgment:blow air into the inlet and observe whether the turbine rotates.</td><td>Rotate</td><td>There are Impurities such as iron filings on the Turbine blades.</td><td>Gently wipe</td></tr>
<tr><td>Do not rotate</td><td>The movement is too dirty and the Transmission is blocked.</td><td>Clean movement and replace bearing</td></tr>
</table>

VII. Transport and Storage

1. The flowmeter shall be packed into a solid wooden box (carton can be used for small caliber instruments). It is not allowed to move freely in the box. It shall be handled with care and rough loading and unloading is not allowed.

2. The storage location shall meet the following conditions:

1). Rain-proof and moisture-proof.

2). Not subject to mechanical vibration or impact.

3). The temperature range is -20℃～ +55℃.

4). The relative humidity is not more than 80%.

5). The environment does not contain corrosive gases.

VIII. Precautions for Unpacking

1. After unpacking, check whether the documents and accessories are complete according to the packing list.

The packing documents include:

one instruction

one certificate of verification

2. Observe whether the sensor is damaged due to transportation for proper handling.

3. It is hoped that the user will properly keep the “Verification Certificate” and do not lose it, otherwise the instrument coefficient cannot be set!

IX. Instructions for Ordering

When ordering turbine flow sensors, users should pay attention to selecting appropriate specifications according to the nominal diameter, working pressure, working temperature, flow range, fluid type and environmental conditions of the fluid.

【Section 2】

Guide for Debugging and Wiring of Gas Turbine Flowmeter

I. Header Implementation Function

1. Interface with temperature/pressure sensor. The temperature can be connected with Pt100 or Pt1000, and the pressure can be connected with gauge pressure or absolute pressure sensor.

2. The output signals are diversified. Two-wire 4-20mA output, three-wire pulse output, equivalent output and 485 communication can be selected according to customer requirements.

3. It has excellent non-linear correction function which greatly improves the linearity of the instrument.

4. It has the function of software spectrum analysis,which improves the anti-interference and anti-seismic capability of the instrument.

5. With ultra-low power consumption, full performance operation of a dry battery can last for at least one year.

6. The working mode can be automatically switched, with battery power supply, two-wire system and three-wire system.

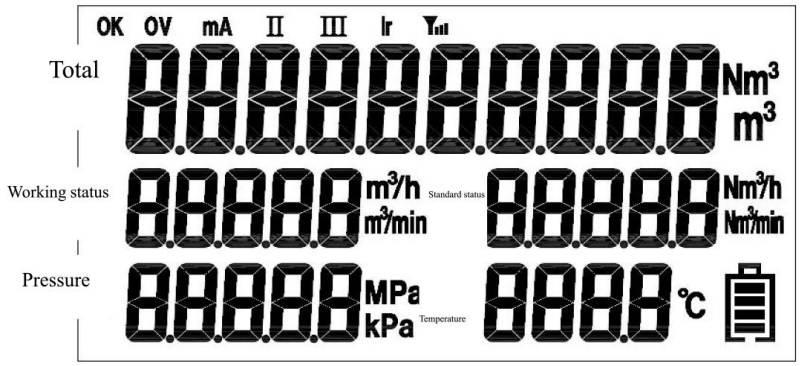
7. It has self-checking function with rich self-checking information, which is convenient for users to overhaul and debug.

8. It has independent password setting. For parameters, total amount clearing and calibration, it can set passwords of different levels, which is convenient for user to manage.

II. Flow Usage and Setting

2.1 Working status

When the instrument is powered on, self-inspection will be carried out. If the self-inspection is abnormal, the self-inspection error interface will be displayed (Please refer to the self-inspection menu for the description of the self-inspection interface), and it will jump to the main interface after about 1~2 seconds. Otherwise, it will jump directly to the main interface. See the following figure for the main interface started:



Main interface

1. “OK”: The meter’s running status is displayed in real time. If it displays “OK” normally, the fault displays “ERR”;

2. “OV”: The instrument operation parameter overflows. If the instrument operation parameter overflows, "OV" will be displayed, and if it is normal, it will be displayed as null (overflow includes negative parameters that cannot be negative, zero parameters that cannot be zero, and data beyond the indicated range);

3. “mA”: For the indicator of output and overflow of instrument current, if current overflow, it displays “mA”; if normal, it displays null;

4. “II” and “II”: For the display of operation power supply mode, if it is in battery mode, it displays the current battery quantity. If it is in two-wire current output connection, it displays the number character “II”. If it is in three-wire system, it displays the number character “III”.

