RST MEASUREMENT CONTROL TECHNOLOGIES

Fluid Measuring Systems

FCKD Mass Flowmeter

Instruction Manual

This manual includes the structure, principle, specifications, usage, applicable scope and precautions of the mass flowmeter sensor and transmitter developed and manufactured by our company. Be sure to read the manual before installation and operation. For more details about the product, please contact our company or the local agents.

The transmitter has passed the explosion-proof certification. No one is allowed to replace parts and components without authorization in case its performance is affected.

For maintenance, the primary power supply should be disconnected first. When opening the explosion-proof enclosure, care must be taken to protect the explosion-proof surface. During installation, make sure that the explosion-proof surface has no damage; cable connection is good; no metal washer, sealing rubber gasket and tightening nut is lost so that the electric explosion-proof performance is maintained.

1. General

1.1 Introduction

FCKD Series Mass Flowmeter (hereafter we call FCKD) is designed according to the Coriolis Principle. It can be widely used for the process detecting and custody transfer/fiscal unit in many industries such as petroleum, petroleum and chemical, chemical industry, pharmacy, paper making, food and energy, and so on. As a fairly advanced kind of flow measurement instrument, it has been paid attention by the circle of measurement and accepted by many customers home and abroad.

1.2 Principle

FCKD is designed according to the principle of Coriolis force. Under the alternating current effect, the magnet and coil installed on the measuring tube will make two parallel measuring tubes vibrate according to some fixed frequency. Once there is flow passing through the pipes, Coriolis force will give rise to deflection (phase shift) on the vibration of two pipes and the deflection of vibration is directly proportional to the mass flow of fluid. Pick up them and the mass flowrate could be calculated.

The vibration frequency of measuring tube is determined by the total mass of measuring tube and inner fluid. When the fluid density changes, the vibration frequency of measuring tube will be also changing, as a result, the fluid density can be calculated.
The temperature sensor installed in the pipeline can pick up the fluid temperature on time under the coordination of measuring circuit.

1.3 Feature

Comparing with the traditional flow measurement method, FCKD has following obvious merits:
1.3.1. Enable to measure directly mass flow rate of fluid in the pipeline without changing any parameters, which avoids the some measurement error of intermediate links. Its mass flowrate can be high accuracy and good repeatability within bigger range of turndown ratio.
1.3.2. Fluid measured can be more extensive, such as the steady uniform flow of common viscosity fluid, the high viscosity fluid, non-Newtonian fluid, slurry containing some solid components and the liquid containing some trace of gas.
1.3.3. Due to the small vibration, measuring tube of the FCKD can be regards as non-moving parts, which will reduce the maintenance of flowmeter, enhance the stability and lifetime.
1.3.4. Besides the mass flow measurement, the density and temperature and even consistency can also be picked up and output.

2. Technical specifications

2.1 Main Technical Specification

2.1.1 Performance specifications

Table 1: Flow Range for liquid with Analogy type transmitter

DN(mm)	Allowable Flow Range (kg/h)	Normal Flow Range for Accuracy 0.1% (kg/h)	Normal Flow Range for Accuracy 0.2% & 0.5% (kg/h)	Stability of Zero Point(kg/h)
10	20～1000	200～1000	100～1000	0.20
15	40～2000	400～2000	150～2000	0.40
25	120～6000	1200～6000	600～6000	1.00
40	600～30000	6000～30000	3000～30000	6.00
50	1000～50000	10000～50000	5000～50000	10.0
80	2400～120000	24000～120000	12000～120000	24.0
100	4000～200000	40000～200000	20000～200000	40.00
150	10000～500000	100000～500000	50000～500000	100.0
200	20000～1000000	200000～1000000	100000～1000000	200.0

Table 2: Flow Range for liquid with DSP type transmitter

DN(mm)	Allowable Flow Range (kg/h)	Normal Flow Range for Accuracy 0.1% (kg/h)	Normal Flow Range for Accuracy 0.2% & 0.5% (kg/h)	Stability of Zero Point(kg/h)
10	20～1000	70～1000	50～1000	0.200
15	40～2000	150～2000	100～2000	0.380
25	120～6000	400～6000	300～6000	1.000
40	600～30000	2000～30000	1500～30000	4.000
50	1000～50000	3500～50000	2500～50000	6.250
80	2400～120000	8000～120000	6000～120000	17.50
100	4000～200000	15000～200000	10000～200000	25.00
150	10000～500000	35000～500000	25000～500000	62.50
200	20000～1000000	70000～1000000	500000～1000000	100.0

