Gear Flow Meter

Technical Manual

Attentions!

- Before installation and use, please read this manual carefully to understand the contents, correctly install the product, connect the circuits, and operate and maintain the product.
- This manual shall be kept by the actual end user.
- This manual shall be kept until the sensor is scrapped.
- The technical specifications of this product may be subject to change without notice.

Product Features:

- High and low temperature resistance (-15℃-80℃)
- Various viscous media can be measured
- High precision and high repeatability
- Pulse output/analog output optional
- Wide range ratio (1:100)
- Wide measuring range
- Strong resistance to corrosion and pollution (acid and alkali)

Application Fields

- Clean water and pure water
- Measurement of resin and glue
- Measurement of hydraulic oil, lubricating oil and grease
- Measurement of fuel oil
- Measurement of ink and asphalt
- Measurement of liquid nitrogen, refrigerant and solvent
- Measurement of edible oil, fish oil and food filling
- Measurement of fluids with chemical and anticorrosive requirements
- Fluid quantitative control system

Overview:

Gear flow meter is a kind of flow meter for measuring volume flow rate with high precision. With the flow of the medium, the gears mesh and rotate; under the action of fluid flow, the differential pressure is formed at both ends of the instrument's inlet and outlet, and no power supply is required; a pair of gears rotate freely and the cavity between the gears is filled with liquid; the liquid is discharged with the rotation, and the flow rate of the liquid flowing through the instrument can be known by measuring the number of revolutions of the gears.

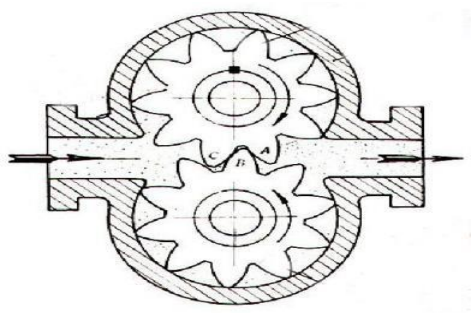


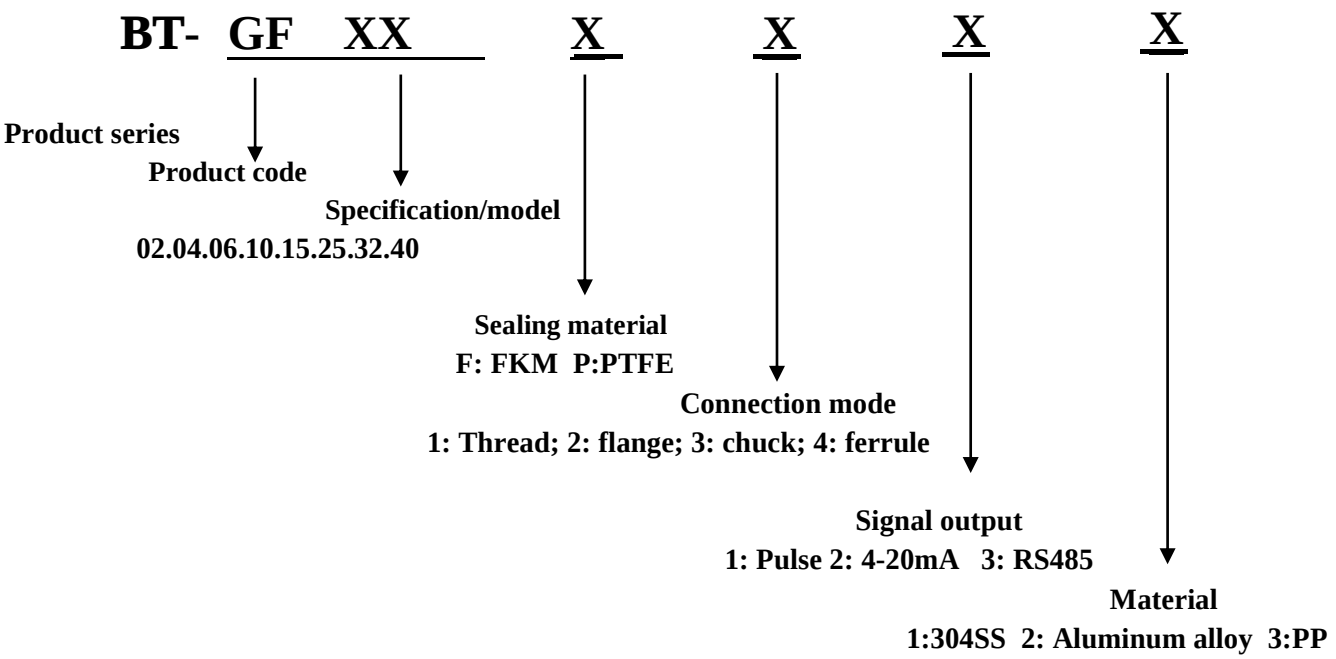
Figure1 Fluid Flow Schematic

The rotation speed of the gear flow meter is detected by the sensing coil in the signal amplifier installed on the meter housing. The signal amplifier is not in contact with the measured medium.

When the gears of the flow meter cut the magnetic line of force generated by the permanent magnet in the housing, the magnetic flux in the sensing coil will change. The sensing coil sends the detected magnetic flux periodic change signal to the preamplifier, amplifies and shapes the signal, and generates a pulse signal proportional to the flow velocity; the pulse signal is sent to the unit conversion and flow integration circuit to obtain and display the cumulative flow rate value; meanwhile, the pulse signal is also sent to the frequency-current conversion circuit to convert the pulse signal into analog current and then indicate the instantaneous flow rate value.