5. Total amount: for cumulative flow, the display value can be retained to 5 decimal places, and the maximum value is 9,999,999,999 with m^3 and Nm^3 available for selection;

6. Working condition flow: the minimum display value is reserved for 3 decimal places, and the maximum value is 99,999m^3/h;

7. Standard flow: the minimum display value is reserved for 3 decimal places and the

maximum value is 99,999Nm^3/h;

8. Pressure: The minimum display value is reserved for 3 decimal places, and the maximum value is 99,999 with Kpa and MPa available for selection.

9. Temperature: the display value ranges from-50℃ to 300℃.

10. "  ": For the display of the power supply mode of operation, it is the power supply prompt for battery, which displays the battery power.

2.2 Key description

The parameters of the instrument are set through keys. Generally, some parameters should be manually set through keys when in use. The instrument has four keys, K1, K2, K3 and K4 in order from left to right. The key description is as follows:

Sign	Name	Function
K1	Key for setting	1. Enter the parameter setting; 2. Switch and display each parameter item; 3. Confirm and save the new parameter values after modifying and setting the parameters.
K2	Key for shift	Make the parameters flash alternately
K3	Key for adding	Loop a place that flashes a parameter from 0 to 9
K4	Key for exit	Exit the parameter setting interface and enter the flow display interface

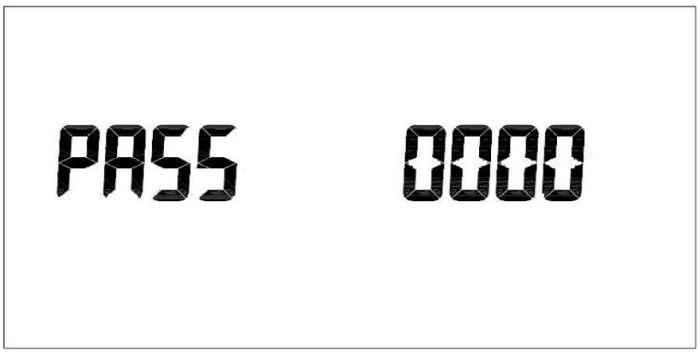
2.3 Parameter setting

In order to prevent malicious modification of instrument parameters which will affect measurement accuracy, this instrument is specially equipped with multi-level password function. When setting or modifying parameters, the corresponding password must be confirmed first, and the parameters can only be set and modified after confirmation. When a place of a parameter is allowed to be modified and set, the corresponding number flashes to show the difference. The parameter setting method comprises the following steps: press the key for setting (K1) to display the password setting on the screen, press the key for shift (K2) and the key for adding (K3) in sequence, set the numerical value as the password of the corresponding parameter place by place from left to right, and then press the key for setting

(K1) to confirm.

Setting of flow parameters

The setting option sets some parameters required for the instrument to work. In order to prevent man-made mis-operation, the password needs to be checked to enter this option. After entering the correct password, it will enter the corresponding parameter setting interface. The password interface is as follows:



Setting of user parameters

For user parameters, it mainly set the parameters that need to be set when the instrument is used, which can be modified by on-site engineers. Press the key for setting (K1) to display the password setting on the screen, press the key for shift (K2) and the key for adding (K3) in sequence, set the value to "1010" place by place from left to right, and then press the key for setting (K1) to enter the user parameter setting.

PASS--Password input (1010);

Function code/display	No.	Key operation				Function description
		K1	K2	K3	K4	
F0	101	Save the item changed	Shift	Change value	Exit	Cut-off frequency of flow lower limit, unit: Hz
FS	102	Save the item changed	Shift	Change value	Exit	Flow range, unit: Nm^3/h; The flow range corresponds to a current output of 20mA;
Gr	103	Save the item changed	Shift	Change value	Exit	The relative density of natural gas is dimensionless. This parameter is provided by the gas analysis report. It can also be calculated according to the formula in Appendix 1 by the molar composition of the gas.

