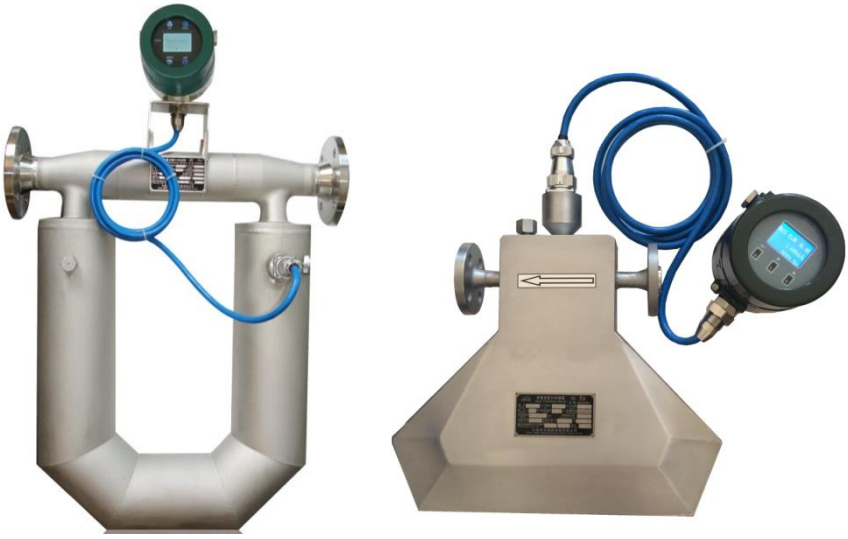
TEKSENS

UNICERT ISO 9001

- **TCMF Coriolis Mass Flow Meter**
- **Operating Manual**



Content

1 TCMF Mass Flow Meter Overview

Teksens coriolis mass flow meter (TCMF) is a new type flow meter which is designed according to Micro Motion and Coriolis principle. This kind of new flow meter can measure the fluid directly in a sealed pipeline. It consists of two sections: Sensor and Signal Transmitter.

1.1 Main Features

- Unchallengeable TCMF performance on liquid mass flow, volume flow, and density measurement
- Unique design delivers unparalleled measurement sensitivity and stability
- Guarantees consistent, reliable performance over the widest flow range
- Designed to minimize process, mounting, and environmental effect

1.2 Application

The TCMF mass flow meter can be used in the following fields to meet the requirements of ingredient, mixing processes and commercial measurement.

- Chemical: containing chemical reaction system
- Petroleum: moisture content analysis
- Lipids: including vegetable oils, animal fats and other oils
- Pharmaceutical
- Painting
- Paper making
- Textile printing and dyeing
- Fuel: crude oil, heavy oil, coal slurry, lubricant and other fuels.
- Food: gas dissolving beverage, health drink and other liquid.
- Transportation: pipeline liquid measurement.
- Low temperature fluid, like liquid oxygen and liquid nitrogen, the low temperature up to -200℃
- High temperature fluid, the maximum temperature up to 300℃
- High pressure fluid, like slurry flow measurement for oil drilling cementing

1.3 Working Principle

If a pipe is rotated around a point (P) while liquid is flowing through it (toward or away from the center of rotation), that fluid will generate an inertial force, with reference to Figure 1-1:

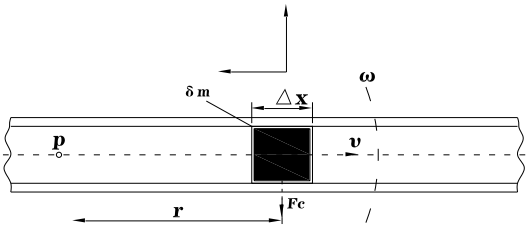


Figure 1-1

A particle (δ_m) travels to the right at a constant velocity (v) inside a tube. The tube is rotating around a fixed point (P) at angular velocity (w), in this case, this particle will get two acceleration components:

1. Normal acceleration (centripetal acceleration), its value is equal to w^2r, its direction is toward the point P
2. Tangential acceleration a_1 (Coriolis acceleration), its value is equal to 2wv, its direction is perpendicular to v

The force generated by tangential acceleration is Coriolis force, its value is equal to Fc =2wvδm. In figure1.1 fluid $\delta_m=\rho A\times\Delta X$, So Coriolis force can be expressed as:

$\Delta Fc=2\omega u\times\delta m=2\omega u\times\rho A\times\Delta X=2\omega\times\delta qm\times\Delta X$

Wherein A is the duct cross-sectional area.

$\delta qm=\delta dm/dt=u\rho A$

For special rotational pipe, its frequency is constant, ΔFc only depends on δqm. Therefore, directly or indirectly measuring the Coriolis force can be measured mass flow. This is how Coriolis mass flow meter works.

The actual flow sensor can't achieve rotational movement, replace by pipeline vibration. The principle is shown in Figure1-2、Figure1-3、Figure1-4. Both ends of a bend pipe are fixed, and the vibration force is applied to the pipe in an middle of the two fixed points (according to the resonance frequency of pipeline), taking the fixed point as axis, making pipeline vibrate at its natural frequency (w). When no fluid flows through the pipeline, the pipeline is only affected by vibration force, the vibration direction of two half-section of pipeline is the same, no phase difference. When fluid flows, by the influence of fluid medium dot Coriolis force Fc inside the pipeline (In the two half-section of pipeline, Coriolis F1 and F2 are equal in magnitude and opposite in direction Figure 1-2), two half-section of pipeline occur twist in the opposite direction to generate phase

difference which is proportional to mass flow. The design of sensor is converting the measurement of Coriolis force to the measurement of phase difference for both sides of the vibrating tube. This is the working principle of Coriolis mass flow meter.

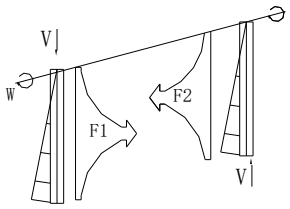


Figure 1-2

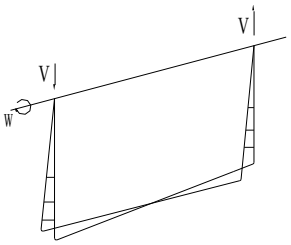


Figure 1-3

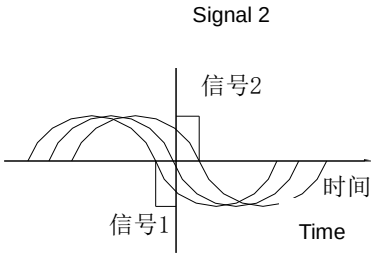
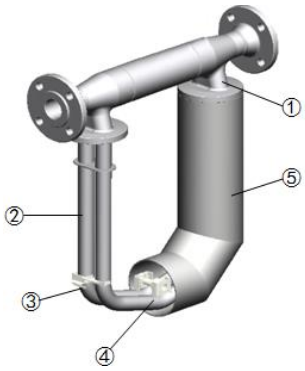


Figure 1-4

2 Sensor Parameters

2.1 Sensor Structure



TCMF series mass flow meter sensor consists of measurement tube, driving device, position detector, support structure, the temperature sensor, housing, etc.