The gear flow meter has high machining precision and is precisely installed. The rotation of the gears is scanned in non-contact form, each tooth generates a pulse, and the resolution is very high. This gear flow meter can measure very small flow rate and quantify small volume liquid.

Product Code



Calculation formula:

The K coefficient (flow coefficient) of the gear flow meter precisely defines the number of pulses per liter within unit flow rate. The following formula is used:

$$Q = 3600 \times F/K$$

Q=Instantaneous flow rate m3/h

F=Output pulse frequency HZ

K=Coefficient of gear flow meter P/L

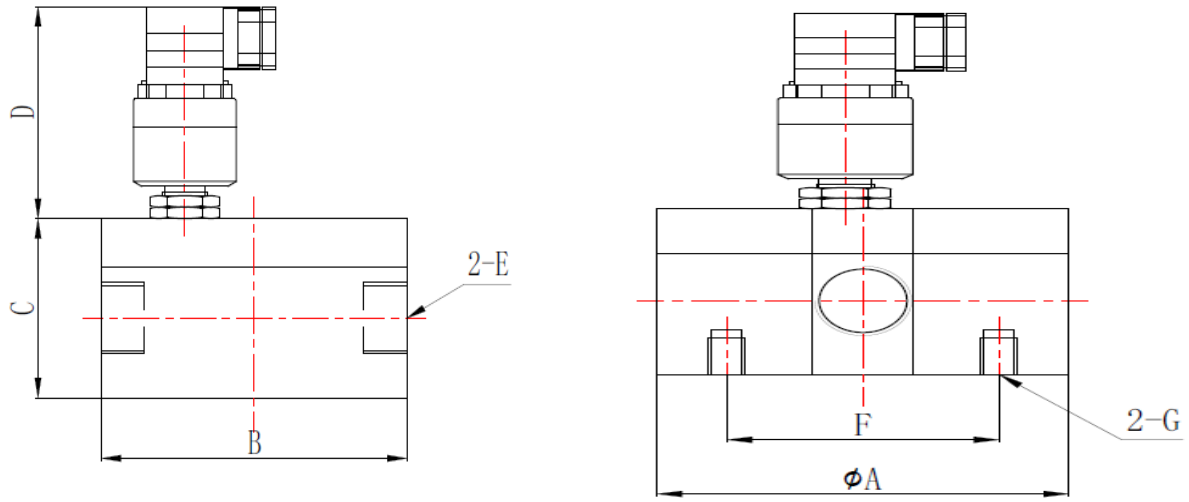
Characteristics:

The gear flow meter is a new volumetric flow transmitter, which is used for precise continuous or intermittent measurement of the flow rate or instantaneous flow rate of liquid in a pipeline.

It is especially applicable to the flow measurement of high viscosity media such as heavy oil, polyvinyl alcohol, resin, etc. (it can measure the fluid with viscosity up to 10000Pa.s). It has advantages such as small volume, light weight, low vibration noise and stable operation. It can also be used to measure micro-flow rate in a small pipe diameter. It has features such as small startup flow rate and wide range ratio, and is applicable to measuring liquid flow rate with large variation. Its measuring precision is not affected by the changes of pressure and flow rate, and it has stable performance, long service life and large flow capacity.

Performance Parameters

Figure 5 Outline Dimension Drawing



Unit; mm

Model / Dimension	A	B	C	D	E	F	G	H
GF02	Φ83	80	55	70	G1/4	40	M6	16
GF04	Φ83	80	55	70	G3/8	55	M6	16
GF10	Φ83	80	65	70	G1/2	55	M6	14
GF15	Φ113	110	65	70	G3/4	90	M6	28
GF25	Φ148	140	82	70	G1	110	M8	40
GF32	Φ218	170	105	70	G1-1/4	180	M8	45

The above dimensions are standard product dimensions. In special cases, the product can be customized according to the customer's site needs.