Function code/display	No.	Key operation				Function description
		K1	K2	K3	K4	
N2	104	Save the item changed	Shift	Change value	Exit	The molar percentage of nitrogen in natural gas. This parameter is provided by the gas analysis report;
CO2	105	Save the item changed	Shift	Change value	Exit	The molar percentage of carbon dioxide in natural gas. This parameter is provided by the gas analysis report;
CA	106	Save the item changed	Shift	Change value	Exit	Communication serial number, i.e. instrument number, input range 1-255;
Cr	107	Save the item changed	——	Switch	Exit	Communication baud rate, with 1200, 2400, 4800, 9600, 19200, 38400 available for selection
CP	108	Save the item changed	——	Switch	Exit	Communication check mode, 0: None, 1: Odd, 2: Even
ST	109	Save the item changed	Shift	Change value	Exit	Set temperature, unit:℃, which is used to compensate when the temperature sensor is damaged or the temperature is set.
SGP/SAP	110	Save the item changed	Shift	Change value	Exit	Set pressure, unit: KPa. SGP: set gauge pressure, SAP: set absolute pressure, which is used for compensation when the pressure sensor is damaged or the pressure is set.
LP	111	Save the item changed	Shift	Change value	Exit	Local atmospheric pressure, unit: KPa
dc	112	Save the item changed	Shift	Change value	Exit	Seismic coefficient, input range: 0-9
DT	113	Save the item changed	Shift	Change value	Exit	Damping time, input range: 0-30
POT	114	Save the item changed	——	Switch	Exit	Pulse output mode, CPU: pulse correction output, pin: original pulse output of sensor
EC	115	Save the item changed	Shift	Change value	Exit	Equivalent coefficient, input range: 0.00001-10
TS	116	Save the item changed	Shift	Change value	Exit	Media type selection, for reference only

Function code/display	No.	Key operation				Function description
		K1	K2	K3	K4	
TLUN	117	Save the item changed	Shift	Change value	Exit	Cumulative flow display type selection, cumulative flow communication data selection. The first value (cumulative flow display type): 0 is the standard condition accumulation, with Nm^3 as the unit; 1 is the accumulation of working conditions, with m^3 as the unit. The second value (cumulative flow communication data): 0 is the standard condition cumulative communication output, with Nm^3 as the unit; 1 is the cumulative communication output under working conditions, with m^3 as the unit.
FLUN	118	Save the item changed	Shift	Change value	Exit	Working condition and standard condition display unit selection. The first value (working condition unit): 0 is m^3/h; 1 is m^3/min; The second value (standard unit): 0 is Nm^3/h, odd; 1 is Nm^3/min.
PUN	119	Save the item changed	Shift	Change value	Exit	Pressure unit selection: 0 is Kpa, 1 is Mpa
DATE	120	Save the item changed	Shift	Change value	Exit	Time setting, Month, Day, Year
clock	121	Save the item changed	Shift	Change value	Exit	Time settings, hours, minutes, seconds
rc	122	Exit	Shift	Change value	Exit	Restore the factory parameters, enter the value of 3, and press the key for setting to restore the set parameters to factory parameters

Setting of factory parameter

For the factory parameter, it mainly sets instrument coefficient, temperature sensor type and coefficient, pressure sensor type and coefficient and current output calibration. Setting the parameters in the factory menu affects the performance and accuracy of the instrument, and it is not necessary to operate the parameters in this menu during normal use. Press the key for setting (K1) to display the password setting on the screen, press the key for shift (K2)

and the key for adding (K3) in sequence, set the value to "2000" place by place from left to right, and then press the key for setting (K1) to enter the user parameter setting.

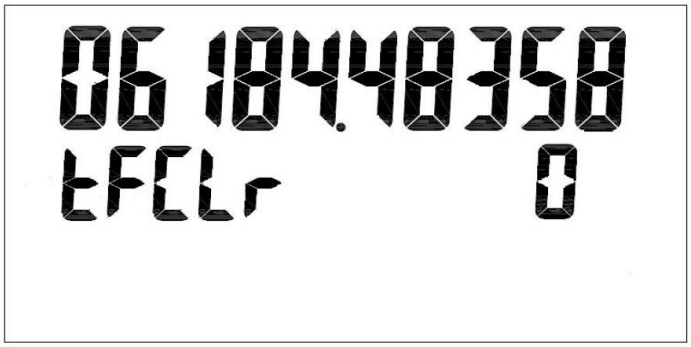
PASS-password input (2020);