① Supporting structure: the measuring tube fixed on the supporting structure as the vibrating axis.

② The measuring tube (Vibrating tube): consist of two parallel tubes.

③ Position detector: used for the measurement of measuring tube distortion.

④ Drive device: generate electromagnetic force to drive measuring tube to make it vibrate close to resonance frequency.

⑤ Housing: Protect the measuring tube, driving unit and detector.,

2.2 Technical Parameters

Dimension and Measuring Range

Specification	DN (mm)	Flow range(kg/h)	Zero Stability, kg/h			Rated Pressure (MPa)	NW (kg)	GW (kg)
			0.2%	0.15%	0.1%			
TCMF-003	3	0~96~144	0.018	0.012	0.012	40	8	19
TCMF-006	6	0~540~810	0.099	0.066	0.066	20	12	22
TCMF-008	8	0~960~1440	0.18	0.12	0.12	20	12	23
TCMF-010	10	0~1500~2250	0.27	0.18	0.18	20	11	24
TCMF-015	15	0~3000~4500	0.63	0.42	0.42	20	12	25
TCMF-020	20	0~6000~9000	1.17	0.78	0.78	16	20	34
TCMF-025	25	0~9600~14400	2.025	1.35	1.35	16	21	35
TCMF-032	32	0~18000~27000	3.6	2.4	2.4	16	27	45
TCMF-040	40	0~30000~45000	5.4	3.6	3.6	12	35	55
TCMF-050	50	0~48000~72000	9	6	6	12	40	60
TCMF-080	80	0~120000~180000	24	16	16	8	90	150
TCMF-100	100	0~192000~300000	40.5	27	27	8	170	245
TCMF-150	150	0~360000	90	60	60	6	255	350

- Accuracy(Liquid) :(With FT-523 Transmitter)

  Measurement accuracy: ±0.1% ±（zero stability/measurement value）%

  Measurement accuracy: ±0.15% ±（zero stability/measurement value）%

  Measurement accuracy: ±0.2% ±（zero stability/measurement value）%

  Repeatability: 1/2 measurement accuracy %

- Density(Liquid) measuring range and accuracy (With FT-523 transmitter)

  Range: 0.3～3.000g/cm^3 Accuracy: ±0.002g/cm^3

- Temperature measuring range and accuracy (With FT-523 transmitter):

  Temperature measuring range: -200～200℃ Accuracy: ±1℃

- Ambient temperature: －20℃～60℃

- Material : The measuring tube SS316L Housing: SS304

- Rated pressure: 0～4.0MPa (standard)

- Explosion-proof level : Ex d ib IIC T6 Gb

2.3 Sensor Dimension

“U” -type Integrated

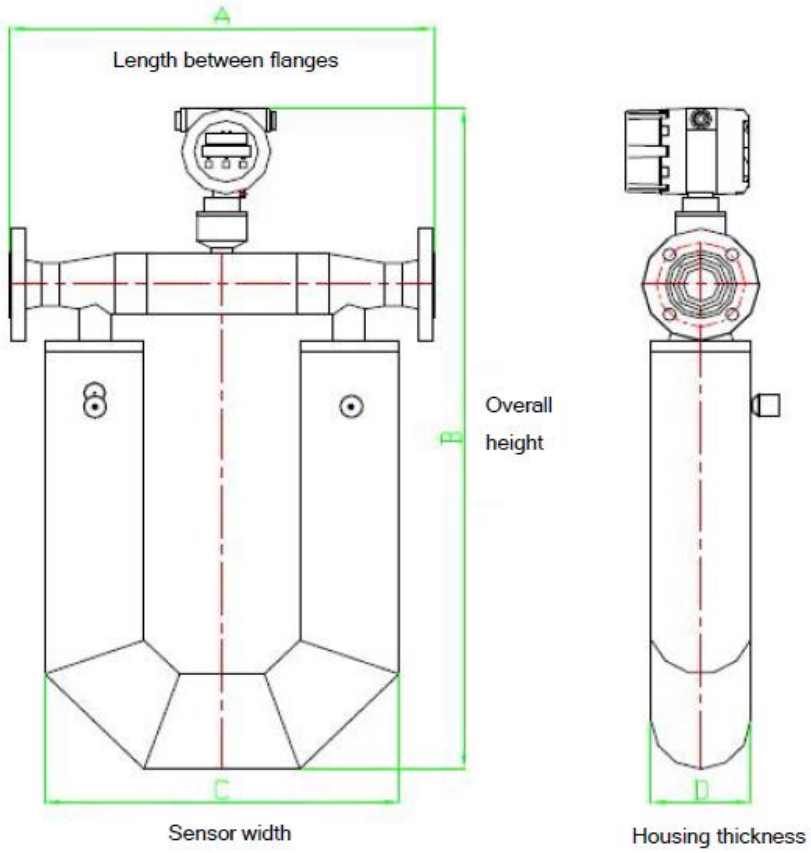


Figure2-1 Integrated-type sensor

Model	A	B	C	D	NW(only sensor)
	mm	mm	mm	mm	kg
TCMF-010	450	590	380	60	7.2
TCMF-015	456	590	380	60	7.5
TCMF-020	540	750	468	108	17
TCMF-025	540	770	468	108	17.5
TCMF-032	545	810	468	108	24
TCMF-040	600	930	500	140	32
TCMF-050	606	955	500	140	36
TCMF-080	866	1177	780	220	87.5