Table 3: Flow Range for gas with DSP type transmitter

DN (mm)	Measurable Flow Range (kg/h)	Flow Range with Accuracy 0.5% (kg/h)	Stability of Zero Point (kg/h)
15	15 ~ 3000	75 ~ 3000	0.38
25	40 ~ 8000	200 ~ 8000	1.00
40	160 ~ 32000	800 ~ 32000	4.00
50	250 ~ 50000	1250 ~ 50000	6.25
80	700 ~ 140000	3500 ~ 140000	17.5
100	1000 ~ 200000	5000 ~ 200000	25.0
150	2500 ~ 500000	12500 ~ 500000	62.5

Table 4: Flow range of volume for air under standard temperature and pressure condition (hereafter we call “standard condition”)
The flow value of other gas medium =

$$\frac{\text{The value in the below table * Air density under standard condition}}{\text{Medium density under standard condition}}.$$

DN (mm)	Start Flow (Nm^3/h)	Flow Range with Accuracy 0.5% (Nm^3/h)
15	12.50	62.5 ~ 2500.0
25	33.33	166.7 ~ 6666.7
40	133.33	666.7 ~ 26666.7
50	208.33	1041.7 ~ 41666.7
80	583.33	2916.7 ~ 116666.7
100	833.33	4166.7 ~ 166666.7
150	2083.33	10416.7 ~ 416666.7

The volume under working condition can be calculated by the following formula:

Volume flow under working condition =

$$\text{Standard volume flow} \times \frac{0.1}{\text{Working Pressure} + 0.1} \times \frac{\text{Working Temperature} + 273}{273}$$

(Note: 1. The unit of working pressure is MPa, the unit of the working temperature is ℃.

2. Other gas medium data can be calculated based on above table data * air density under standard condition /medium density under standard condition)

Table 5: Flow rate factor of DSP type FCKD for gas measurement

In many cases, we need to know the flow rate of the medium while using DSP type FCKD Mass Flowmeter for gas measurement. The connection size reducing is widely popular in mass flowmeter gas measurement application, thus the flow rate of FCKD Mass Flowmeter (with DSP transmitter) need to be calculated according to the formula below:

$$\text{Medium Flow Rate} = \frac{\text{Volume Flowrate under working condition}}{\text{Flow Rate Factor}}$$

DN (mm)	15	25	40	50	80	100	150
Flow Rate Factor	0362	1.046	3.535	5.436	15.89	26.15	58.84

(**Note: 1.** The gas flow rate is usually much higher than liquid when measured by flowmeter, so there will be noise caused by gas medium and tube wall of flowmeter under high speed gas flow and if the noise become larger, the signal of flowmeter will be influenced, so **please use FCKD -Mass Flowmeter for gas medium measurement at speed less than 1/3 of sound velocity!**
2. Please use FCKD -Mass Flowmeter for gas with pressure loss not more than 0.2Mpa!)

2.1.2 Mass Flow Measuring

2.1.2.1 Flow Range shown in Table 1-4

2.1.2.2 For liquid: Conversion of Basic Error for Mass flow (Table 6)

0.1%	0.2%	0.5%
$\pm 0.1\% \pm (\frac{StabilityofZeroPo\,\text{int}}{Ins\,\tan\tan\,eousFlow} \times 100\%)$	$\pm 0.2\% \pm (\frac{StabilityofZeroPo\,\text{int}}{Ins\,\tan\tan\,eousFlow} \times 100\%)$	$\pm 0.5\% \pm (\frac{StabilityofZeroPo\,\text{int}}{Ins\,\tan\tan\,eousFlow} \times 100\%)$
Accuracy is calculated based on the water measurement under the condition of +20℃～25℃and 0.1MPa～0.2MPa.		