Function Code/ Display	No.	Key operation				Function description
		K1	K2	K3	K4	
F1	201	Save the item changed	Shift	Change value	Exit	Flow segmentation, frequency 1, unit: Hz
C1	202	Save the item changed	Shift	Change value	Exit	Flow segmentation, coefficient 1, unit: $1/m^3$
F2	203	Save the item changed	Shift	Change value	Exit	Flow segmentation, frequency 2, unit: Hz
C2	204	Save the item changed	Shift	Change value	Exit	Flow segmentation, coefficient 2, unit: $1/m^3$
F3	205	Save the item changed	Shift	Change value	Exit	Flow segmentation, frequency 3, unit: Hz
C3	206	Save the item changed	Shift	Change value	Exit	Flow segmentation, coefficient 3, unit: $1/m^3$
F4	207	Save the item changed	Shift	Switch	Exit	Flow segmentation, frequency 4, unit: Hz
C4	208	Save the item changed	Shift	Switch	Exit	Flow segmentation, coefficient 4, unit: $1/m^3$
..		..	..	..	..	..
C10	219	Save the item changed	Shift	Change value	Exit	Flow segmentation, coefficient 5, and flow greater than frequency 4 are all calculated with coefficient 5, and the coefficient is the same as the coefficient of the maximum frequency. Unit: $1/m^3$
AC	220	Save the item changed	Shift	Change value	Exit	Average instrument coefficient, unit: $1/m^3$
TST	221	Save the item changed	——	Switch	Exit	Temperature input mode, with three modes of Pt1000, Pt100, setting.
TC	222	Save the	Shift	Change	Exit	Temperature sensor coefficient

Function Code/ Display	No.	Key operation				Function description
		K1	K2	K3	K4	
		item changed		value		
TZ	223	Save the item changed	Shift	Change value	Exit	Temperature sensor zero
NT	224	Save the item changed	——	Switch	Exit	Standard condition temperature, used for standard condition conversion calculation, with two options: 0℃ and 20℃
PST	225	Save the item changed	——	Switch	Exit	Pressure input, AP: absolute pressure sensor, GP: gauge pressure sensor, SAP: set absolute pressure, SGP: set gauge pressure
PC	226	Save the item changed	Shift	Change value	Exit	Pressure sensor coefficient
PZ	227	Save the item changed	Shift	Change value	Exit	Pressure sensor zero
IC	218	Save the item changed	Shift	Change value	Exit	Current coefficient,
Iz	229	Save the item changed	Shift	Change value	Exit	Current zero
sc	230	Save and exit	Shift	Change value	Exit	Save the factory parameter settings, enter the value of 3, and press the key for setting to save the set parameters as factory parameters.

Total amount cleared

The key for setting (K1) is displayed on the screen as password setting. Press the key for shift (K2) and the key for adding (K3) in sequence to set the value to "3030" place by place from left to right, and then press the key for setting (K1) to enter the user parameter setting. The interface is as follows:



There are two ways to clear the total amount. One is to modify the number to clear, shift through the key for shift (K2), and change the number value from left to right through the key for modifying (K3) until the number is cleared. The other is to clear it directly: set the value to the right of TFCLK to 3 and press the key for setting (K1) to clear it.

2.4 Password

Through this option, the passwords of user parameters and factory parameters can be modified respectively. Press the key for setting (K1) to display the password setting on the screen. Press the key for shift (K2) and the key for adding (K3) in sequence to set the value to "1805" place by place from left to right, and then press the key for setting (K1) to enter the password setting.

PASS-password input (6210);

Function Code/ Display	No.	Key operation				Function description
		K1	K2	K3	K4	
PSET	601	Save the item changed	Shift	Change value	Exit	User parameter password
PSET	602	Save the item changed	Shift	Change value	Exit	Factory parameter password
PSET	603	Save the item changed	Shift	Change value	Exit	Total clearance password

III .Electrical Wiring

3.1 Description of sensor terminal

1	2	3	4	5	6	7	8	9	10	11	12	13
VCC	PIN	GND	IP+	VP+	VP-	IP-	T1	T2	S1+	S1-	S2+	S2-

Flow signal Pressure sensor Temperature sensor Vortex flow signal

The instrument can accept the processed signal and supply power to the signal processing board. The wiring method is as follows:

VCC: Supply 3V

PIN: Frequency input

GND: Commons

Pressure sensor:

IP+, pressure sensor power+;

VP+, pressure sensor signal+;

VP-, pressure sensor signal-;

IP-, pressure sensor power supply-;

Temperature sensor (Pt100 or Pt1000):

T1: Pt100(1)

T2: Pt100(2)

Sensor channel 1 (vortex flow signal):

S1: +

S1: -

Sensor channel 2 (vortex flow signal):