I. Table 1 Basic Parameters

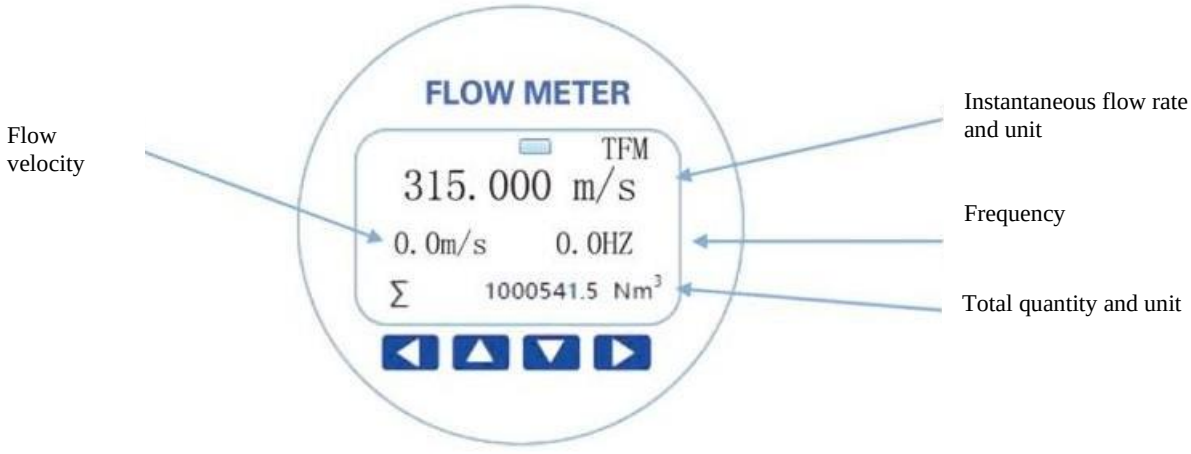
Model	Flow rate range	K coefficient	Conventional pressure bar		Temperature	Accuracy	Interface
			Aluminum alloy	304SS			
BT-GF02	0.6-50L/h	11200	16	50	-15℃-80℃	±0.5%	G1/4
BT-GF04	5-250 L/h	4780	16	50	-15℃-80℃	±0.5%	G3/8
BT-GF06	10-500 L/h	3468	16	50	-15℃-80℃	±0.5%	G1/2
BT-GF10	20-1200 L/h	2780	16	50	-15℃-80℃	±0.5%	G1/2
BT-GF15	200-3000 L/h	334	16	50	-15℃-80℃	±0.5%	G3/4
BT-GF25	1000-12000L/h	110	16	50	-15℃-80℃	±0.5%	G1
BT-GF32	2000-20000L/h	40	16	50	-15℃-80℃	±0.5%	G1-1/4

II. Electrical Installation and Wiring Diagram:

1） Hirschmann pulse wiring mode: (pulse output): three-wire wiring mode: brown:+5V -+26V, blue: COM: black: Pulse;

2） Description and wiring method of electrical output terminals:

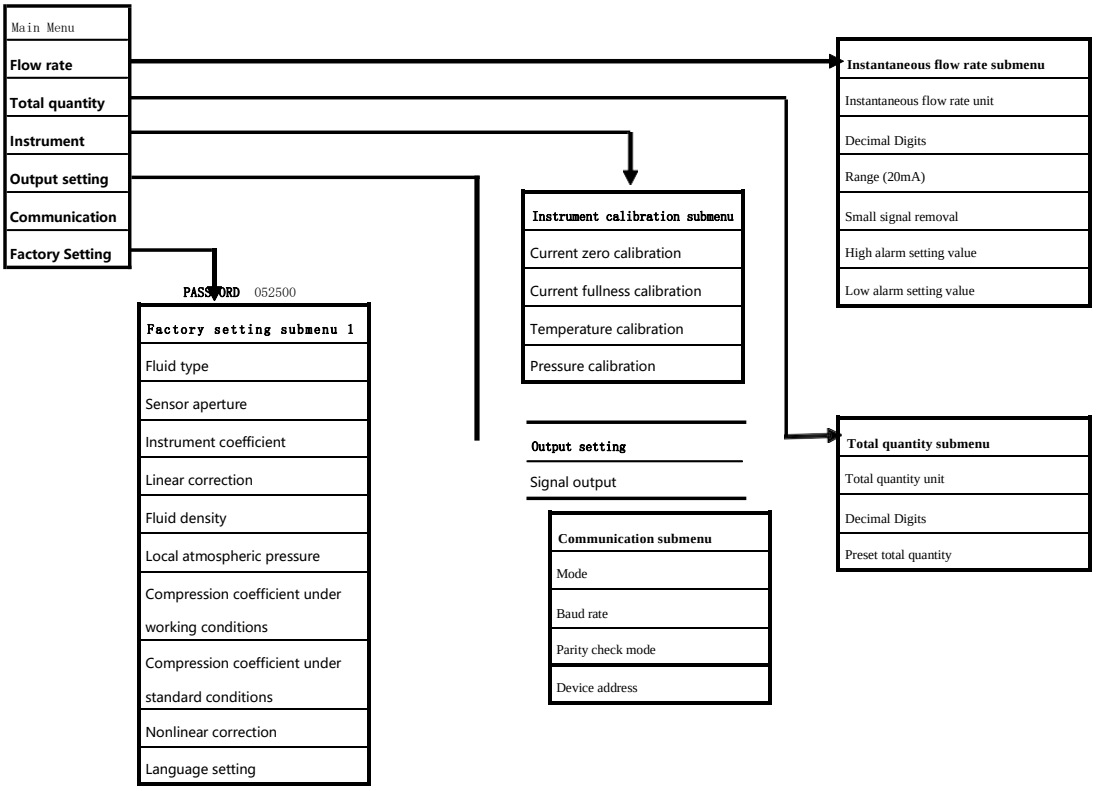
1.1 Keyboard Definition and Display



Move left, parameter setting confirmation key and subdirectory exit key; Factory setting shortcut key, move down, and numeric decrement keys;

Move up, numeric decrement key; Move right, entering parameter setting

1.2 Converter Menu Structure



1.3 Converter Parameter Description

- **Instantaneous flow rate parameter setting**

Flow rate unit	Options: L/s L/m L/h m3/s m3/m m3/h Nm3/h USG/s USG/m USG/h Kg/s Kg/m Kg/h t/s t/m t/h Default value: m3/h Define the units of instantaneous flow rate L (liter), h (hour), t (ton), s (second), m (minute)
Decimals of flow rate	Options: 0 1 2 3, Default value:1 Define the number of decimal places of instantaneous flow rate
Range	Floating point number: 99999999.00-0.00 m3/h, default value: 100.0 m3/h When the instantaneous flow rate reaches the range, the converter will output 20mA. Changing this parameter will affect the current output, high alarm and low alarm. **Note: When you modify the set value (range), please pay attention to the unit of this parameter (range). You can modify the unit of this parameter (range) as required.**