TCMF-100	950	1335	833	273	165
TCMF-150	1300	1593	1144	324	252
TCMF-200	1300	1600	1144	400	350

“U” -type Remote type

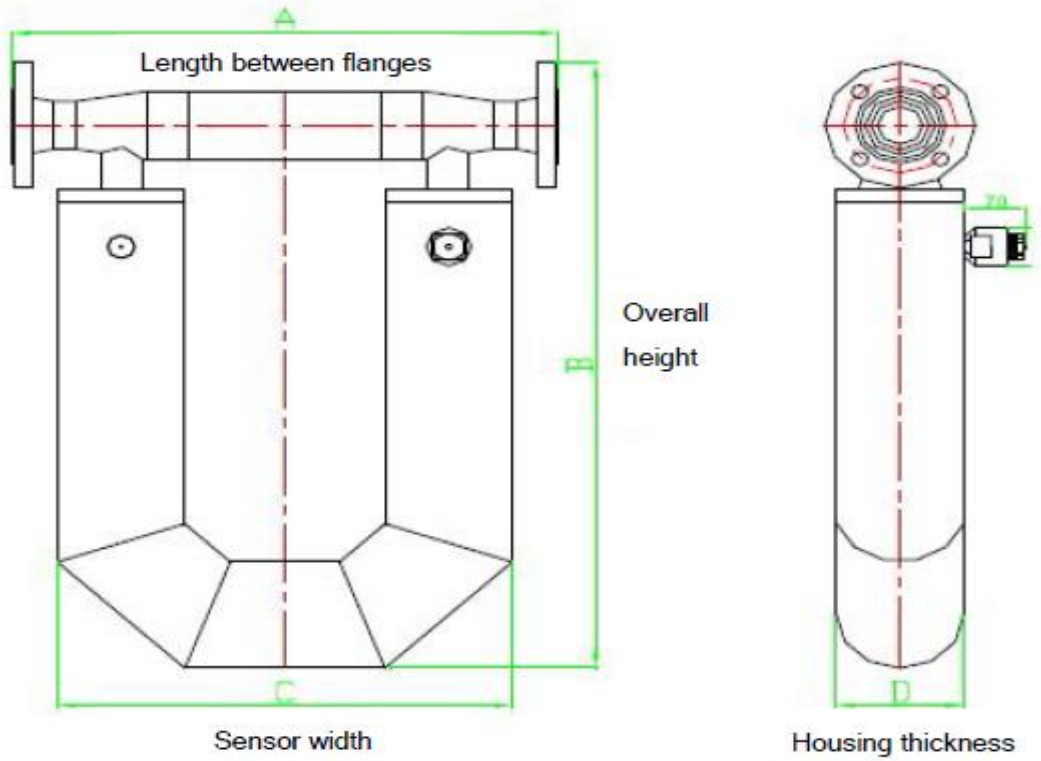


Figure2-2 Split-type sensor

Model	A	B	C	D	NW(only sensor)
	mm	mm	mm	mm	kg
TCMF-010	450	370	380	60	7.2
TCMF-015	456	370	380	60	7.5
TCMF-020	540	530	468	108	17
TCMF-025	540	550	468	108	17.5
TCMF-032	544	590	468	108	24

TCMF-040	600	710	500	140	32
TCMF-050	606	735	500	140	36
TCMF-080	866	957	780	220	87.5
TCMF-100	950	1115	833	273	165
TCMF-150	1300	1373	1144	324	252
TCMF-200	1300	1380	1144	400	350

Triangle - Integrated type

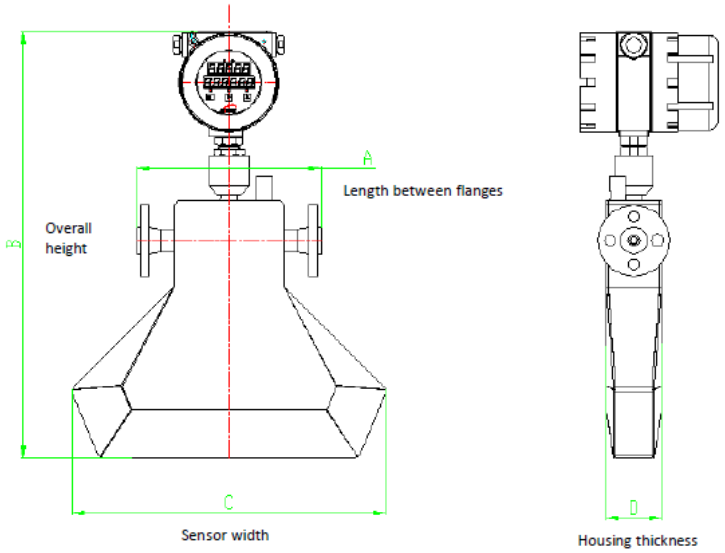


Figure 2-4 MTCMF-008 / MTCMF-006 / MTCMF-003

Model	A	B	C	D	NW
	mm	mm	mm	mm	kg
TCMF-003	178	420	250	54	4.8
TCMF-006	232	550	360	70.5	8.1
TCMF-008	232	565	395	70.5	8.2
TCMF-010	95	525	370	70.5	6.5
TCMF-015	95	540	405	70.5	6.5

3 Selection and Installation

3.1 Selection

The following conditions should be considered for flow meter selection.

Medium characteristics	▪ Measurability Coriolis mass flow meter is widely used for lots of fluid, but some conditions like slug flow, pulsating flow etc, where you want to install Coriolis mass flow meter, some appropriate support measures must be taken. ▪ Corrosivity Coriolis Figure 2-5 TCMF010 / 015 316L, housing material SS304. If the standa corrosion wetted material should be selected. ▪ Operating temperature and pressure Standard configuration: -50…+200℃, 4.0MPa, please contact with manufacturer for special parameters. ▪ Ambient condition Standard ambient temperature is -20…+60℃. The flow meter will fail to display if the ambient temperature exceeds the standard range. Please contact with manufacturer for special parameters. ▪ Protection and Explosion Transmitter ex-proof: flame type, Sensor ex-proof: intrinsic type Transmitter and Sensor protection: IP67
Preferred measuring range	1/3~2/3 of standard flow range
Allowable pressure loss	Pressure loss should be considered especially for reduced pipe. Pressure loss reference table is shown as below

3.2 Installation

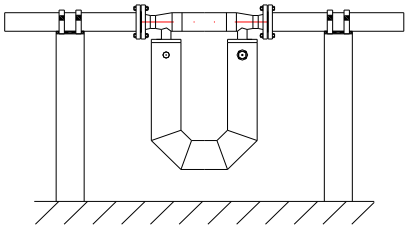
3.2.1 Basic Requirements on installation

- Flow direction should be in accordance with TCMF sensor flow arrow.
- Properly supporting is required for preventing tubes vibrating.
- If a strong pipeline vibration is inevitable, it is recommended to use a flexible tube to isolate the sensor from the pipe.
- Flanges should be kept parallel and their center points should be located on the same axis to avoid subsidiary force generation.
- Installation vertically, make the flow from the bottom up when measuring, meanwhile, the meter should not be installed on the top to prevent air getting trapped inside the tubes.

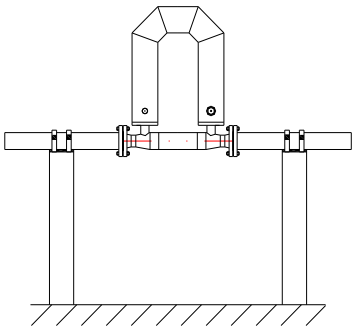
3.2.2 Installation Direction

In order to ensure the reliability of the measurement, the ways of installation should consider the following factors;

The meter should be installed downward when measuring liquid flow (Figure3-1), so that air cannot get trapped inside the tubes.



The meter should be installed upward when measuring gas flow (Figure3-2), so that liquid cannot get trapped inside the tubes.