2.1.2.3 For gas: Conversion of Basic Error for Mass flow

The accuracy of FCKD Mass Flowmeter (with DSP transmitter) for measuring gas:
Accuracy ≤ 0.5% (For the flow within the flow range of turn down ratio 40:1)
Accuracy ≤ 0.5% $\pm 0.5\% \pm (\frac{StabilityofZeroPo\,\text{int}}{Ins\,\tan\tan\,eousFlow} \times 100\%)$
(For the flow within the flow range of turn down ratio 40:1)

2.1.2.4 Repeatability (Table 7)

Accuracy	0.1% for liquid	0.2% for liquid	0.5% for both of liquid and gas
Repeatability	±0.05%	±0.1%	±0.25%
Accuracy is calculated based on the water measurement under the condition of +20□～25℃and 0.1MPa～0.2MPa.			

2.1.3 Density Measuring (Table 8)

Density Range	(0.2～2.0)g/cm^3
Basic Error	±0.002g/cm^3 (Affected by the sensor)
Repeatability	0.001g/cm^3

2.1.4 Temperature Measuring (Table 9)

Temperature Range	(-50～+125)℃	Integrated Type
	(-50～+℃)℃	Separate Type
Basic Error	≤±1.0□	

2.2. Specification of Function

2.2.1 Current Output (Table 10)

Passive 4-20mA Current Output can be configured to denote the mass flow or volume flow.

Output Range	(4～20)mA
Resolving Power	0.000244mA
Basic Error	0.2%F.S
Temperature Influence	±0.005%F.S/□
External resistor should be 250～600Ω	

2.2.2 Pulse Output (Table 11)

Active Pulse Output can be configured to denote the mass flow or volume flow.

Output Range	(0～10)kHz
Resolving Power	0.152Hz
Basic Error	±0.075%
Temperature Influence	±0.001%F.S/□
Capability of Outrange is 12kHz	

2.2.3 Low Flow Cutoff

When the flow value measured is lower than the value of Low Flow Cutoff, the FCKD will output zero flow and the totalizer will stop to accumulate. The value of Low Flow Cutoff is usually sets to be 1% of the maximum flowrate.

2.3 Environment Limitation

2.3.1 Environment vibration (Table 12)

Frequency Range	(10～2000)Hz
Acceleration amplitude value	2g
Circulation time	50 times

2.3.2 Environment temperature (Table 13)

Working Temperature	(-20～+55)℃
Storage Temperature	(-20～+70)℃

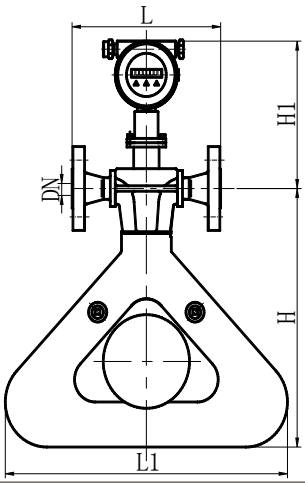
2.3.3 Environment humidity (Table 14)

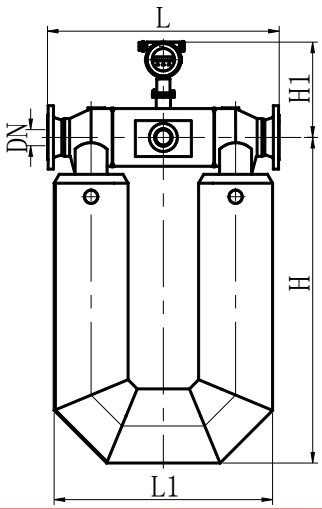
Working Humidity	＜90%	+25□

Storage Humidity	＜95%	No condensation

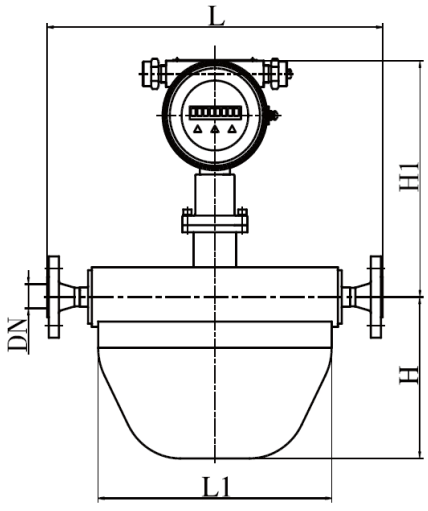
2.3.4 Enclosure Grade: IP65

2.4. Outline Dimension (See the following Drawings and Tables)





	DN	L			L1	H	H1	
		GB/DIN (MPa)		ΔL (mm)			Integrated	Separated
		≤ 4.0	≥ 6.3					
015	15	180	194	±1.5	350	290	260	190
040	40	520	547	±2.5	470	660	280	210
050	50	558	588		550	750	290	220
080	80	780	808		710	1040	320	250
100	100	920	948		860	1290	350	280
150	150	1100	1140	±3.5	1050	1600	380	310
200	200	1364	1410		1160	1740	420	350
300	300	2070	2120		1270	3150	520	450