Small signal removal	Floating point number: 9.90~0.00%, default value: 0.0% This set value is a percentage of the range.
High alarm	Floating point number: 99.00 ~ 1.00 %, default value: 90.0 % This set value is a percentage of the range. For example, if this value is set to 10, it is equal to 10% of the range. If the absolute value of instantaneous flow rate is greater than (range × 10%), the converter outputs a high alarm signal, and the high alarm contact is closed.
Low alarm	Floating point number: 99.00 ~ 0.00 %, default value: 0.0 % This set value is a percentage of the range. For example, if this value is set to 10, it is equal to 10% of the range. If the absolute value of instantaneous flow rate is less than (range × 10%), the converter outputs a low alarm signal, and the low alarm contact is closed.
Damping time	Floating point number: 30.0 ~0.1, default value: 1

- **Total quantity setting:** Define the relevant parameters of the total quantity.

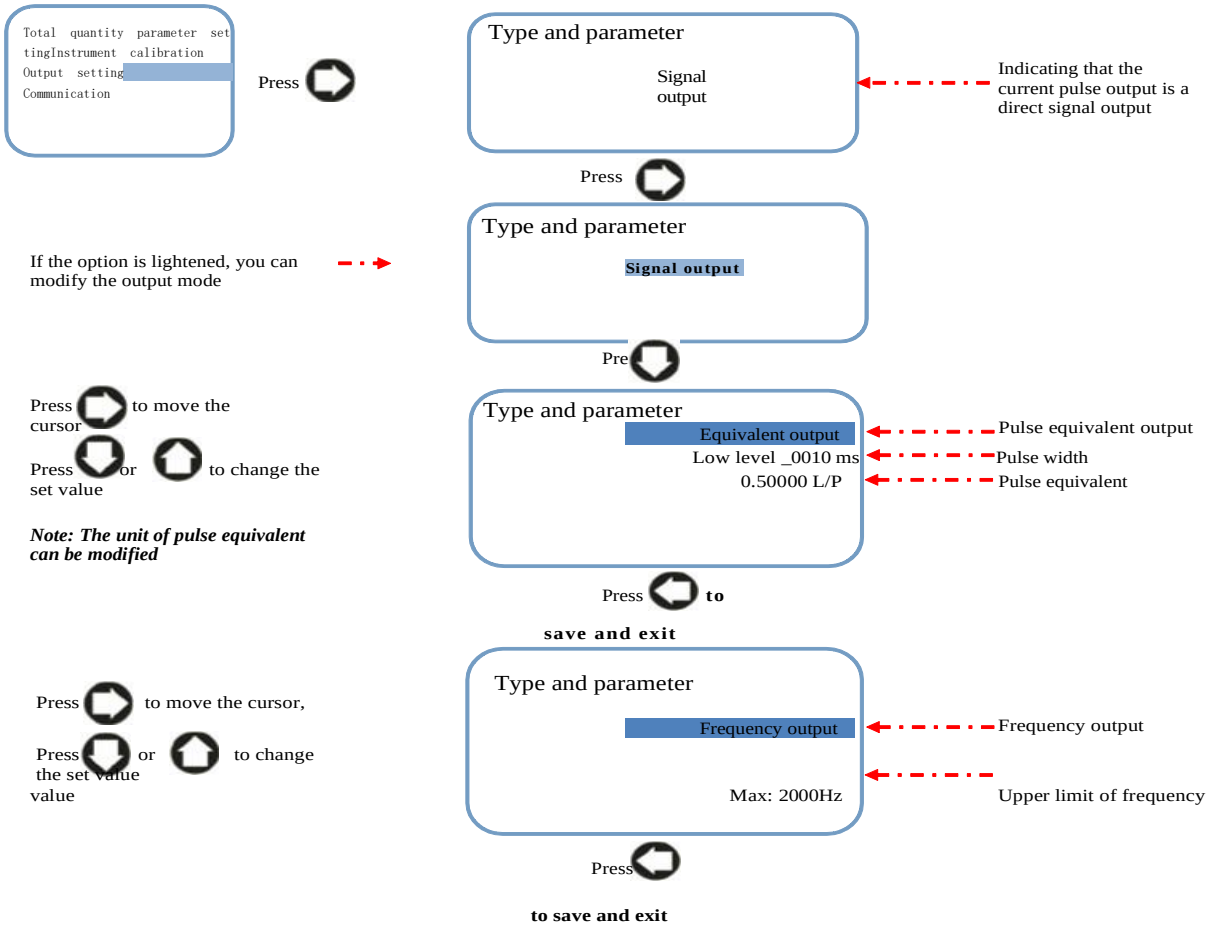
Total quantity unit	Options: L(liter) **m^3 Nm^3 USG Kg t(ton), default value: m^3** Define the total quantity unit
Decimals of total quantity	Options: 0 1 2 3, default value: 1 Define the number of decimal places of total quantity
Preset total quantity	Options: 99999999.00-0.00 m3/h, default value: 0.0 m3/h Clear the total quantity or set the total quantity value