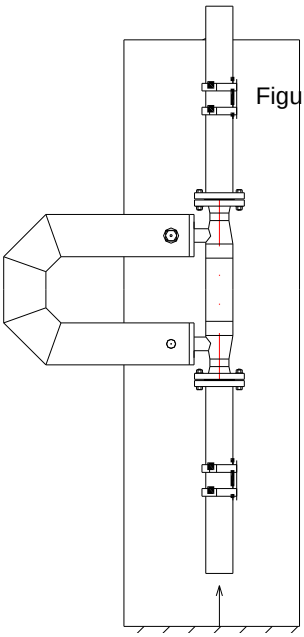
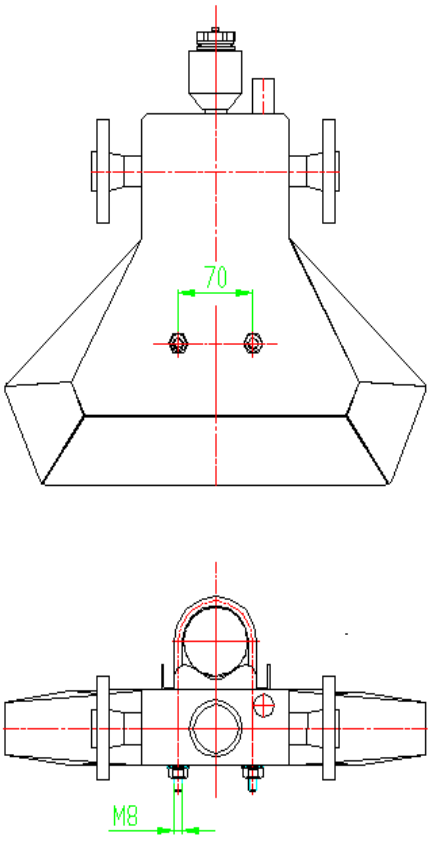


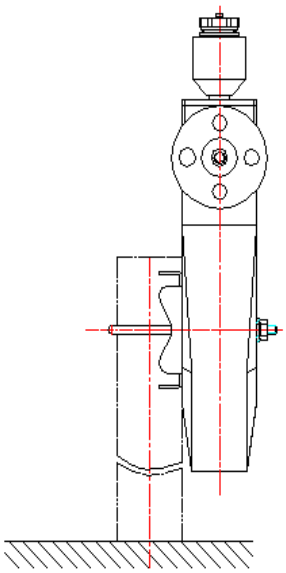
Figure 3-2

The meter should be installed sideward when the medium is turbid liquid (Figure3-3) to avoid particulate matter accumulated in the measuring tube. The flow direction of medium goes from the bottom up through the sensor.

2.3 Sensor Fixed

Coriolis mass flowmeter is a vibrating instrument, when they work, the two vibrating tube is always in a state of vibration. Therefore, external vibration or pipeline vibration may have effect on their normal operation.





/ to avoid vibration

because of the small Please make sure

that the installation b s shown as Figure

3.4

4. Transmitter

4.1 Working conditions

1) Atmospheric pressure: 86~106KPa

2) Ambient temperature: LCD display: -20~+60℃; No display:-40~+85℃

3) Relatively humidity: 35%~95%

4) Power supply: 22~245V

5) Power consumption: ≤15W

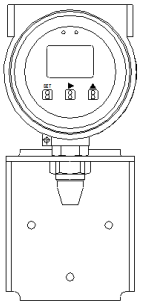
6) Communication interface:

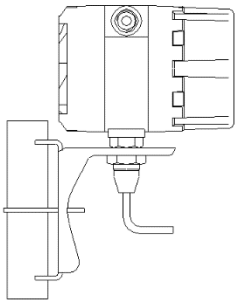
4~20mA current loop (passive, error≤±0.005mA), Pulse 0~10KHz, RS485

4.2 Using area and Explosion

This flow meter meets the requirements of Ex d ib IIC T6 Gb in GB3836.1-2010、GB3836.2—2010、GB3836.4-2010, which is suitable for Zone1, Zone2, Temperature class T6 of explosive atmospheres.

4.3 Installation

Installation Type	Description
	**FT523 Integrated type** The signal cable between sensor and transmitter have been connected well before delivery, the users only need to connect external wiring.

	**FT523 Remote type** Mounting bracket will be equipped for remote type. Cable length for standard configuration is 2m Use air plug to connect transmitter and senor (air plug protection is IP67)

4.4 Terminal and Wiring

Table 4-4 show the name of terminals, Figure 4-4 show the wiring method, Current 2 have HART

The 1st line signal terminals	Signal Descriptions
1	RS485+
2	RS485-
3	Current output 1+
4	Current output 1-
5	Current output 2+
6	Current output 2-
7	Frequency output +
8	Frequency output -
The 2nd line signal terminals	Signal Descriptions
1	Power +
2	Power -
3	Shielding Grounding

Table 4-4 Wiring terminal definition

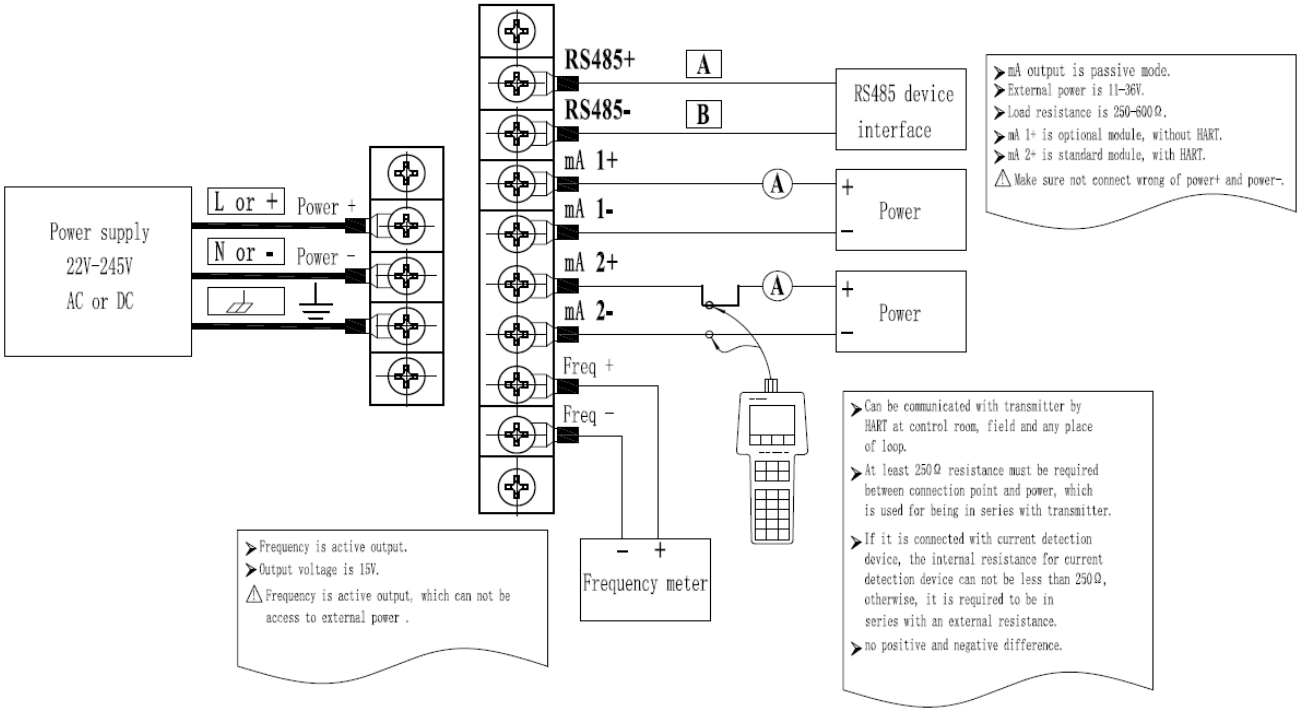


Figure 4-4 Wiring method

4.5 Cable Connection

A special 9-core double shielded signal cable is used for connecting transmitter and sensor. To facilitate wiring, we provide air-plug. Structure is shown as below