	DN	L			L1	H	H1	
		GB/DIN (MPa)		ΔL (mm)			Integrated	Separated
		≤ 4.0	≥ 6.3					
015W	15	360	374		240	180	290	220
025W	25	500	536		360	250	300	230
040W	40	600	634		500	340	310	240
050A	50	660	688		500	340	320	250
050B	50	800	828		500	420	320	250
080A	80	900	928		700	405	350	280
080B	80	1000			800	630	350	280
100A	100	1130	1156		860	660	370	290
100B	100	1200			900	820	370	290
150W	150	1410	1410		1200	900	400	330
200W	200	1800	1844		1450	1170	420	350
250W	250	1850	1890		1530	1180	420	350
300W	300	2000	2050		1600	1300	460	390

2.5. Model Selection

FCKD —□□□ □ □ □ □ □ □ □ □ □ □

0 1 2 3 4 5 6 7 8 9 10 11

Note:
0—FCKD Series Mass Flowmeter
1—Nominal Size(mm)
2—Medium: Y—Liquid Q-Gas
3—Structure: 1—Integrate Type(-50～+125℃) 2—Separate Type(-50～+200℃)
4—Sensor shape: U—U shape W—Micro-bend
5—Transmitter type: P—Analog type D-Digital Signal Processing type
6—A—General Type B—Explosion-proof Type (See more details in Table 16)
7—Power Supply: 1—24VDC 2—220VAC
8—Output Interface: S—RS485 N—No
9—Nominal Pressure(MPa): 1.6; 2.5; 4.0; 6.4; 10; 25(only for size ≤25mm)
10—Signal Output: F—Pulse Output I—(4～20)mA
11—Accuracy: A—±0.1% B—±0.2% C—±0.5%

Table 16: Explosion-proof classification

Model	Explosion-proof class

Integrate Type	FCKD -010～200	Exdib ⅡCT4～T6(ⅡC just includes H_2)
Separate Type	FCKD -010～080	Ex ib ⅡCT3～T6(ⅡC just includes H_2)
	FCKD -100～200	Exdib ⅡCT3～T6(ⅡC just includes H_2)

For example: FCKD -025 2 U D B Y 1 S 2 2.5 F B

Meaning: FCKD Series Mass Flowmeter, DN25mm, Separate Type(working temperature -50～+200℃), U shape sensor; Digital Signal Processing type, Exdib ⅡCT3～T6(ⅡC just includes H_2), Liquid, 24VDC, RS485 Interface, 2.5MPa, Pulse Output, ±0.2% accuracy.

3. Introduction

3.1 About This Manual

This manual mainly introduces the installation, connection, startup, operation, and trouble-shooting of FCKD. The user must read this manual carefully before use, because improper installation may cause incorrect measurement and even damage the flowmeter.

3.2 Safety

3.2.1 When the flowmeter is required to be installed in the dangerous region, please confirm the explosion-proof performance of the flowmeter consistent with the environment in order to avoid the danger.

3.2.2 Please ensure that the power goes off to avoid the accident of electric shock when assembling a transmitter.

3.2.3 Please defer to the way of installation and usage to ensure the normal operation of the flowmeter.

3.3 Components

FCKD is made up of sensor and transmitter, which can be installed integrally or separately. When FCKD is installed separately, the sensor and transmitter should be connected through special Nine-Core Cable.

3.4 Installation Process

3.4.1 Step 1: Location: Determine the installation location of sensor, which should take the installation area, pipeline, transmitter location and valve into account.

3.4.2 Step 2: Direction: Determine the installation direction of sensor in the pipeline.
3.4.3 Step 3: Installation: Install the sensor and transmitter in the pipeline.

3.4.4 Step 4: Connection: When FCKD is installed separately; the sensor and transmitter should be connected through special Nine-Core Cable.

