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Gas Turbine Flow Meter

User Manual

CONTENT

I、Overview

The TRFM 1.0 -G Series gas turbine flow meter is a precision measuring instrument used for gas flow measurement. This product is developed by AKTEK with the absorption of foreign advanced technology combined with our own experience and expertise. It has small pressure loss, high accuracy, and low dynamic flow, great anti-vibration and anti-pulsation performance, wide range ratio, excellent low and high-pressure measurement performance, multiple signal output methods and low sensitivity to fluid disturbances.

TRFM1.0-G Series gas turbine flow meter take into account the compressibility of gases, and the correlation between volume, temperature and pressure of the medium. To convert Process Condition medium to Standard Condition, temperature and pressure sensors are added to track temperature and pressure changes of the measuring medium. TRFM1.0-G Series gas turbine flowmeters are widely used in gas metering and gas pressure regulating stations for petroleum gas, chemical gas, electric power and industrial boilers, as well as gas transmission and distribution pipeline networks, urban natural gas metering. It is the preferred instrument for trade settlements.

II、Features

● Advanced rectification technology assures the reliability of metering accuracy under unsatisfactory installation conditions such as short front and rear straight pipe sections, vibrations, or large variations of flow rate;

● The advanced dust-proof structure effectively prevent the rapid wear and stuck of bearing caused by the impurities in the medium;

● Oxidized high-strength aluminum alloy turbine and impeller are corrosion-resistant, and anti-ageing, they offer long service life, high accuracy, and good repeatability;

● German-made high-precision, dust-proof, stainless steel special bearings for flow meters, with good stability, high accuracy, good sensitivity, long service life and wide range;

● Built-In temperature and pressure sensors can measure temperature, pressure and flow rate of gases to be measured. The sensors are used to automatically compensate for temperature and pressure change. Instantaneous flow and accumulated flow are displayed in normal condition units.

● The intrinsically safe and flameproof circuit design is suitable for different explosion-proof requirements;

●Advanced dual-power supply, micro-power consumption technology. One set of two lithium batteries are expected to operate 3+ years, it can also be connected to an external power supply. TRFM1.0- G Series gas turbine flow meter also has battery under-voltage, or valve closing alarm output Function, it is suitable for usage with an IC card management system;

●Diversified output signal, (4～20) mA standard analog signal, working condition pulse signal, IC card standard volume signal and 485 communication available;

●According to user needs, the GPRS network function can be provided to realize low-cost, long-distance wireless data real-time transmission; the Internet of Things interface function is reserved to realize the LOT function.

●Internal battery low-voltage alarm reminds users to replace batteries in time;

●Intelligent flow Totalizer can rotate 350 degrees counterclockwise, convenient for data reading in different directions;

●Time display and real-time data storage ensure that the internal data will not be lost and can be stored permanently;

●Large-screen LCD, displaying rich and clear contents; The LCD screen of the Totalizer can withstand a high temperature of 80℃;

●Flow upper limit and pressure upper alarm error display and record feature, allow users to analyze flow patterns.

● Working modes can be switched automatically, battery-powered, two-wire system, and three-wire system;

●When the system module fails, it will display the fault content and initiate the corresponding mechanism;

●Diversified pressure ports, supports digital pressure sensor and pressure sensor; Pt100 or Pt1000 temperature sensors are supported;

●Automatically run diagnosis upon pressure/temperature sensor failure. In the presence of sensor failure, Totalizer will use preset pressure and temperature value for smart compensation.

●Unique reverse thrust structure design reduces and balances the bearing force, ensuring a reliable long-term use of the bearing;

●The unique pressure balance design of the sealed chamber can effectively reduce wearing or stuck of the bearing caused by dust or impurities.

III、Technical Data

3.1 Operating Environment

1) Ambient Temperature: flameproof type: -20℃～+60℃, intrinsic safety type: -30℃～+50℃

2) Medium temperature: -30℃～+80℃

3) Relative Humidity: 5%～95%

4) Atmospheric pressure: 50kPa～110kPa

3.2 Nominal Diameter

DN25～DN400, larger diameter gas turbine flow meter can be manufactured upon request.

3.3 Pressure

(0.5～4.0) MPa, higher pressure versions gas turbine flow meter can be manufactured upon request.

3.4 Measuring Range Ratio

Under standard environmental conditions (P=101.325kPa, T=293.15K), the range can reach 40:1 or wider.

(*Note: For some smaller diameter turbine flow meters, the ratio will be reduced).

3.5 accuracy

±1.0% (0.2Qmax～Qmax±1.0%; Qmin～0.2Qmax ±2.0%)

±1.5% (0.2Qmax～Qmax±1.5%; Qmin～0.2Qmax ±3.0%)

(*Note: Qmin is the minimum flow rate that can be measured within the flow rate range, and Qmax is the maximum flow rate that can be measured within the flow rate range.

Special order meters are delivered according to 1.5 grades, and the other accuracy grades need to be specified when ordering.)

3.6 Repeatability

Better than 0.2%

3.7 Explosion-proof Grade

Exia Ⅱ B T4 Ga, Exd Ⅱ B T4 Gb, Protection grade: IP65

3.8 Shell Material

Aluminum alloy, Carbon steel, Stainless steel.

3.9 Electrical performance indicators

3.9.1 Power Supply

1) External power supply: +12～24VDC±15%, ripple <5%, suitable for 4～20mA output, pulse output, alarm output, RS-485, etc.;

2) Internal power supply: 1 set of two 3.6V lithium batteries, when the voltage is lower than 3.0V, an under-voltage indication will appear.

3.9.2 Power Consumption:

1) External power supply: <2W;

2) Internal power supply: average power consumption ≤1mW, a set of two lithium batteries can be used continuously for more than 3 years, and power consumption ≤0.3mW when in the sleep state.

3.9.3 Pulse Output Type：

1)Working condition pulse signal (FOUT), directly amplify and output the working condition pulse signal detected by the flow sensor through optocoupler isolation, high-level ≥ 20V, low-level ≤ 1V

2)Equivalent pulse signal (H/L), amplified and output by optocoupler isolation, high -level amplitude ≥20V, low-level amplitude ≤1V, unit pulse represents the volume of standard conditions. The settable range: 0.01 m3, 0.1 m3, 1m3, 10m3; upper and lower limit alarm signal (H/L): photoelectric isolation, high and low-level alarm, working voltage +12V~+24V, maximum load current 50mA

3.9.4 RS－485 communication(optoelectronic isolation), The following functions can be achieved：

Using RS-485 interface, it can be directly connected to the host computer or secondary meter, and can remotely transmit the medium's temperature, pressure, instantaneous flow rate, total standard volume and meter's real-time data

3.9.5 4～20mA Standard current signal (photoelectric isolation)

It is proportional to the standard volume flow rate, 4mA corresponds to 0 m3/h, 20 mA corresponds to the maximum standard volume flow rate (this value can be set in the first level menu), system: two-wire or three-wire system, the flow meter can recognize and outputs correctly based on the inserted current module automatically.