- **Instrument calibration: calibrate the current output and the temperature and pressure measuring circuits.**

Current zero calibration	Floating point number: 5.0~3.0, default value: 0.0 After entering this submenu, use a multimeter to measure the current output value. If the current value is not equal to 4.0mA, the real value measured by the multimeter is input, and the converter will automatically complete the 4mA current output calibration. Standard value. Note: **If the current output deviation is too large, multiple corrections shall be performed to meet the requirements. The maximum input value for each correction is 5.0**
Current fullness calibration	Floating point number: 21.0 ~19.0, default value: 0.0 After entering this submenu, use a multimeter to measure the current output value. If the current value is not equal to 20.0mA, the real value measured by the multimeter is input, and the converter will automatically complete the 20mA current output calibration. Note: **If the current output deviation is too large, multiple corrections shall be performed to meet the requirements. The maximum input value for each correction is 21.0**

- **Output setting:** Set the parameters of three output modes such as equivalent output, frequency output and signal output.

Upper frequency limit	Floating point number: 5000.0 - 100.0 Hz, default value: 2000.0 **Output frequency (Hz)=instantaneous flow rate (m3/h) ÷ measuring range (m3/h) × upper frequency limit (Hz).** For example, if the instantaneous flow rate is equal to 100m3/h, the measuring range is equal to 200m3/h, and the upper limit of frequency is set to 2000HZ, the output frequency corresponding to the instantaneous flow rate of 100m3/h is 1000HZ.
Pulse equivalent	Floating point number: 9999.0 – 0.0, default value: 0.0 **The unit of pulse equivalent is L (liter)/pulse. The user can change the unit of pulse equivalent as follows as required: USG/P, Kg/P, t/P, Nm^3/P, or m^3/P**
Pulse width h(ms)	Floating point number: 1000.0 ~ 0.0 ms, default value: 0.0 When the pulse width is set to "0", the duty cycle of pulse is 1:1
Signal output	Original signal output Note: 1. Only distinguish frequency output from equivalent output 2. Nonlinear correction also works on the original signal output 3. Related to the instrument coefficient K **F(HZ)=3600/(Q*K)** **Q: Instantaneous flow rate (m3/h); K: Instrument coefficient**

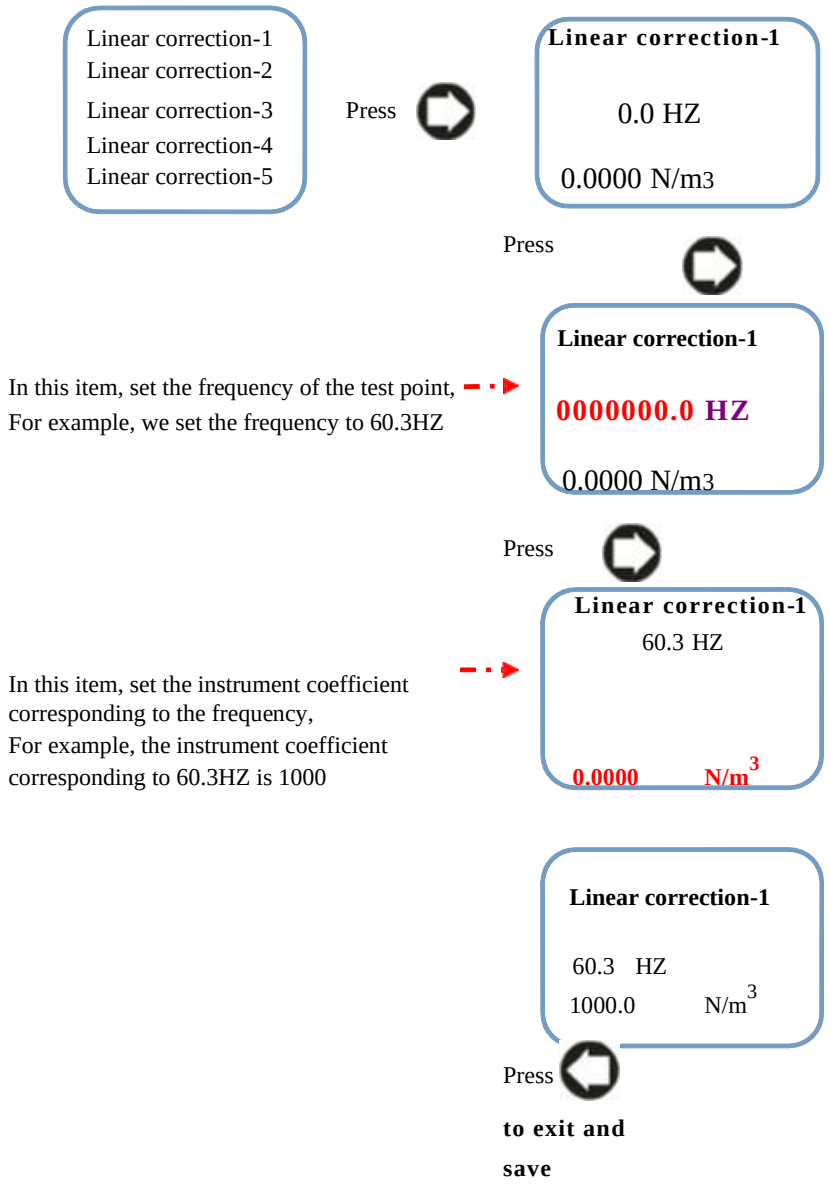


- Communication setting: set RS485 communication parameters

Mode	Option: Modbus-RTU Modbus-ASCII Default value:Modbus-RTU
Baud rate	Option: 1200 2400 4800 9600 19200 38400 Default value: 19200 **Note: Please set the baud rate to no lower than 9600**
Parity check mode	Options: No parity, even parity, odd parity Default value: odd parity
Device address	Value: 247 ~ 1, default value: 1