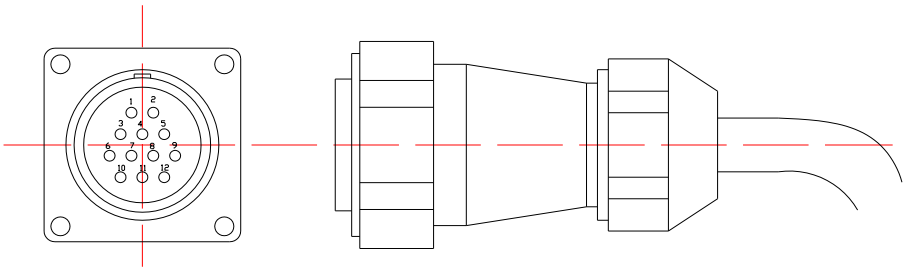
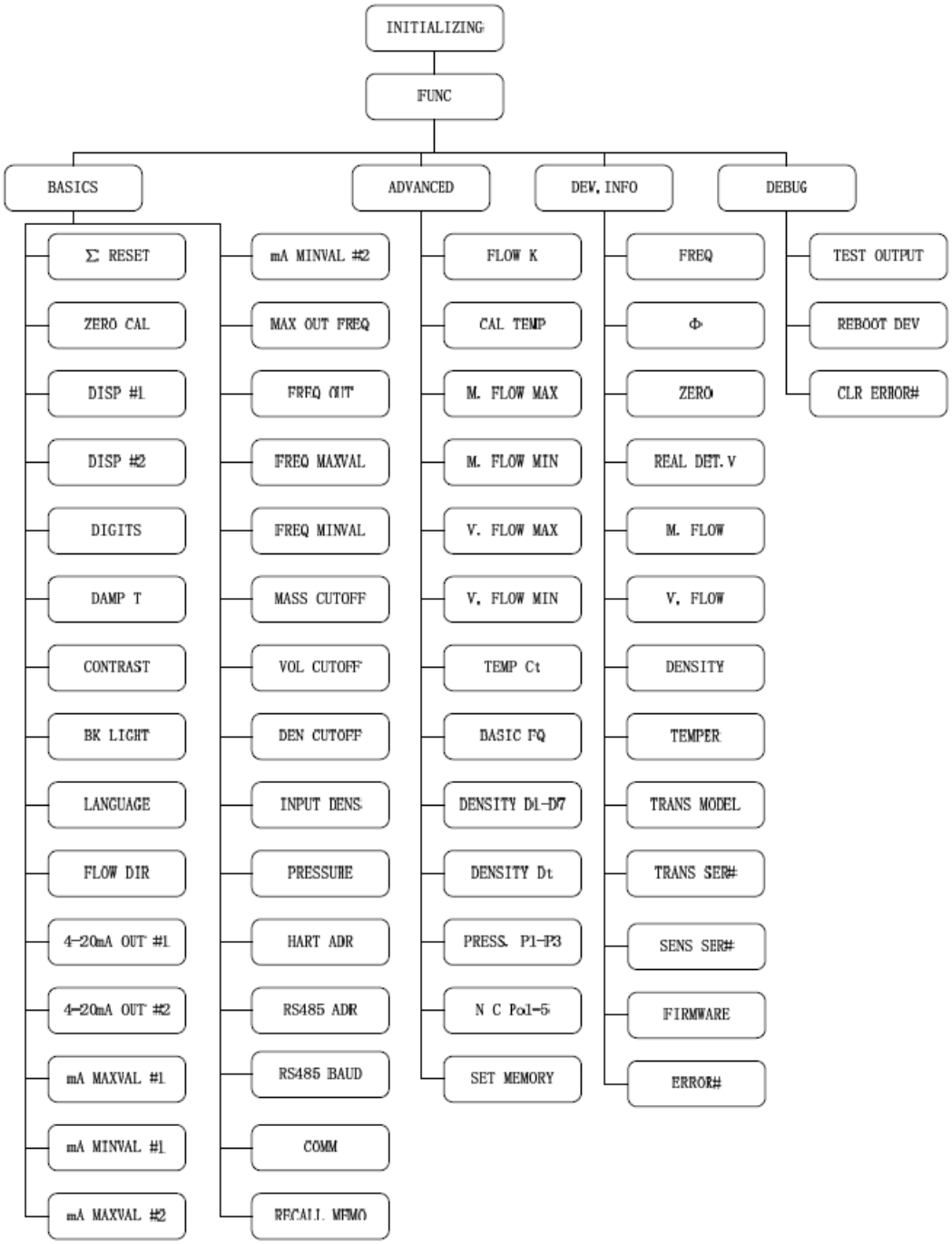


Figure 4-5 Cable between sensor and transmitter

4.6 Software operating procedure



4.7 Panel and Button

4.7.1 Button function

Figure 4-7-1 Button diagram

UP: move up the selection cursor

DOWN: move down the selection cursor

FUNC: function selection (main interface), confirm (setting interface)

ESC: exit the current menu

Note: The button is capacitive touch type, Use finger to touch the button to achieve the corresponding function.

4.7.2 Interface description

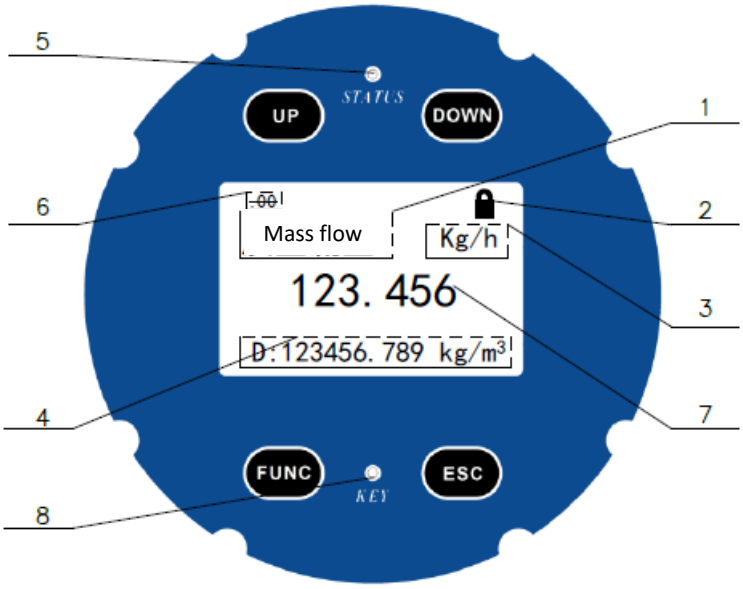


Figure 4-7-2 Display interface diagram

- **DISP #1**

Any one of the following six variables can be displayed: mass flow, volume flow, total mass, total volume, density, temperature. User can set in “BASICS-＞DISP #1 menu”.