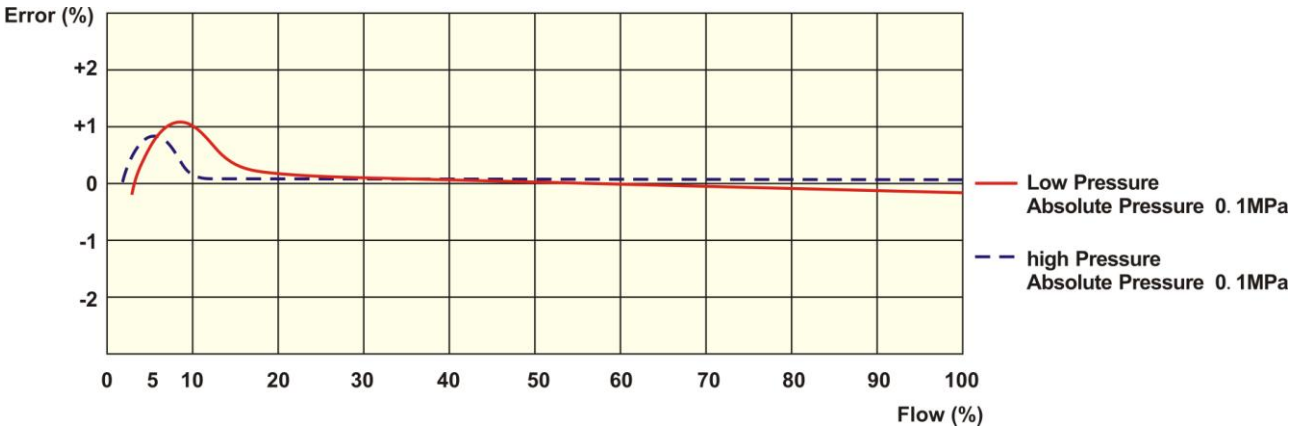
3.9.6 Control Signal Output：

1)IC card standard volume signal (IC_out): output in pulse signal, the pulse width is 50ms, 100ms, 500ms, the pulse amplitude is about 3V, normal level can be set, transmission distance ≤50m, each pulse represents 0.01m3, 0.1m3, 1m3, 10m3, suitable for use with IC card system

2)Battery voltage output (BC terminal, first-level battery low voltage alarm): open collector output, amplitude ≥2.8V, load resistance ≥100kΩ;

3)Battery under-voltage alarm output (BL terminal, secondary battery low voltage alarm): open collector output, amplitude ≥2.8V, load resistance ≥100kΩ

3.9.7 Typical error curve of flow meter (see below figure)



3.9.8 The uncorrected flow range of the flow meter at the condition of air under normal temperature and pressure

Diameter（mm/inch）	Model	Flow specification	Flow Range（m³/h）	Startup Flow Rate（m³/h）	Maxi. Pressure Loss（kPa）	Shell material	Weight（kg）
DN25（1″）	TRFM1.0-G-50(A)	G50	5-50	≤1	1	≤1.6MPa aluminum ≥2.0MPa carbon steel or SS304	7
DN40（1½″）	TRFM1.0-G50(A)	G60	6-60	≤1	1		8
50(2″)	TRFM1.0-G-50(A)	G40	6.5-65	≤1.3	0.9		8.5
	TRGM1.0-G-50(B)	G65	8-100	≤1.6	zz0.8		
	TRFM1.0-G-50(C)	G100	10-160	≤2.4	2.0		
80(3″)	TRFM1.0-G-80(A)	G100	8-160	≤2.4	1.0		9.5
	TRFM1.0-G-80(B)	G160	13-250	≤3.0	1.6		
	TRFM1.0-G-80(C)	G250	20-400	≤5.0	2.0		
100(4″)	TRFM1.0-G-100(A)	G160	13-250	≤3.3	1.0		15
	TRFM1.0-G-100(B)	G250	20-400	≤4.2	1.6		
	TRFM1.0-G-100(C)	G400	32-650	≤6.7	1.8		
150(6″)	TRFM1.0-G-150(A)	G400	32-650	≤7.8	1.6		27
	TRFM1.0-G-150(B)	G650	50-1000	≤10	2.0		
	TRFM1.0-G-150(C)	G1000	80-1600	≤12	2.3		
200(8″)	TRFM1.0-G-200(A)	G650	50-1000	≤13	1.6	carbon steel or SS304	45
	TRFM1.0-G-200(B)	G1000	80-1600	≤16	2.0		
	TRFM1.0-G-200(C)	G1600	130-2500	≤20	2.2		
250(10″)	TRFM1.0-G-250(A)	G1000	80-1600	≤20	1.2		128
	TRFM1.0-G-250(B)	G1600	130-2500	≤22	2.0		
	TRFM1.0-G-250(C)	G2500	200-4000	≤25	2.3		
300(12″)	TRFM1.0-G-300(A)	G1600	130-2500	≤22	1.6		265
	TRFM1.0-G-300(B)	G2500	200-4000	≤25	2.0		
	TRFM1.0-G-300(C)	G4000	320-6500	≤35	2.3		
400(16″)	TRFM1.0-G-400(A)	G1600	300-2500	≤25	1.8		380
	TRFM1.0-G-400(B)	G2500	500-4000	≤35	2.0		
	TRFM1.0-G-400(C)	G4000	600-8000	≤40	2.3		

（1） Accuracy level: + -1.0%, + -1.5%;

（2） "Maximum pressure loss" is the measured pressure loss value when medium is air and max flow under the standard state;

（3） The shell pressure grade:1.6MPa,2.5MPa,4.0MPa;

（4） Weight is reference data under pressure 1.6mpa;

（5） When other pressure specifications and special shell materials are needed, please specify when ordering.

IV、Working Principle, Structure and Size

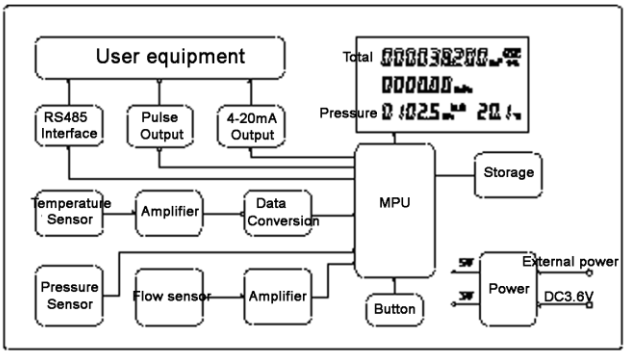
4.1 Working Principle

When the gas flows into the flow meter, it is rectified and accelerated as it passes through the integrated two-stage rectifier, then it acts on the turbine blades at a certain angle to the flow direction. Under the momentum of the gas, because the turbine blades are at a certain angle with the flow direction of the gas, the turbine generates a rotational torque at this time, the turbine begins to rotate after it overcomes the resistance torque and the friction torque.