- **Factory parameter setting: first password 052500**

Fluid type	Options: gas flow rate under working condition and gas flow rate under standard condition Default value: gas flow rate under working condition **Select an appropriate medium before calibrating the flow meter or using it. After selecting different options, the software executes different algorithms**
Aperture	Options: 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, and 200 mm Default value:50 mm
Instrument coefficient	Floating point number, default value: automatically corresponding to each aperture Q (instantaneous flow rate, m^3/h) ＝ 3600 × F (frequency, HZ) ÷ k (k coefficient)) **After the real flow detection is completed, the final K coefficient needs to be set here. K (k coefficient) represents the number of pulses output per cubic meter**

Linear correction	 After completing the linear correction of the first point, enter "Linear Correction - 2" **Note: The test point with the highest frequency must be taken as the first point. The frequency is set from large to small.**

1.4 How to Set Parameters

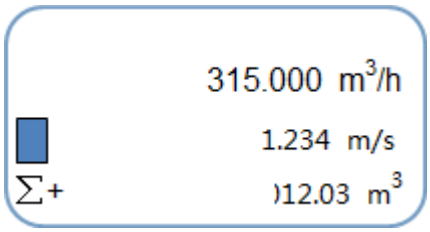


Figure 1 Instantaneous Flow Rate Display Interface

Press to enter the menu setting, as shown in Figure 2:

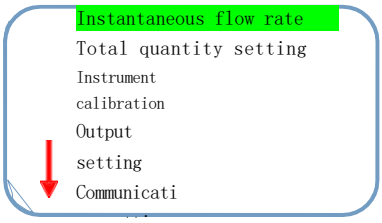


Figure 2

In the interface shown in Figure 2, Press or to select a different submenu. Press to return to the flow display interface, as shown in Figure 1; Press or to select a different submenu. Press to enter the submenu to set parameters. For example, we need to set "Instantaneous Flow Rate Parameter", When the instantaneous flow rate parameter submenu is lightened, press to display Figure 3 below:

Figure 3

Press or to select the parameter you want to modify; then ehe selected parameter will be lightened. If you need to return to the menu shown in Figure 2, press ; If you need to enter the next menu, press to set parameters, as shown in Figure 4:

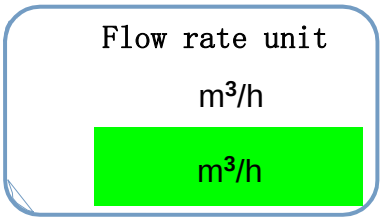


Figure 4

In this case, press or to modify the parameters. For example, as shown in Figure 4, You need to change the instantaneous flow unit “

m³/h ” into " **m³/m ”**, press to change the instantaneous flow unit into **“ m³/m ”**, as shown in Figure 5:

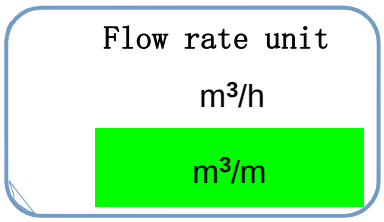


Figure 5

After modifying the parameters, if you need to save the setting, press , and then the system will automatically save the setting, as shown in Figure 6:

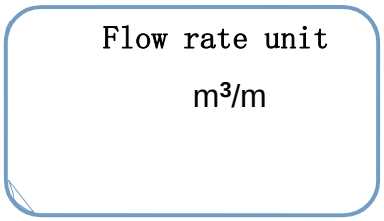
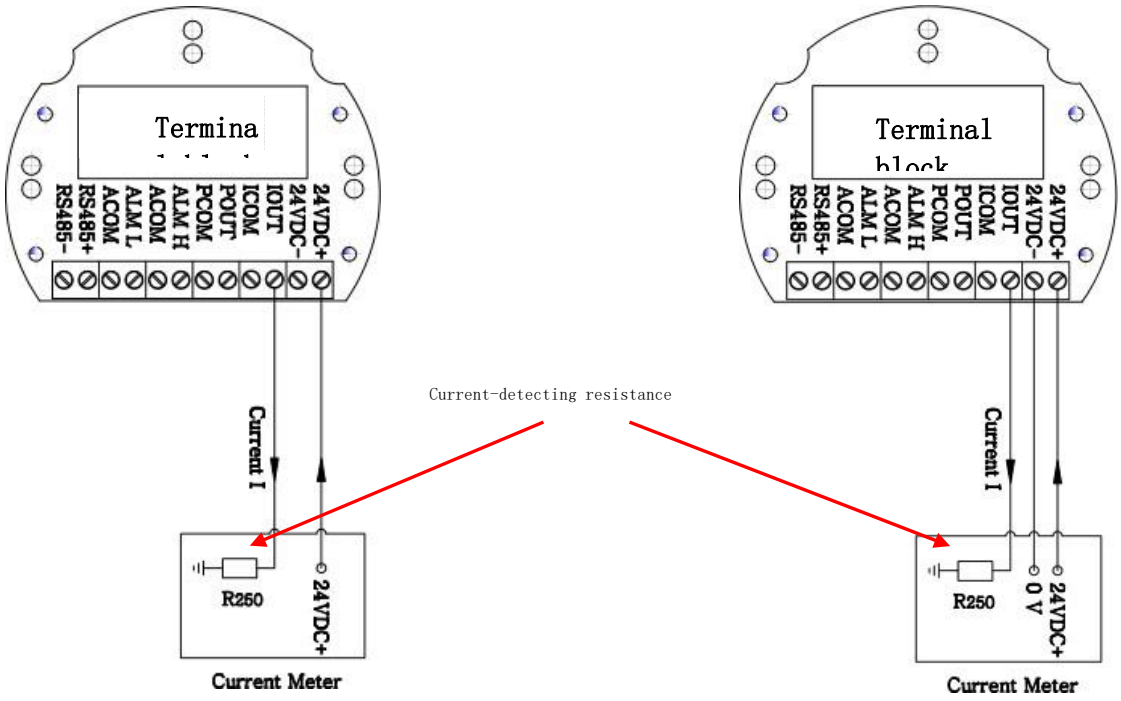