- **Keyboard lock logo**

🔓: the keyboard has been unlocked

🔒: the keyboard has been locked

- **DISP #1 unit**

User can set in “BASICS -＞DISP #1 menu”.

- **DISP #2**

Any one of the following six variables can be displayed: mass flow, volume flow, total mass, total volume, density, temperature. Also measurement value, unit and variable code of DISP #2 can be displayed. At the main interface, the auxiliary display variable can be switched by UP and DOWN keys.

You can set the unit of DISP #2 in “BASICS -＞DISP #2 menu”.

Table 4-7-2 DISP #2 code

Mass flow	Total mass	Volume flow	Total volume	Density	Temperature
Fm	∑m	Fv	∑v	D	T

- **Keyboard status indicator lights**

Green light is for unlocking and pressing keys

Red light is for locking or not pressing keys

- **Decimal cutoff indicate**

When the integer length of DISP #1 or DISP #2 is too long, the display digits will be intercepted. You can set display digits in “BASICS -> DIGITS”

- **DISP #1 measurement value**

Displayed updating time and damping time set by device is the same, with reference to (10.1 damping)

- **Key indicator**

When the button is triggered, the indicator lights.

4.8 Lock and unlock

4.8.1 Lock

If no operation lasts for 30 seconds, the screen will lock automatically, and lock screen icon will appear.

4.8.2 Unlock

Press and hold UP and DOWN buttons for 6 seconds, when the indicator light turns green, that means unlocking is successful, then unlocking icon will appear.

4.9 System menu setting structure

4.9.1 Enter menu

In the main interface, press FUNC to enter system setting menu, and press UP or DOWN to select function.

BASICS
ADVANCED
DEV.INFO
DEBUG

Table 4-9-1 Main interface menu table

4.9.2 Selection function

Press the FUNC button to enter the selection function, you need to input password to enter BASICS and ADVANCED.

4.10 BASICS menu structure

Enter the system setting menu and select BASICS, press FUNC to confirm, enter the password by direction button (initial password is 17), press FUNC to confirm and enter menu, press ESC to exit to the main interface.

Enter BASICS menu, using the UP and DOWN keys to select the submenu. Press the FUNC key to modify and select the parameters by the UP and DOWN keys. Press the FUNC key to confirm or press ESC to cancel.

Serial No.	Menu	Setting Method	Parameters Range
1	DISP #1	Option	Mass flow/volume flow/total mass/total volume/density/temperature
2	DISP #2	Option	Mass flow/volume flow/total mass/total volume/density/temperature
3	DIGITS	Set data	0~3
4	DAMP T	Set data	0~60.0s
5	CONTRAST	Set data	25~50
6	BK LIGHT	Option	Open/close
7	LANGUAGE	Option	Chinese/English
8	FLOW DIR	Option	Positive/ reverse/ bidirectional/ absolute value
9	MASS CUTOFF	Set data	0~50%
10	4~20mA OUT #1	Option	Mass flow/volume flow/density/temp.
11	4~20mA OUT #2	Option	Mass flow/volume flow/density/temp.
12	mA MAXVAL #1	Set data	-60000~60000 (unit is the same as range)
13	mA MINVAL #1	Set data	-60000~60000 (unit is the same as range)

14	mA MAXVAL #2	Set data	-60000~60000 (unit is the same as range)
15	mA MINVAL #2	Set data	-60000~60000 (unit is the same as range)
16	MAX OUT FREQ	Set data	0.0000~10.0000kHz
17	FREQ OUT	Option	Mass flow/volume flow
18	FREQ MAXVAL	Set data	-60000~60000 (unit is the same as range)
19	FREQ MINVAL	Set data	-60000~60000 (unit is the same as range)
20	MASS CUTOFF	Set data	0~50%
21	VOL CUTOFF	Set data	0~50%
22	DEN CUTOFF	Set data	0.000~1.000g/cm3
23	INPUT DENS	Set data	0.0000~3.0000g/L
24	PRESSURE	Set data	0.00~99.00MPa
25	RS485 ADR	Set data	0~31
26	RS485 BAUD	Option	1200/2400/4800/9600
27	COMM	Option	RS485/HART
28	RECALL MEMO	Option	Yes/No
29	RESET	Option	Yes/No
30	ZERO CAL	Option	Yes/No

Table 4-10 BASICS menu and parameters

4.11 Factory setting menu structure

Enter the main menu and select the ADVANCED setting, press the FUNC key to confirm, enter the password by direction key (User password 987, Factory password 951), press FUNC key to confirm and enter the menu, press the ESC key to exit to the main interface.

Serial No.	Menu	Setting Method	Parameters Range
1	FLOW K	Set data	0~9999.99
2	CAL TEMP	Set data	-50.0~100.0
3	M.FLOW MAX	Set data	0~60000 Unit: t/h, kg/h, g/h
4	M.FLOW MIN	Set data	0~60000 Unit: t/h, kg/h, g/h
5	V.FLOW MAX	Set data	0~60000 Unit:m^3/h, L/h, mL/h
6	V.FLOW MIN	Set data	0~60000 Unit:m^3/h, L/h, mL/h
7	TEMP Ct	Set data	-999.999~999.999
8	BASIC FQ	Set data	0~500.00
9	DENSITY D1	Set data	-999.999~999.999
10	DENSITY D2	Set data	-999.999~999.999
11	DENSITY D3	Set data	-999.999~999.999
12	DENSITY D4	Set data	-999.999~999.999
13	DENSITY D5	Set data	-999.999~999.999
14	DENSITY D6	Set data	-999.999~999.999
15	DENSITY D7	Set data	-999.999~999.999
16	DENSITY Dt	Set data	-50~100.0
17	PRESS.P1	Set data	-999.999~999.999
18	PRESS.P2	Set data	-999.999~999.999
19	PRESS.P3	Set data	-999.999~999.999
20	N C Po1	Set data	0~150 -50~50.00
21	N C Po2	Set data	0~150 -50~50.00

22	N C Po3	Set data	0~150 -50~50.00
23	N C Po4	Set data	0~150 -50~50.00
24	N C Po5	Set data	0~150 -50~50.00
25	SET MEMORY	Option	Yes/No

Table 4-11 ADVANCED menu and parameters

Enter ADVANCED menu and select the submenu by the UP and DOWN keys. Press the FUNC key to modify and select the parameters by the UP and DOWN keys. Press the FUNC key to confirm and press ESC to cancel. The ADVANCED menu and parameters are shown in Table 4-11.

4.12 Display setting

4.12.1 DISP #1 setting

DISP #1 can be set separately for mass flow, volume flow, total mass, total volume, density, temperature.