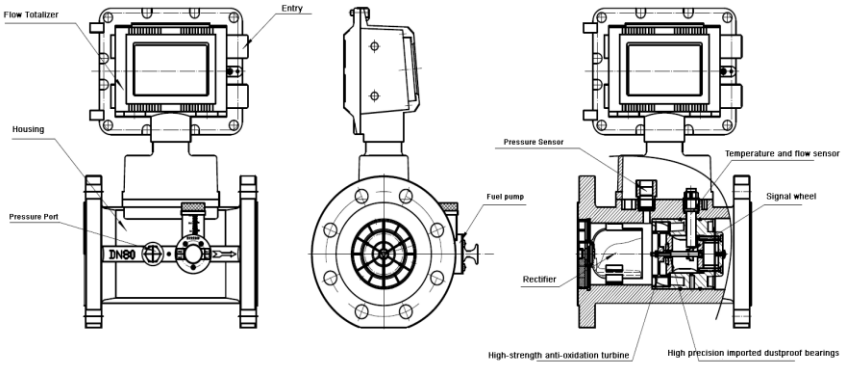
When the torques are balanced, the rotation speed is constant, and the turbine rotation angular velocity has a linear relationship with the flow rate. Using the principle of electromagnetic induction, a rotating turbine drives the top magnetizer of the signal generator to periodically change the magnetic resistance, so that the magnetic field also changes accordingly, thereby inducing a pulse signal proportional to the fluid volume flow.

The signal is amplified by the preamplifier, and after shaping, the pressure and temperature signals detected by the pressure sensor and the temperature sensor are input to the flow totalizer for calculation processing and converted into a flow value, which directly displays the standard instantaneous volume flow and volume total flow.

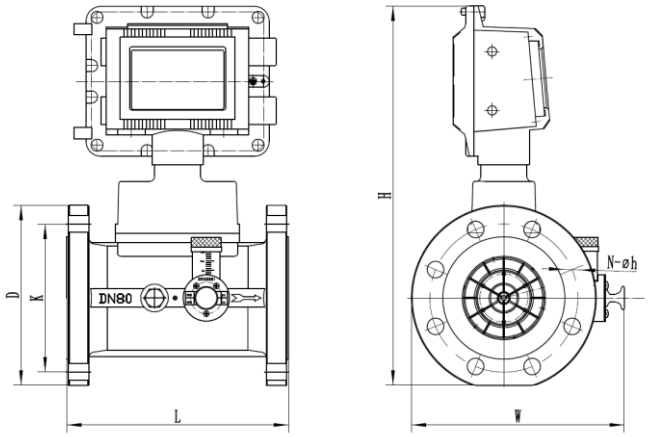
4.2 Working Principle Diagram



4.3 Structure Drawing



4.4 Gas turbine flow meter connection size



Nominal Diameter	L	D	K	N-Ø h	H	W	Notes
DN25(1″)	200	115	85	4-φ14	335	200	1. Flange standard: GB9113.1-2000 2. Pressure: 1.6MPa 3. Unit: mm
DN40(1½″)	200	150	110	4-φ18	365	230	
DN50(2″)	150	165	125	4-φ18	375	275	
DN80(3″)	240	200	160	8-φ18	409	280	
DN100(4″)	300	220	180	8-φ18	430	285	
DN150(6″)	450	285	240	8-φ22	495	370	
DN200(8″)	600	340	295	12-φ22	559	390	
DN250(10″)	750	405	355	12-φ26	629	480	
DN300(12″)	900	460	410	12-φ26	680	535	
DN400(16″)	1200	580	525	16-φ30	793	665	

Ⅴ、Model Selection

TRFM1.0-G	Specifications	×××	×	×	×	×	×	×	×	×
Nominal Diameter (mm)	Check code number									
Flow Range	Check 4.9.8		A							
	Check 4.9.8		B							
	Check 4.9.8		C							
Accuracy	1.0 Class			1						
	1.5 Class			2						
Nominal Pressure	1.0MPa				1					
	1.6MPa				2					
	2.5MPa				3					
	4.0MPa				4					
Structure	Remote Type					1				
	Compact Type					2				
Body Material	Aluminum Alloy						1			
	Carbon Steel						2			
	Stainless Steel						3			
Output/ Communication	Pulse							1		
	4~20mA							2		
	4~20mA+485							3		
	4~20mA+HART							4		
Power Supply	External Power 24-30VDC(Two Wire Type)								1	
	External Power 24-30VDC(Three Wire Type)								2	
	Lithium Battery Powered (3.6VDC)								3	
Ex-Proof	None									1
	Intrinsically safe									2
	Flameproof									3

Code Number

Nominal Diameter (mm)	Code
25	250
32	320
40	400
50	500
80	800
100	101
150	151
200	201
250	251
300	301
400	401

5.1 Selection of Flow Meter

TRFM1.0-G series gas turbine flow meter integrates flow sensor, temperature sensor, pressure sensor and intelligent flow totalizer to realize the temperature and pressure compensation and compression factor correction of the flow, directly display the volume flow under the standard state. According to the gas equation of formula (1) to calculate and compensation. The gas equation is as follows (circuit):

$$Q_n = \frac{P_a + P_g}{P_n} \times \frac{T_n}{T_g} \times \frac{Z_n}{Z_g} \times Q_g \quad \text{.....(1)}$$

Where:
Qn: Corrected volume flow (m3/h)
Qg: Uncorrected volume flow (m3/h)
Pa: Local atmospheric pressure (kPa)
Pg: Gauge pressure at the pressure detection point of the flowmeter (kPa)
Pn: Standard atmospheric pressure (101.325kPa)
Tn: Absolute temperature under standard state 293.15K (20℃)
Tg: The absolute temperature of the medium (273.15K+T)
T: Celsius temperature of the measured medium (℃)
Zn: Media compressibility under standard conditions
Zg: Media compression factor under working conditions

(*Note: For natural gas Zn/Zg=(FZ)2, FZ is the super compressibility factor, calculated according to the formula in China National Petroleum Corporation's standard SY/T6143-1996) (circuit)

How to choose the size of flow meter

The user should estimate the maximum and minimum volumetric flow of the pipeline according to the gas volume of the pipeline and the possible temperature and pressure range of the medium, then select the flow meter specifications correctly. When two sizes of flow meters can both cover the minimum and maximum volumetric flow rate, the smaller size flow meter should be selected when the pressure loss allows.

Calculated as follows:

$$Q_g = Q_n \div [\frac{P_a + P_g}{P_n} \times \frac{T_n}{T_g} \times \frac{Z_n}{Z_g}] \quad \text{.....(2)}$$

Where: Tg, Pg, Pa same as above

Qg is working condition volumetric flow

Qn is the standard volumetric flow

- Example of how to choose the size of flow meter

One pipeline actual working pressure range is gauge pressure (1.0～1.2) MPa, the medium temperature is (-10～+40)℃, max standard flow is 10000m^3/h, min standard flow is 3500 m^3/h. Natural gas actual relative density is Gr=0.519,N_2 Moles is Mn=1.6%, CO_2 Moles is M_C=0.8%

When atmospheric pressure is 101.325kPa, which size of flow meter should choose?

According to the above information:

When the lowest pressure and highest temperature, according to formula SY/T6143-1996,

We can get that Zn/Zg=1.0127, and max volumetric flow:

$$Q_{gmax}=Q_n \div [\frac{P_a+P_g}{P_n} \times \frac{T_n}{T_g} \times \frac{Z_n}{Z_g}]$$

=10000÷{[(1000+101.3)/101.325] ×[293.15/(273.15+40)] ×1.0127}
=970.5（m^3/h）

The same we can get the min volumetric flow is 236 m^3/h

Thus we need to choose DN150mm gas turbine flow meter.

Gas turbine flow meter pressure loss

The pressure loss of the gas turbine flow meter is related to the drive of the turbine flow meter, the friction inside the pipeline, and the direction & speed of the fluid.