S2: +

S2: -

3.2 Description of external wiring terminals

1	2	3	4	5	6	7	8	9
+24v	0V	I+	I-	FOUT	DOUT	RGND	A	B

+24v: power supply DC24V+

0V: power supply 0V

I +: current output +

I - : current output-

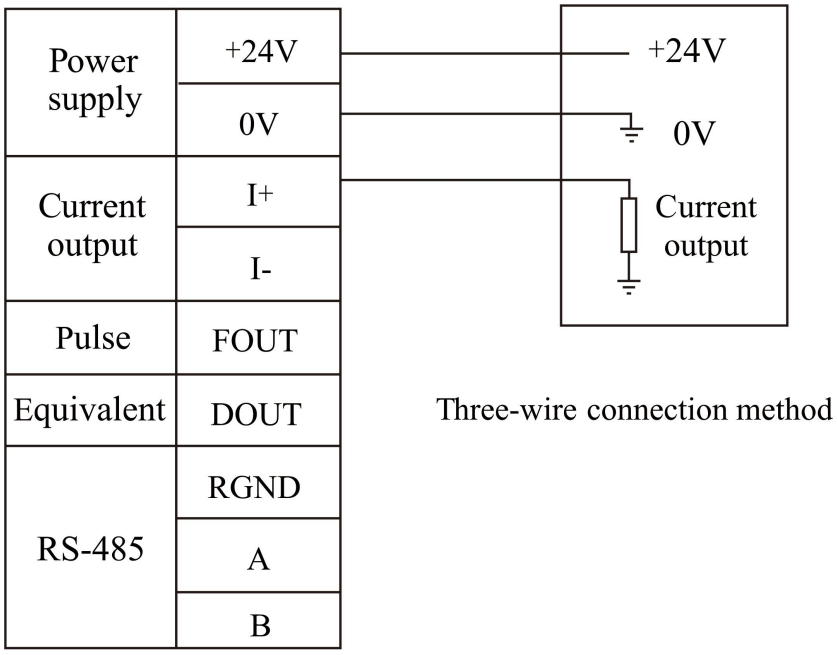
FOUT: pulse output

DOUT: equivalent output

A: RS-485 communication A

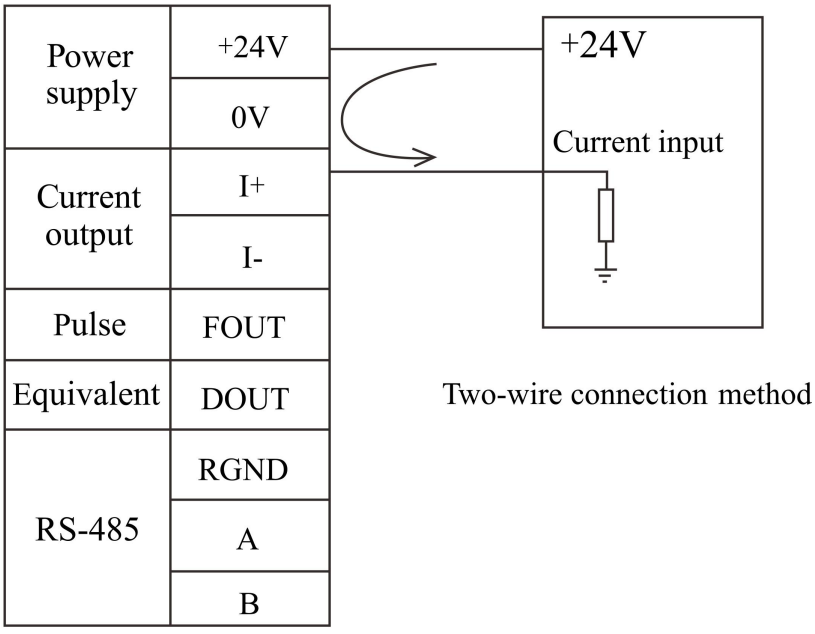
B: RS-485 communication A

a. Three-wire current connection:



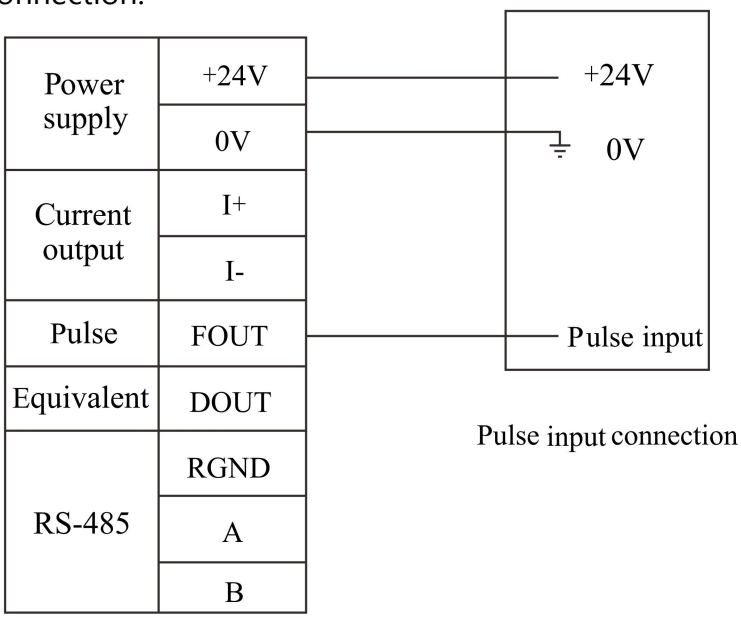
Three-wire connection method

b.Two-wire current connection：



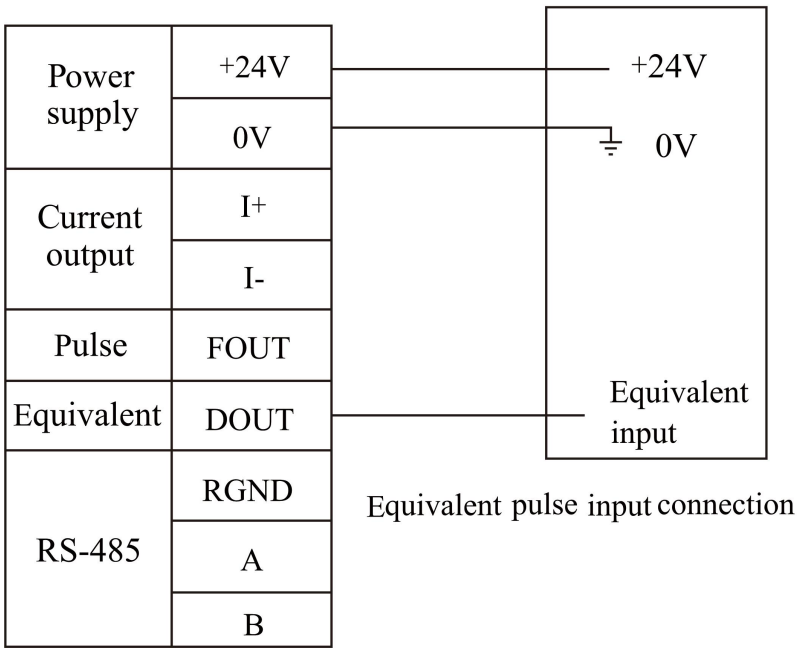
Two-wire connection method

c. Three-wire pulse connection:



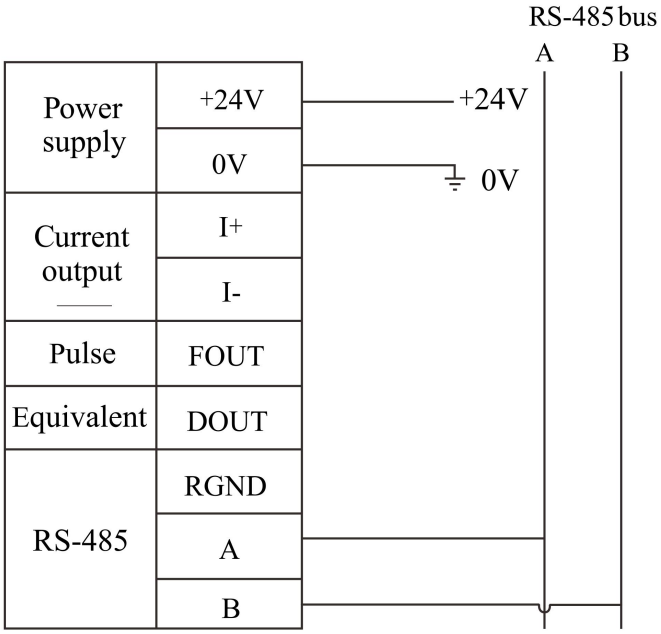
Pulse input connection

d. Three-wire equivalent connection:



Equivalent pulse input connection

e. RS485 communication connection:



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