Display variable	**Display variable unit**							
Mass flow	g/s	g/min	g/h	kg/s	kg/min	kg/h	kg/day	t/s
	t/min	t/h	t/day	lb/s	lb/min	lb/h	lb/day	
Volume flow	ml/s	ml/min	ml/h	L/s	L/min	L/h	L/day	m3/s
	m3/min	m3/h	m3/day	Gal/s	Gal/min	Gal/h	Gal/day	
Total mass	g	kg	t	lb	—	—	—	—
Total volume	ml	L	m3	Gal	—	—	—	—
Density	g/cm3	g/L	g/ml	kg/L	kg/m3	lb/Gal	—	—
Temperature	℃	℉	—	—	—	—	—	—

Table 4-12-1 Display variable type and unit

Setting method for DISP #1: BASICS ->Input password -> DISP #1 setting ->Select the type of display variables ->Select the display unit.

4.12.2 DISP #2 setting

Same as DISP #1

4.12.3 DIGITS

DIGITS setting range is 0-3, when DISP #1 or DISP #2 automatically intercepts digits because of too long integer bits, “00” will be displayed at the upper left corner of the screen, which means the current displayed values have decimal digits to be intercepted..

DIGITS Setting: BASICS ->Input password -> DIGITS -> Set digits.

4.12.4 CONSTRAST

Setting value is 25-50, set the contrast of the current LCD. LCD contrast setting method: BASICS ->Input password -> CONSTRAST ->Set the contrast value

4.12.5 BK LIGHT

You can select backlight-off when the transmitter LCD is in a bright place; You can select backlight - on under dark environment. The setting method for BK LIGHT: BASICS ->Input password -> BK LIGHT - >Select the backlight state

4.12.6 LANGUAGE

Chinese and English are optional

Language setting methods: BASICS -> Input password -> LANGUAGE -> Select the language type

4.13 Measurement setting

4.13.1 DAMP TIME

This setting is used to eliminate the small and dramatic fluctuations during measurement process. The damping value sets the reaction time of transmitter response to the change of process variable (Unit is second and setting range is 0-60S). This setting value will affect the response speed of mass flow, volume flow and density andnot affect the totalmass and total volume.

1) Higher damping value makes the measurement value change significantly smoother, the change for display, current output and frequency output is slower;

2) Lower damping value makes the measurement value change more quickly, the change for display, the current output

and the frequency output is faster;

3) Imposing higher damping value on fast and intense flow changes may result in measurement error;

4) As long as the damping value is not zero, the measurement value will lag behind the actual change value, since the measurement value is an average over time; Generally, low damping value is preferred because ofa low probability of data loss and shorter lag time between the actual changed value and the measurement value;

5) Updating damping setting: BASICS ->Input Password ->DAMP T -> Modify damp values

4.13.2 Small signal cutoff

This setting specifies the minimum measurement values, the measurement value which is lower than the cutoff value will be displayed as 0; This setting includes mass flow cutoff, volume flow cutoff and density cutoff.

1) Mass flow cutoff setting range is 0-50% of range, 2 display digits;

2) Volumetric flow cutoff setting range is 0-50% of range, 2 display digits;

3) Density cutoff setting range is 0-1g/cm^3, 3 display digits;

4) Volume flow cutoff does not affect the measurement value of mass flow and density; Mass flow cutoff and density cutoff will affect the measurement value of volume flow; The measurement value of volume flow is calculated by the density;

5) Mass flow cutoff setting method: BASICS ->Input password ->MASS CUTOFF -> Modify the mass flow cutoff

6) Volume flow cutoff setting method: BASICS -> Input password ->VOL CUTOFF -> Modify the volume flow cutoff

7) Density cutoff setting method: BASICS ->Input password -> DEN CUTOFF -> Modify the density cutoff

Note: The Display of measurement value, frequency output and current output are to undergo the small signal cutoff.

4.13.3 INPUT DENS

For the volume flow measurement of the known fluid density, when the input density is not 0, then the volume flow calculation will ignore the actual density measurement value, use the input density as a reference of volume flow. Input the density unit is g/cm^3,input range is 0-3g/cm^3, display digit is 4.

Setting method: BASICS -> Input password -> INPUT DENS -> modify the fluid density

4.13.4 FLOW DIR

Flow direction will determine how the fluid forward flow and reverse flow affect the measurement value, the current output value and frequency output value.

1) Forward flow: in accordance with flow direction arrow on the sensor;

2) Reverse flow: in contrast to the flow direction arrow on the sensor;

Flow direction setting	The relation with sensor arrow	The relation with displayed value
Forward	Apply to the same in the direction of the flow arrow and most of the traffic situation	Forward flow displayed value is the measurement value; Direction flow displayed value is 0; Forward flow total mass and total volume increase; Reverse flow total mass and total volume are not changed.
Reverse	Apply to the opposite in the direction of the flow arrow and most of the traffic situation	Direction flow displayed value is 0; Forward flow displayed value is the measurement value（no minus sign）; Forward flow total mass and total volume are not changed; Reverse flow total mass and total volume increase.
Absolute value	Regardless of the direction of arrow	Forward flow displayed value is the measurement value; Direction flow displayed value is the measurement value（no minus sign）; Forward flow total mass and total volume increase; Reverse flow total mass and total volume increase.
Bidirection	Apply to the forward flow and reverse flow, and forward and reverse flow can not be ignored	Forward flow displayed value is the measurement value; Direction flow displayed value is the measurement value（with minus sign） Forward flow total mass and total volume increase; Reverse flow total mass and total volume decrease.

Table 12-1 Flow selection table

3) The effect of flow direction on current output

Flow direction will affect the current output type only when the current output configuration at mass flow or volume flow.

4) The effect of flow direction on frequency output

Flow direction setting	Actual flow direction		
	Forward	Zero flow	Reverse
Forward	Output>0	Output=0	Output0
Reverse	Output=0	Output=0	Output>0
Absolute value	Output>0	Output=0	Output>0
Bidirection	Output>0	Output=0	Output>0

Table 12-2 The effect of flow direction on frequency output table

5) The effect of flow direction on total mass

Flow direction setting	Actual flow direction		
	Forward	Zero flow	Reverse
Forward	Total mass increases	Total mass not changed	Total mass not changed
Reverse	Total mass not changed	Total mass not changed	Total mass increases
Absolute value	Total mass increases	Total mass not changed	Total mass increases
Bidirection	Total mass increases	Total mass not changed	Total mass decreases

Table 12-3 The effect of flow direction on total mass table

4.14 4~20mA OUT

This setting is used for the configuration scheme of current output, and flow range represented by output current (including 4-20mA OUT #1 and 4-20mA OUT #2)

4.14.1 4~20mA OUT setting

You can select mass flow, volume flow, density and temperature as the value of current output.

4~20mA OUT setting method: BASICS->Input user password ->4-20mA OUT ->Select value

4.14.2 4~20mA MAXVAL and 4~20mA MINVAL

4~20mA output mass flow: value is -60000~60000, the unit is the same as mass flow range.