The pressure loss of the turbine flow meter in the working state is obtained by the following formula:

$$\Delta P = \Delta P_{max} \times \frac{\rho_n}{1.205} \times \frac{P_a+P_g}{P_n} \times \frac{T_n}{T_g} \times \frac{Z_n}{Z_g} \times (\frac{Q}{Q_{max}})^2 \quad \text{.....(3)}$$

Meanings：
ρn：Density of gas in standard state
△ P_{max}：Max. pressure lose in standard state(medium is dry air)
（20℃,101.325kPa, ρ=1.205kg/m^3）
Pa：Local atmospheric pressure（kPa）
Pg：Medium meter pressure（kPa）
Pn：Standard atmospheric pressure（kPa）
Tn：Absolute temperature under standard condition（273.15+20℃）
Tg：Absolute temperature under working condition（273.15+T）
T：Tested medium temperature（℃）
Zn：Gas compressibility under standard conditions
Zg：Gas compressibility under working conditions
Q：flow under working condition（m^3/h）
Qmax：Max flow under working condition（m^3/h）

Gas density under standard condition

Gas	Density（kg/m^3）	Gas	Density（kg/m^3）
Natural Gas(H_4)	0.828	Carbon	1.250
Ammonia(NH_2)	0.771	Methane(CH_4)	0.720
Argon(Ar)	1.780	Propane(C_3H_8)	2.010
Butane(C_4H_{10})	2.700	Pentane(C_5H_{12})	3.460
Ethane(C_2H_6)	1.360	Nitrogen(N_2)	1.250
Ethylene(C_2H_4)	1.260	Hydrogen(H_2)	0.090
Carbon	1.980	Air(N_2+O_2)	1.290

Ⅵ、Installation

To make sure high accuracy of the flow meter, we must install it correctly.

6.1 Straight Pipe Requirements：

1) Flow meter must install on the pipe horizontally(The inclination is within 5°），The axis of the flow meter should be concentric with the axis of the pipeline during installation, and the flow direction should be same
2) There should be straight pipe not less than 2D upstream of the flow meter. If it's possible, it is recommended that the upstream straight pipe section be 20D and the downstream be 5D.

6.2 Pipeline requirements:

Pipeline's inner diameter should be same as flow meter's inner diameter.(Both upstream and downstream)

6.3 Bypass pipe requirements：

To make sure it would not affect the medium's using while maintain the flow meter, we should install shut off valve before and behind the pipe. Meanwhile, set the bypass pipe. Flow control valve should install downstream of flow meter. While using the flow meter, upstream valves should be all open to avoid unstable measurement.

6.4 Environment requirements：

Flow meter's better install indoors. While install outdoors, please take sun protection, rain protection measures so as not to affect the service life.

6.5 Impurities in the medium：

To ensure a long service life, should install a filter before flow meter.

6.6 Installation place：

Flow meter should be installed in a place that is convenient for maintenance and free from strong electromagnetic interference and heat radiation.

6.7 Installation and welding requirements：

1) User should match a pair of flanges to install flow meter, don't welding the flow meter on pipe directly.
2) Before installation, the welding slag and other dirt in the pipeline should be cleaned. It is best to use an equal diameter pipeline (or bypass channel) instead of the flow meter to purge the pipeline.

Notice: The gasket between the flanges cannot be recessed into the pipe.

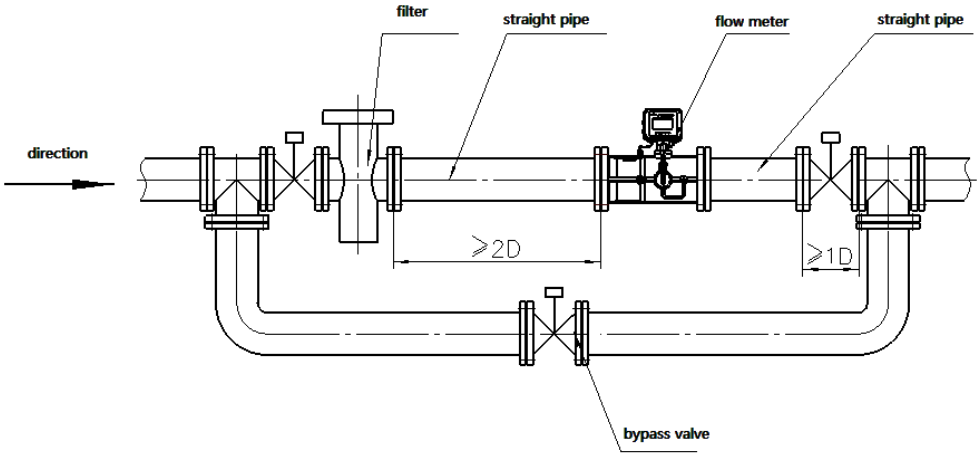
6.8 Grounding：

Flow meter should be grounded reliably, it can not share ground wire with strong current system.

6.9 Explosion Proof Requirements：

For safety, please check whether the working environment of the explosion-proof flow meter conforms to the user's explosion-proof requirements and regulations. Please strictly abide by the national explosion-proof product use requirements during installation and using. User is not allowed to change the connection method of the explosion-proof system and is not allowed to open the front and back cover, pressure port and other components of the flow meter.

6.10 Installation Diagram：



VII、Flow Meter Display/Parameters Setting

7.1 Working Condition

Flow meter will perform a self-check when it is powered on. If the self-check is abnormal, the self-check error menu will be displayed (refer to the self-check menu for the description), and it will jump to the main interface after about 1 to 2 seconds. Otherwise, it will directly jump to the main menu. After the main menu is started, it is as shown below:

Main interface

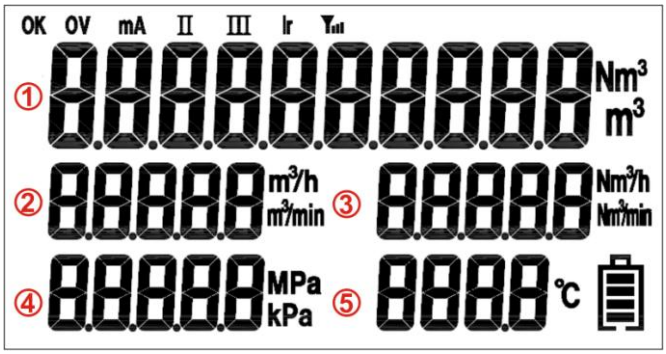
① : Total Flow

② : Working Condition

③ : Standard Condition

④ : Pressure

⑤ : Temperature



1) “OK”: The running status of the flow meter is displayed in real time. If it displays "OK" if it woks well, it displays "ERR" if it’s fault
2) “OV”: The operating parameter of the instrument overflows. If the operating parameter of the instrument overflows, it will display “OV”. If it is normal, it will display empty (overflow includes the parameter that cannot be negative is negative, and the value that cannot be zero is zero, and the data exceeds the display range);
3) “mA: The indicator of the current output overflow of the instrument, if the current overflows, it will display "mA", if it is normal it will be empty;
4) “II” and “III”: Operating power supply mode display. If it is in battery mode, the current battery level will be displayed. When the two-wire current output is connected, the number sign "II" will be displayed. If it is three-wire system, the number sign "III" will be displayed.
5) “IR”：Remote control button prompt, when this symbol appears, it indicates that the remote control button is available.
6) Wireless communication, prompting the communication signal strength;
7) Total amount: cumulative flow, the display value can retain 5 decimal places, the maximum value is 999999999; the unit is m3, Nm3 for selection;
8) Flow rate under working conditions: the minimum display value is 3 decimal places, and the maximum value is 99999m3/h;
9) Flow rate under standard conditions: the minimum displayed value is 3 decimal places, and the maximum value is 99999Nm3/h;
10) Pressure: The minimum display value is 3 decimal places, the maximum value is 99999, and the unit has Kpa and Mpa for selection;
11) Temperature: display value range is -50℃-300℃;
12) Operation power supply mode display, and displays battery power.