Figure 6

In this case, press to save the set value and exit (as shown in Figure 3).

2. Wiring Diagram and Output Definition

2.1 4-20mA Current Output Wiring Diagram

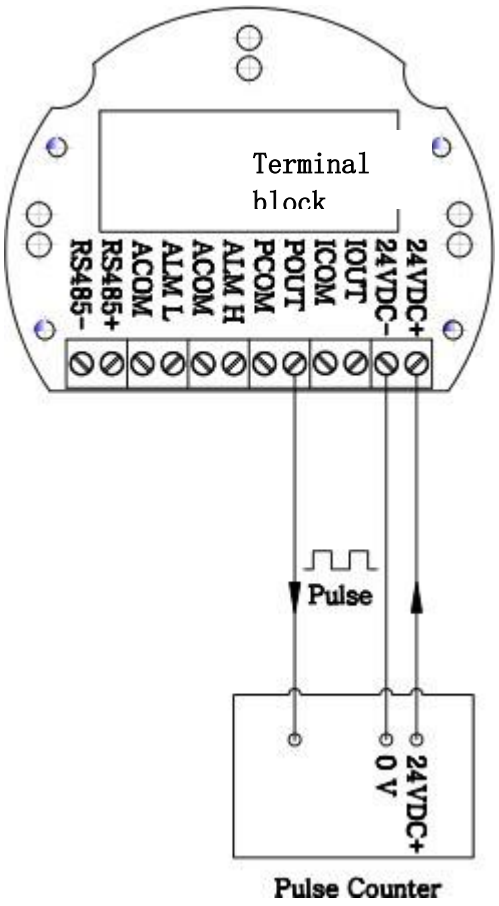


Two-wire wiring diagram **Three-wire wiring diagram**

Wiring terminal definition

Wiring terminal screen printing	Function	Remarks
24V +	DC 18 - 36V +	Power supply 24V +
24 -	DC 18~36v -	Power supply 24V -
IOUT	4~20Ma +	Load resistance <=- 500Ω
ICOM	4~20mA -	
POUT	Frequency & pulse output+	
PCOM	Frequency & pulse output common terminal	
ALM **H**	High alarm +	It is recommended to use a 24VDC intermediate relay with load current ≤ 30mA
ACOM	High alarm common terminal	
ALM **L**	Low alarm +	
ACOM	Low alarm common terminal	
RS+	RS485 +	RS485 wiring terminal
RS-	RS485 -	

2.2 Pulse Output Wiring Diagram



Installation Requirements

- The site installation position of the gear flow meter shall avoid the environment with high temperature, large mechanical vibration, strong magnetic field interference and strong corrosion as far as possible. The gear flow meter shall be installed at a position easy for maintenance and repair.
- Generally, the gear flow meter shall be installed horizontally, and the sensor must be firmly installed on the assembly body with screws. If the gear flow meter must be installed vertically, the liquid direction must be upward. The pipeline shall be filled up with liquid without bubbles.
- When installing the accessories of the gear flow meter, the base center line shall be aligned with the center line of the pipeline, and the sealing gasket at the connection shall not protrude into the liquid.
- When a flow regulating valve needs to be installed, it must be installed on the downstream side of the sensor.
- When installing a sensor on a new pipeline, it is recommended to install a filter upstream of the flow meter to prevent impurities in the pipeline from entering the transmitter.
- In order not to affect the normal transmission of liquid during maintenance, a bypass pipeline shall be installed at the installation position of the flow meter.
- The magnetic field near the gear flow meter and similar interference sources may affect the pickup signal of the sensor; therefore, the connection between the flow meter and the display instrument shall use a shielded cable with metal, and the shielding layer of the transmission cable shall be grounded at one point at the end of the display instrument.

Use and Maintenance

1. Attentions on Use

- The measured liquid shall be kept clean and free of fibrous and granular impurities during use.
- When the gear flow meter is put into operation, the sequence of opening and closing the valves is as follows:

  For the gear flow meter without a bypass pipe, first open the upstream valve of the transmitter at a medium opening degree, then slowly open the downstream valve and run for 10 minutes at a low flow rate, and then fully open the upstream valve to the required normal flow rate.