4~20mA output volume flow: value is -60000~60000, the unit is the same as volume flow range.

4~20mA output temperature: value is -250~400℃

4~20mA output density: value is 0~3000, the unit is the same as density.

4mA is corresponding to the mA MIN value.

20mA is corresponding to the mA MAX value.

mA MAX value and mA MIN value setting method:

BASICS->Input user password -> mA MAX value ->Modify value

BASICS ->Input user password -> mA MIN value ->Modify value

4.15 FREQ OUT

This setting is used for configuration scheme of frequency output, as well as the flow rate of the output frequency represents. Settings include frequency output configuration, frequency maximum value, pulse output equivalent, frequency minimum value.

4.15.1 FREQ OUTPUT

Mass flow and volume flow can be optional;

Setting method: BASICS ->Input user password -> FREQ OUTPUT ->Select mass flow or volume flow.

4.15.2 FREQ MAXVAL

Be used for setting the flow value which high frequency represents, unit is the same as that of device range, modify the scope of value (0-60000).

4.15.3 FREQ MINVAL

This value is identically equal to zero.

Setting method: BASICS ->Input user password ->FREQ MINVAL->Set value

4.15.4 MAX OUT FREQ

Be used for setting the frequency value corresponding to max flow.

4.16 RESET

After reset, the total mass flow and total volume flow will accumulate again.

Setting method: BASICS ->Input password ->RESET-> Select yes.

4.17 ZERO CAL

After installation, modify the stored zero value to the zero value which is applied to the current application, the setting method is below:

4.17.1 Preparatory condition

1) After flow meter is power on, warm-up 10 minutes;
2) Enable the fluid to flow through the sensor until the sensor temperature and the measured fluid are the same;
3) Shutdown downstream and upstream valves of the sensor (if have), so that make the fluid static, and make sure the fluid has been cut off and the fluid is full of the sensor;

4.17.2 Zero adjustment setting

In the system menu, select "BASICS>Input password>ZERO CAL>Yes"

4.17.3 Troubleshooting for ZERO CAL

1) Make sure the sensor has been filled with fluid and the fluid is completely static;
2) Ensure that the fluid does not contain precipitated particles;
3) Repeat the procedure of zero adjustment;
4) Please contact with the manufacturer.

4.18 COMM

4.18.1 COMM selection

In system menu select “BASICS-Input password-COMM-Select RS485 or HART”

4.18.2 RS485

RS485 ADR: in system menu select “BASICS-input password-RS485 ADS-Input the address for the current device”, the range is 0-31

RS485 BAUD: in system menu select “BASICS-input password-RS485 BAUD-select value”, 2400/4800/9600 can be optional.

4.19 RECALL MEMO

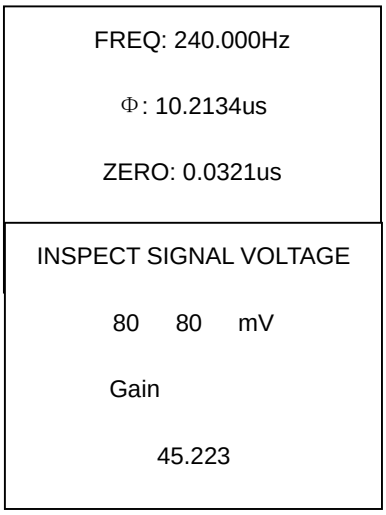
In system menu select” BASICS-input password-RECALL MEMO-select Yes”, restore the current settings to the initial status.

4.20 Device status and output test

4.20.1 DEV.INFO

Enter the system setting menu and select the DEV.INFO, press the FUNC key to enter and query by the direction key. Press ESC key to exit to the main interface. DEV.INFO is read-only mode and can not be modified.

DEV.INFO includes data info, closed loop data info, range info, series info, model info, firmware info and error code, shown as below:



M.FLOW kg/h 0 500 V.FLOW L/h
DENSITY kg/m^3 0 2500 TEMPER ℃
TRANS MODEL 330 TRANS SER#
SENS SER# SN:154321 FIRMWARE VER. 00-12-34
ERROR # XX

4.20.2 DEBUG

- TEST OUTPUT

Provide test function for frequency and current output. After enter this function, frequency and current output is stable value; After exit this function, return to normal output. This function can be used for adjusting current coefficient and verify the work status of device output part. After enter this function, the output value of frequency and current can be adjusted through adjusting percentage of output by UP or DOWN key.

- REBOOT DEV

Reboot the device.

- CLR ERROR#

Clear the error code of the device.

4.21 ADVANCED menu

This menu can be only set under the condition of field replacing sensor and calibration. When the device is working in the field, the parameters of this menu can not be adjusted, otherwise it may cause measurement error.

4.21.1 Flow K

This coefficient can be adjusted only under the following conditions:

1) Re-calibration

2) Replace sensor

3) The error for the measurement value and the actual flow value exceeds flow meter error level.

The adjustment method is as follows:

The new flow coefficient = the stored flow coefficient × (flow value measured by calibration device/ flow value measured by flow meter)

Note: Flow value measured by flow meter is required to take the average of multiple measurements (at least 3 times)

4.21.2 CAL TEMP

Calibration temperature is used for recording the fluid temperature when flow coefficient calibrate, which is for temperature compensation.

4.21.3 M.FLOW MAX/MIN

Mass flow range of the device, which is required to be set according to the connected sensor. Normally, M.FLOW MIN is set according to dynamic range setting. Device range unit: t/h, kg/h, g/h

4.21.4 V.FLOW MAX/MIN

Volume flow range of the device, which is required to be set according to the connected sensor. Device range unit: m^3/h, L/h, mL/h

4.21.5 TEMP Ct

Temperature coefficient is used for temperature compensation. This is advanced setting and can not be changed. Please contact with the manufacturer for any changes, otherwise, any changes will make the measurement parameters (mass flow etc) inaccuracy when temperature is changed.

4.21.6 BASIC FQ

Basic frequency is the parameter used for density measurement. After sensor installation, record the vibration frequency when the pipe is empty and input the value here, which is sued for the calculation of density. This is advanced setting and can not be changed. Please contact with the manufacturer for any changes, otherwise, any changes will make the measurement parameters (density/volume etc) inaccuracy.

4.21.7 DENSITY D1

This density D1 and basic frequency is used for calculating fluid density, the method of modification and calibration is the same as Flow coefficient.

4.21.8 DENSITY D2~D7

This coefficient can be used only for adopting <JJG_370-2007 Online vibration tube liquid density meter verification procedures>

4.21.9 DENSITY Dt

This coefficient is used for recording fluid temperature when DENSITY D1 calibration, which is used for temperature compensation for density.

4.21.10 SET MEMORY

Make the current setting stored as initial factory setting.

4.21.11 ADVANCED SETTING

Pressure coefficient P1-P3, N C Po1~5 is advanced setting, which can not be changed. Please contact with the manufacturer for any changes, otherwise, it will lead to inaccuracy in measurement.