Warning: Don’t open the cover when there is explosive gas on site!

7.2 Function description of keys

The flow meter is used to set the parameters by pressing the buttons. Generally, some parameters need to be set manually by pressing the buttons during use. The flow meter has four buttons, from left to right, there are four buttons: SET, SHT, INC and RST. The description of the buttons is as follows:

Button	Name	Function
SET	Set Key	1. Enter parameter setting; 2. Switch to display each parameter item; 3. Confirm and save new parameters after modifying and setting the parameter
SHT	Shift Key	Make the parameters flicker in turn
INC	Plus Key	To cause a bit of parameter to flicker from 0 to 9.
RST	Exit Key	Exit the parameter setting interface and enter the flow display interface

VIII、Terminal Structure & Connection Instruction of Flow meter

8.1 Connection

1	2	3	4	5	6	7	8	9	10	11
VCC	PIN	GND	MS	GND	IP+	VP+	VP-	IP-	T1	T2
Flow Signal			Magnetic Attach Interface		Pressure Sensor				Temperature Sensor	

1) The flow meter can receive processed signals and can supply power to the signal processing board. The wiring is as followings:

VCC: supply power 3V

PIN: frequency In

GND: ground

2) Magnetic Attack Interface：

MS: magnetic attack input

GND: ground

3) Pressure Sensor：

IP+，pressure sensor power supply +；

VP+，pressure sensor signal +；

VP-，pressure sensor signal -；

IP-，pressure sensor power supply -；

4) Temperature Sensor（Pt100 or Pt1000）：

T1： Pt100（1）

T2： Pt100（2）

8.2 External Terminal Definition

1） J17 Terminal Definition

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

+24v：power supply DC24V+
0V：power supply 0V
I+: current output
I-: current output
FOUT: pulse output
DOUT: equivalency output
A: RS-485 A
B: RS-485 B

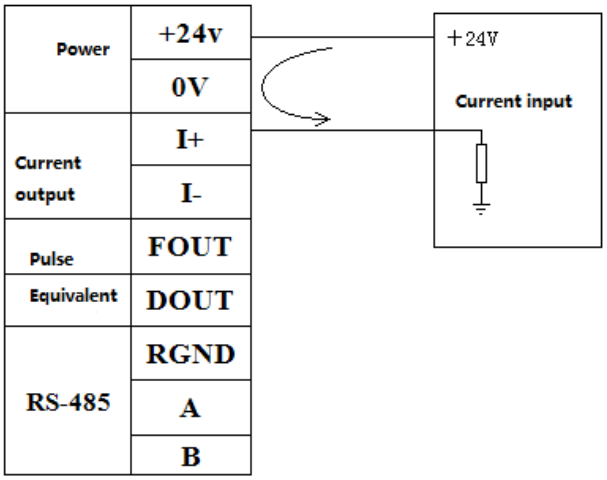
2） J18 Terminal Definition

1	2	3	4	5	6	7	8
A1	B1	IC	BC	BL	GND	GND	VCC

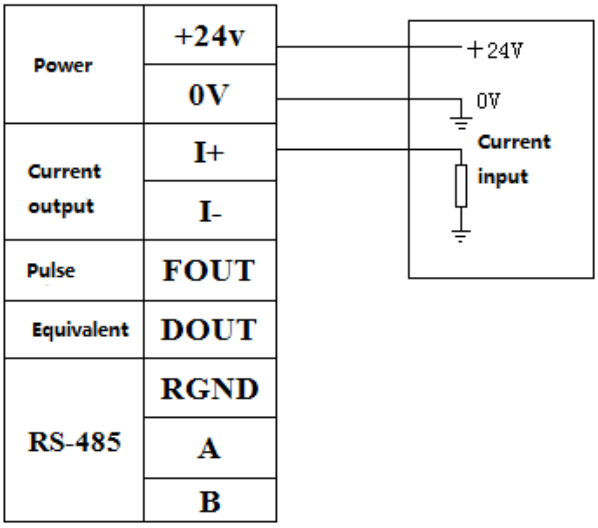
A1：Reserved RS485
B1：Reserved RS485
IC: IC card controller pulse (amplitude 3VDC)
BC: First level low power alarm, used for IC valve control
BL：Second order to low power alarm, used for IC valve control.
GND：IC card controller pulse Output -
GND： GND Output（Controllable）
VCC：+3VDC Output（Controllable）

8.3 Output Wiring Instructions

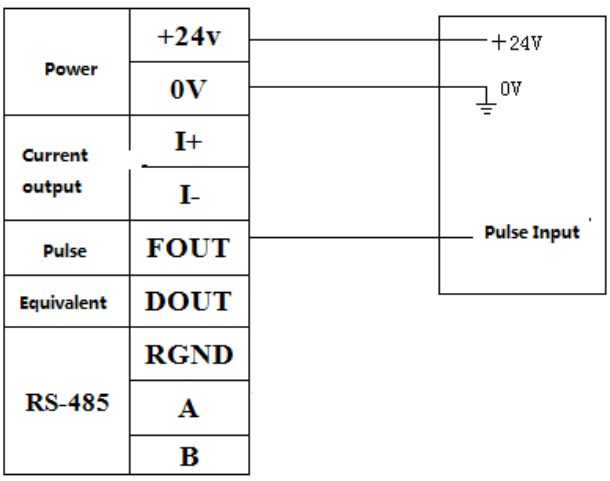
1）Two-wire current connection:



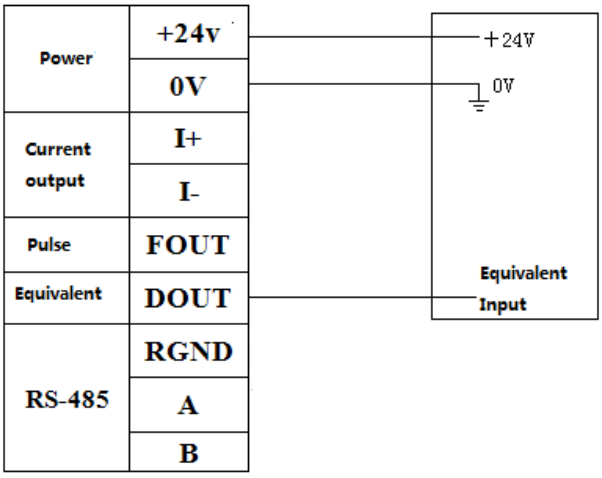
2）Three-wire system current connection method：