  For the gear flow meter with a bypass pipe, first fully open the bypass valve, open the upstream valve at a medium opening degree, then slowly open the downstream valve, and reduce the opening degree of the bypass valve, so that the transmitter runs at a low flow rate for 10 minutes; then fully open the upstream valve and fully close the bypass valve (to ensure no leakage), and finally adjust the opening degree of the downstream valve to the required normal flow rate.

  The valves shall be opened and closed as gently as possible. If the opening and closing of the valves is automatically controlled, especially for medium and large aperture sensors, it is better to adopt the mode of "two-section opening and two-section closing" to prevent the gears from being damaged due to the water hammer effect caused by the sudden impact of liquid.
- In order to ensure the long-term normal operation of the transmitter, Operation inspection shall be strengthened at ordinary times. Once any anomaly is found, some measures shall be taken to eliminate it. Pay special attention to the monitoring of gear rotation, and timely check the transmitter in the event of abnormal sound.
- The maintenance cycle of the flow meter is generally three months. During checking and cleaning, take care not to damage the internal parts and assemble them according to the original assembling position.
- When the gear flow meter is not in use, the internal liquid shall be cleaned up, and protective sleeves shall be added at both ends of the transmitter to prevent dust from entering, and then the gear flow meter shall be stored in a dry place.

- The installed filter shall be cleaned regularly; when not in use, a protective sleeve shall be added on the filter to prevent dust from entering, and then it shall be stored in a dry place.
- The transmission cable of the sensor can be laid overhead or buried (plastic pipes or iron pipes shall be covered on the cable when buried).

2.

Troubleshooting

Table 2 Troubleshooting

Fault symptom	Cause analysis	Removal method
The liquid flow is normal, but the display instrument has no display	1. The power supply is not connected, or the wiring between the sensor and the instrument is incorrect, or there are faults such as open circuit, short circuit, poor contact, etc. 2. Preamplifier failure. 3. The gears are stuck	1. Connect the power supply or check whether the wiring is correct, and use a multimeter to check the fault point. 2. Check the preamplifier. 3. Remove foreign matters and clean or replace the gears. After the gears are replaced, the flow meter shall be calibrated again to obtain a new instrument coefficient.
The flow rate is not reduced, but the flow rate display value gradually decreases.	1. Whether the filter is blocked. 2. The core of the value on the sensor pipeline is loose, and the valve opening degree automatically decreases. 3. The transmitter gear is blocked by debris, which increases the resistance and slows down the speed	1. Clean the filter 2. Repair or replace the valve. 3. Remove the sensor and clean it.
The liquid does not flow, and the flow rate display is not zero or the display value is unstable	1. The transmission wire is poorly shielded and grounded, and the external interference signal enters the input terminal of the display instrument 2. The pipeline vibrates and then the gear vibrates to generate wrong signals 3. Interference caused by internal fault of display instrument	1. Check the shielding layer and whether the display instrument's grounding terminal is well grounded 2. Secure the pipeline or the sensor screws. 3. Repair the display instrument

Annex 1

Communication Address Table

Variable name	First address of register	Register length	Command code	Data type
Instantaneous flow rate	0x01	0x02	0x04	32-bit single-precision floating point number
Instantaneous flow rate unit	0x03	0x01	0x04	16-bit unsigned integer
Total quantity	0x04	0x04	0x04	64-bit double-precision floating point number
Total quantity unit	0x08	0x01	0x04	16-bit unsigned integer
Temperature	0x09	0x02	0x04	32-bit single-precision floating point number
Pressure	0x0b	0x02	0x04	32-bit single-precision floating point number
Total quantity (m3)	0x0d	0x02	0x03 0x04	32-bit single-precision floating point number
Continuous reading (continuous single-precision floating point number)				
Instantaneous flow rate	0x14	0x02	0x04	32-bit single-precision floating point number
Total quantity	0x16	0x02	0x04	32-bit single-precision floating point number
Temperature	0x18	0x02	0x04	32-bit single-precision floating point number
Pressure	0x1a	0x02	0x04	32-bit single-precision floating point number
Continuous reading (continuous inverted single-precision floating point number)				
Instantaneous flow rate	0x1e	0x02	0x04	32-bit single-precision floating point number (inverted)
Total quantity	0x20	0x02	0x04	32-bit single-precision floating point number
Temperature	0x22	0x02	0x04	32-bit single-precision floating point number
Pressure	0x24	0x02	0x04	32-bit single-precision floating point number

Definitions of Unit

	Unit	Code	Unit	Code
Instantaneous flow rate	Nm3/h	0x00	usg/h	0x09
	Nm3/m	0x01	usg/m	0x0a
	Nm3/s	0x02	usg/s	0x0b
	m3/h	0x03	kg/h	0x0c
	m3/m	0x04	kg/m	0x0d
	m3/s	0x05	kg/s	0x0e
	L/h	0x06	t/h	0x0f
	L/m	0x07	t/m	0x10
	L/s	0x08	t/s	0x11
Total quantity	Nm3	0x00		
	m3	0x01		
	L	0x02		
	usg	0x03		
	kg	0x04		

Tem perat ure	t	0x05

For the supporting display instrument, see the display instrument manual for details.