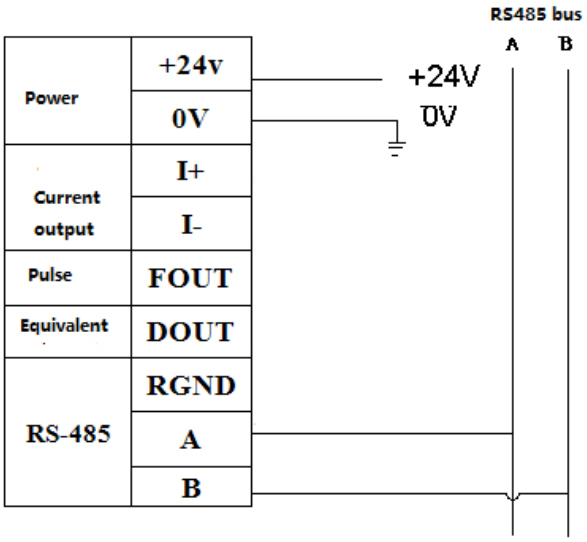
3）Three-wire pulse connection：



4）Three-wire equivalent connection：



5）RS485 Communication connection：



IX、Application Note

1. The selection is within the specified flow range to prevent long-term overload operation to ensure the desired accuracy and normal service life;
2. When the flow meter is installed and put into operation, the front valve should be opened slowly, and then the rear valve should be opened to prevent instantaneous airflow from damaging the turbine;
3. Lubricating oil should be operated in accordance with the refueling sign. The number of refueling depends on the cleanliness of the temperament, usually every 2 to 3 months.
4. Prevent the turbine from over-speeding due to pressure test, purging pipes or exhaust, and the turbine running in reverse flow may damage the flow meter;
5. It is not allowed to open the front cover at will when the flow meter is running (there is a circuit board in the cover, and an accidental short circuit will cause electric sparks. When there is flammable and explosive gas at the scene, it will cause serious accidents), and change the operating parameters (changing the parameters will affect The normal operation of the flow meter); (circuit)
6. Install gaskets carefully to ensure that no protrusions enter the pipeline to prevent interference with normal flow measurement；
7. When the flow meter is calibrated, the pressure should be collected on the pressure port of the flow meter. After the calibration is completed, the pressure port bolt should be tightened in time to prevent air leakage during use;
8. The upper limit pressure should be correctly selected according to the actual working pressure. The working pressure range of the corrector is required to be 20% Pmax ~ Pmax. Too small a pressure will affect the measurement accuracy, and if the upper limit pressure is too large, the pressure sensor will be damaged;
9. When the corrector is in operation, it is not allowed to open the back cover or change the internal related parameters, otherwise it will affect its operation; (circuit)
10. If the correction instrument outputs a 4mA-20mA current signal, in order to improve its accuracy, the user should set the value corresponding to 20mA according to the actual maximum value. (Circuit)

Ⅹ、Notification for explosion-proof products

10.1 Intrinsically safe flow meter should follow the following items

1) The specific model specifications of the product certification are the products included
2) in this manual; (circuit)
3) The ambient temperature of the product is: -30 ℃ ～ + 50 "; (circuit)
4) The battery must be replaced in a safe place; (circuit)
5) There is no harmful gas corrosive to aluminum alloy at the installation site; (circuit)
   The product shell is equipped with a grounding terminal, and the user should be reliably grounded when using it（Circuit）
6) The user shall not replace the parts of the product by himself, and shall work with the company to solve the faults in operation to prevent damage（Circuit）
7) The safety barrier must be installed in a safe place, and its installation, use and maintenance must comply with the safety barrier instruction manual
8) When installed and used on site, it must be connected with a safety barrier approved by the explosion-proof inspection agency to form an intrinsically safe explosion-proof system; if it is to be connected with other types of safety barriers, it must be approved by the explosion-proof inspection agency
9) The connecting cable between the corrector and the safety barrier (the cable must have an insulating sheath), the cross-sectional area of the core wire is ≥0.5mm2, the cable wiring should eliminate the influence of electromagnetic interference as much as possible, and the cable distribution parameters should be controlled within 0.04uF/1mH
10) When installing, using and maintaining this product, the user must also comply with the instruction manual, GB3836.13-2013 "explosive gas environment, Part 13: Equipment Repair, Overhaul, Repair and Transformation", GB/T3836.15-2017 "Electrical Equipment for Explosive Gas Environment; Part 15: Electrical Installation in Hazardous Locations (Except Coal Mines)", GB/T3836.16- 2017 "Electrical Equipment for Explosive Gas Atmosphere; Part 16: Inspection and Maintenance of Electrical Equipment (Except Coal Mines)" GB/T3836.18-2017 "Explosive Atmosphere; Part 18: Intrinsic Safety System" and GB50257-2014 "Electrical Equipment Installation engineering explosion and fire hazard environment electrical installations construction and acceptance regulations";
11) During normal working, maintenance and cleaning of the instrument, avoid the ignition hazard caused by electrostatic charge. Do not touch or wipe the equipment when used in an explosive environment. If you must wipe or touch, it should be carried out in a well-ventilated place without gas leakage. Wipe the case with a damp cloth that has been wrung out to avoid sparks caused by static friction. (Circuit)

10.2 Explosion-proof flow meters should follow the following items:

1) Ambient temperature:-20℃～+60”
2) Please contact manufacturer for repairs involving flameproof joints
3) Measures should be taken to avoid the risk of ignition caused by electrostatic charges on exposed non-metallic parts of the product
4) There is no harmful gas corrosive to aluminum alloy at the installation site
5) The shell grounding wire should be reliably grounded
6) Strictly abide by "It is strictly forbidden to open the cover when power is on" when using and maintaining on site
7) The user shall not replace the parts of the product by himself
8) When installing, the cable entry must be equipped with a cable entry device that has been approved by the explosion-proof inspection and has a thread specification of M16X1.5, the corresponding explosion-proof grade, and the temperature resistance is not less than 90°C and is compatible with the product.
9) When installing, using and maintaining the product, the user must strictly abide by the product instruction manual and GB3836.13-2013 "Explosive Gas Atmosphere, Part 13: Equipment Repair, Overhaul, Repair and Modification", GB/T3836.15-2017 "Electrical equipment for explosive gas atmospheres; Part 15: Electrical installation in hazardous locations", GB/T3836.16-2017 "Electrical equipment for explosive gas atmospheres; Part 16: Inspection and maintenance of electrical installations" and GB50257-2014 "Electrical The relevant provisions of the “Code for Construction and Acceptance of Electrical Installations in Explosive and Fire Hazardous Environments for Installation Engineering”

XI、Maintenance and troubleshooting

Fault description	Causes	Solution
After power on no output signal	1. No flow rate or flow rate is lower than starting flow rate 2. Checking the power supply and whether the output wiring is normal	1. Increase flow rate 2. Correct wiring
Display instantaneous flow under no flow in pipe	1. Poor grounding of the flow meter or other electrical interference 2. Unstable power supply, poor filtering or other electrical interference	1. Correct grounding wiring, preclude interference 2. Maintenance/replace power, preclude interference
No display when gas flows through the flow meter	1. Flow rate is lower than the starting flow 2. Impurities in the pipeline jam the impeller 3. Pressure difference between the two ends of the instrument is too large to cause shock 4. The over-range causes the over-speed to damage the bearing	1. Replace instrument or use smaller size 2. Clean Impurities 3. Return to factory
Instantaneous flow rate is unstable	1. The impeller speed of the flow meter is unstable and the flow is unstable 2. Poor grounding 3. Unstable power supply 4. There are impurities in the shell 5. The flow is below the low limit 6. The gasket extends into the pipe to cause interference 7. Unsteady flow rate	1. Re install the impeller or remove dirt 2. Checking grounding wiring and make it correct 3. Repair and replace the power supply, eliminate interference 4. Remove dirt 5. Increase flow rate 6. Replace or correct sealing gasket 7. Measuring again after flow rate is stable
Cumulative does not match the actual flow	1. Wrong K factor 2. The user's normal flow is lower or higher than the normal flow range of the selected flow meter	1. Enter new K factor 2. Adjust the pipeline flow rate to make it normal or select appropriate specifications 3. Calibrate again
Abnormal Display	Key issue	Replace Key
Replace new batteries Crash	The power-on reset circuit is abnormal or the oscillation circuit does not vibrate	Re install the battery (need to discharge after 5 seconds)

XII、Transportation and Storage

12.1 The flow meter should be packed in a wooden box (the medium and small diameters should be packed in a carton with foam for anti-vibration). It is not allowed to move freely in the box. When moving, handle it with care and do not allow rough handling.

12.2 The storage location should meet the following conditions

1) Rain proof and Moisture proof

2) Not subject to mechanical vibration or shock

3) Temperature range -30℃～+50℃

4) Relative humidity is not more than 80%

5) The environment does not contain corrosive gas

XIII、Unpacking and Inspection

13.1 Check the integrity of the external packaging when unpacking, check the contents, specifications, and integrity of the instrument and accessories according to the packing list.

13.2 Included documents:

1) Instruction manual (1 copy)
2) Product qualification certificate (1 copy)
3) Product inspection certificate (1 copy)
4)Packing list (1 copy)

13.3 Accessories

1) Filter gasket (1 piece)
2) Rubber gasket (1 piece)
3) Bearing lubricant (1 bottle)

Order form

TRFM1.0-G Series Gas Turbine Flow Meter

Client's name:			Order date:	
Contact:			Department:	
Address:			Postal code:	
Tel:			Fax:	
E-mail:			Delivery time:	
Consignee:			Tel:	
Detailed delivery address:				
Delivery method	□Logistics	□Express	□Air	□Other
Remarks:				
Detailed parameters of flow meter				
Model				
Diameter				
Material				
Accuracy				
Measuring medium				
Max flow rate				
Min flow rate				
Min temperature				
Max temperature				
Min pressure				
Max pressure				
Ambient temperature				
Environmental pressure				
Output	□(4～20)mA □IC Card Quantitative pulse □Battery alarm signal □Flow alarm signal		□(4～20)mA □IC Card Quantitative pulse ☒Battery alarm signal □Flow alarm signal	□(4～20)mA □IC Card Quantitative pulse □Battery alarm signal □Flow alarm signal
Communication	□RS232C □RS485 □MODBUS		□RS232C □RS485 □MODBUS	□RS232C □RS485 □MODBUS
Quantity	Set		Set	Set

XIV、 Communication Protocol（RTU）（V1.0)

14.1 Data Format Description

14.1.1 Communication Mode

This meter adopts MODBUS RTU Format.

The protocol is used for data communication in master-slave query mode.

14.1.2 Data Format

Data format is n, 8, 1（1 start bit, 8 data bits, 0 parity bit, 1 stop bit)

Baud: 1200, 2400, 4800, 9600

Start	Address	Function	Data	CRC Check	END
T1-T2-T3-T4	8 bit	8 bit	n*8 bit	16 bit	T1-T2-T3-T4

Note: T1, T2, T3, T4 are the time intervals between each frame, and the transmission between two frames must be greater than the interval time。

1.3 Address

The address of the instrument is specified in the protocol as “0-255”, the "0" address is used for broadcasting(this protocol does not support broadcasting), and the rest are reserved.

14.2 Command Description

14.2.1 This instrument uses 1 command in MODBUS protocol as below：

Command 03	Read single or multiple holding registers

14.2.2 Data Format

The data in the protocol includes: integer, floating point

Integers are represented as 16-bit unsigned integers.

32 single-precision floating-point numbers (SINGLE format) is IEEE754, equivalent to 4 bytes, the arrangement order is 3-4-1-2

After converting to the 1234 sequence, the positions from highest to lowest are 31st, 30th, 29th, ..., 0.

31	30-23	22-0
S	Level Code	Tail Code

The 31st bit is the sign bit (S), 1 indicates that the number is negative, 0 otherwise;

30-23 bit，Total 8 bit level code;

22-0 bit，Total 23 bit tail code.

Command 3 Format As Below: (Read Register Command):

MODBUS Query:

Meter Address	1 BYTE	01-255
Function Code	1 BYTE	03
Starting Address	2 BYTE	0-FFFF
Loader /Reads As	2 BYTE	1-20
CRC Low	1 BYTE	
CRC High	1 BYTE	

MODBUS Response：

Meter Address	1 BYTE	01-255
Function Code	1 BYTE	03
Byte Count	1 BYTE	N
Input Mode	N*2 BYTE	
CRC Low	1 BYTE	
CRC High	1 BYTE	

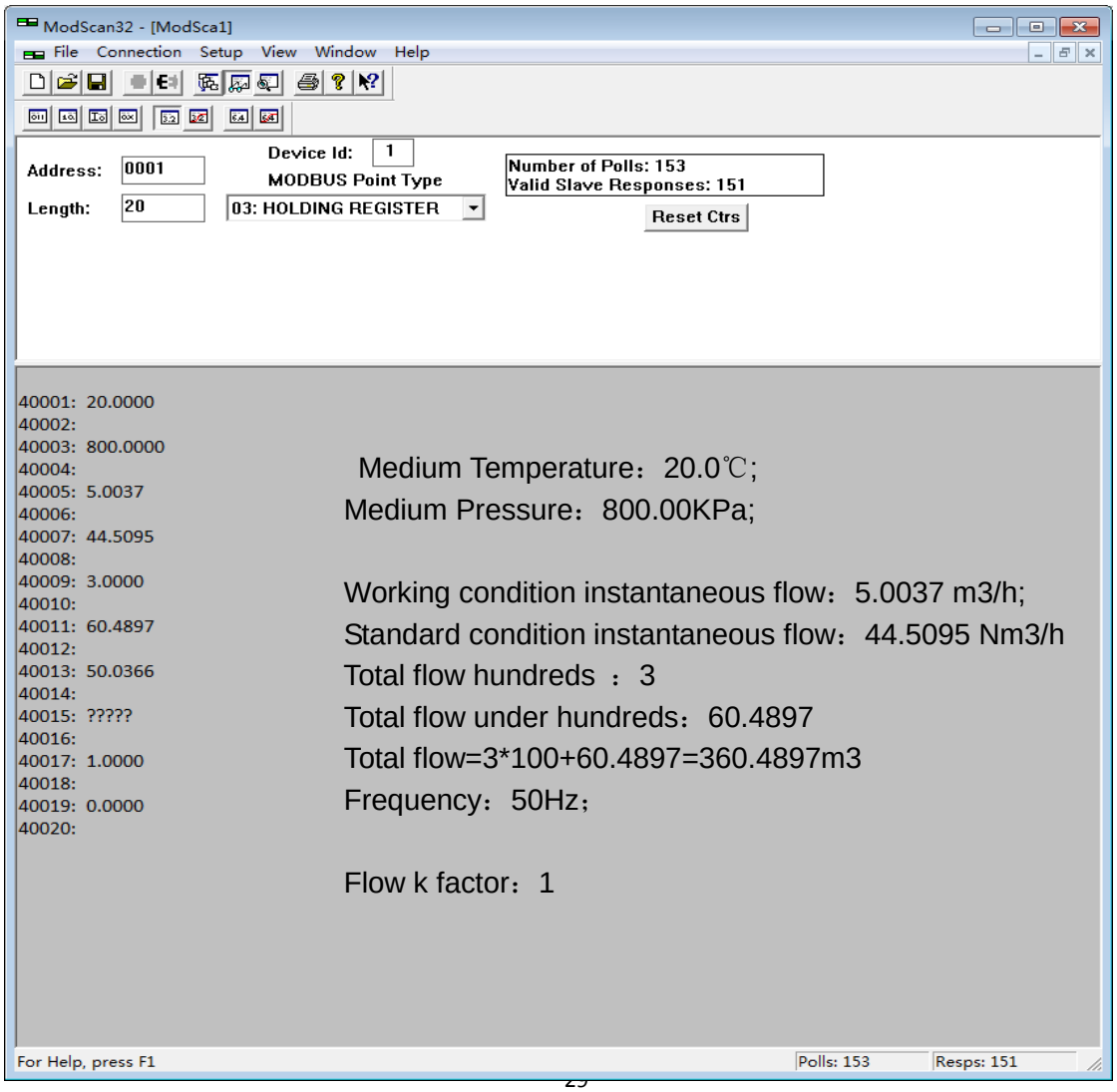
Example:

Query		**Respond**	
Domain	Data（HEX）	Domain	Data（HEX）
Meter Address Code	01	Meter Address Code	01
Function Code	03	Function Code	03
Starting Address High（byte）	00	Byte Count	08
Starting Address Low（byte）	00	Register High（0001）	0C
Read Data Volume High（Byte）	00	Register Low（0001）	E8
Read Data Volume Low（Byte）	04	Register High（0002）	C2
		Register Low（0002）	FB
		Register High（0003）	C9
		Register Low（0003）	26
		Register High（0004）	C3
		Register Low（0004）	7B
CRC Check	Parity bit	CRC Check	Parity bit

Data Definition

	Address	Register Length	Data Type	Discription
R	40001-2	2	SINGLE	Medium Temperature (℃)
R	40003-4	2	SINGLE	Medium Pressure（kPa）
R	40005-6	2	SINGLE	Instant Flow（m^3/h）
R	40007-8	2	SINGLE	Nominal Instant Flow（Nm^3/h）
R	40009-10	2	SINGLE	Accumulative Flow Above Hundred's Digit
R	40011-12	2	SINGLE	Accumulative Flow Below Hundred's Digit
R	40013-14	2	SINGLE	Sensor Frequency（Hz）
R	40015-16	2	Retain	Retain
R	40017-18	2	SINGLE	Cv Values
R	40019-20	2	Backup	Retain

MODSCAN32 Communication Interference（03 command）：



Temperature：20℃；
Pressure：800KPa；
Working condition instantaneous flow：5.0037 m3/h;
Standard condition instantaneous flow per second：44.5095 Nm3/h；
Total flow above hundred：3 Nm3
Total flow under hundred：60.4897 Nm3
Flow sensor frequency:50Hz
Flow K factor：1.000

Read register data (in this example, read the data displayed in the current converter)

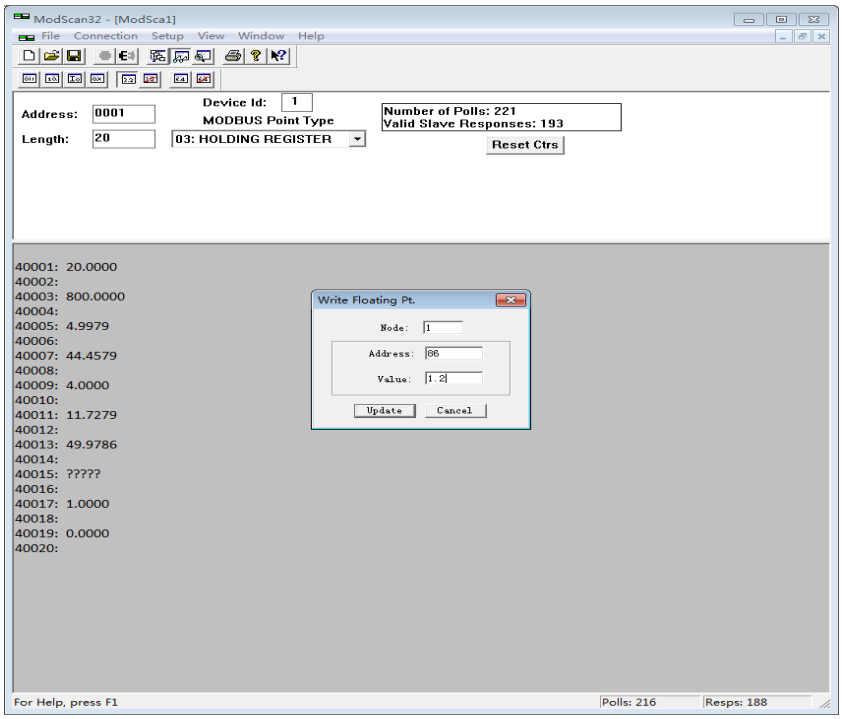
Master request：	01	03	00 00	00 14	45 C5
	Add	Function Code	Start	Length	CRC

Slave response frame：

01 03 28 00 00 41 A0 00 00 44 48 16 84 40 A0 01 6A 42 32 00 00 40 40 74 5E 42 86 1C 24 42 48 00 00 FF 00 00 00 3F 80 00 00 00 00 9A 67

01 03 28	Address, function code, number of bytes
00 00 41 A0	20℃；Temperature
00 00 44 48	80 Kpa；pressure
16 84 40 A0	5.002 m3/h；Working condition flow
01 6A 42 32	44.5013 Nm3/h；Standard condition flow
00 00 40 40	3.0 Nm3，Total flow hundreds
74 5E 42 86	67.2272 Nm3，total flow under hundreds;
1C 24 42 48	total flow =3.0*100+67.2272= 367.2272 50.027Hz，frequency
00 00 FF 00	Reserve
00 00 3F 80	1.0 flow k factor
00 00 00 00	Reserve
4D 43	CRC Check

Flow coefficient communication modification method (modified by Modscan32 software):



Flow coefficient communication modification method (Command No. 10 (send in HEX format)):

If the meter address is 1, write the coefficient 1.0, and send the data as follows:

Send：01 10 00 55 00 02 04 00 00 3F 80 26 FC

01 10	Add, Command No
00 55	Write start add
00 02	Write length
04	Send data byte length
00 00 3F 80	K factor（Float）
26 FC	CRC Check

Return：01 10 00 55 00 02 51 D8 Returning this data indicates successful writing.

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