3.4.5 Step 5: Start-up.

4. Installation

4.1 Position selection

4.1.1 The sensor should be placed away from interference source which may cause pipe's mechanical vibration such as the pump along the process pipeline. If sensors are used in series along the same line, care must be taken to guard against the mutual influence due to resonance. The distance between sensors should be at least more than three times its width.

4.1.2 When installing the sensor, pay attention to the expansion and contraction of the process pipeline due to temperature change. It is strongly recommended that the sensor should not be installed near the expansion joint of the process pipeline. Otherwise, the pipe expansion and contraction of the pipeline will bring about transverse stress which can affect the sensor‘s zero, as a result of which the measurement accuracy will be affected.

4.1.3 The sensor should be placed away from industrial electromagnetic interference sources such as large power motors and transformers, otherwise, the measuring tube's auto-oscillation within the sensor will be interfered, and the weak signal detected by the speed sensor may be drowned by the electromagnetic noise. Therefore, the sensor should be away from such sources as motors and transformers, at least five meters.

4.1.4 The sensor should be placed in the position where its measuring tube is always filled with fluids and a certain pressure out is maintained, thus it should be placed in the lower end of the pipeline.

4.1.5 Basic requirement: Install the FCKD in the lower position of the pipeline so that the fluid can fill with the sensor during the process of zero point calibration and running. The transmitter should be installed in the environment with temperature from -20～+55℃and humidity <90%.

4.1.6 Dangerous area: Please confirm the installation environment is suitable to the explosion-proof performance indicated in the nameplate of FCKD for the installation of dangerous area.

4.1.7 Straight pipe: FCKD does not require the special straight pipe upstream or downstream. However, if tow or more mass flow sensors are installed serially in the same pipeline, please ensure the length of pipe between any two sets is more than 2 meters.

4.1.8 Maximum length of cable: (shown in Table 15)

Cable Model	Cable Specification	Max. Length
Special Nine-Core Cable	Special	300m
Current Power Line	18AWG(0.8mm2)	300m

4.1.9 Working temperature of sensor: (shown in Table 16)

Integral Type	(-50～+125)℃
Separate Type	(-50～+200)℃
High temperature Separate Type	(-50～+300)℃ under developing
Low temperature Separate Type	(-150～+125)℃ under developing

4.1.10 Valve: It is necessary to carry through zero point calibration once the installation of FCKD is finished. The downstream stop valve has to be close at first before zero point calibration, and then close the upstream stop valve.

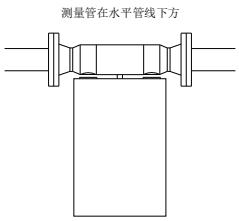
4.2 Direction

4.2.1 Basic requirement:

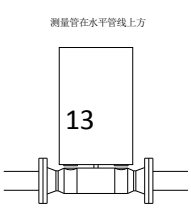
The FCKD works well only when the liquid fills with the measuring tube. In principle, as long as the measuring tube is full of liquid, the FCKD will function in any orientation installation. Generally speaking, the FCKD is installed in the orientation which makes the liquid fill with the measuring tube.

For the horizontal installation, the measuring tube should be installed underside the pipeline when the process medium is liquid or slurry (shown on Picture 1) and topside the pipeline when the process medium is gas (shown on Picture 2). For the vertical installation, the measuring tube should be installed besides the pipeline when the process medium is liquid or slurry or gas (shown on Picture 3).

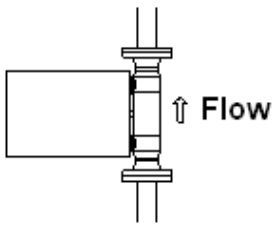
Picture 1



Picture 2



Picture 3

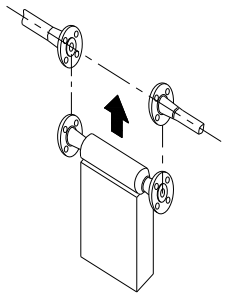


4.2.2 Flow direction:

There is obvious flow arrow which indicates the proper flow direction on the front of the sensor, so please install the FCKD according to it. Otherwise, the transmitter may not display the mass flow normally.

For vertical installation, if the process medium is liquid or slurry, the flow direction is down-to-up; if the process medium is gas, the flow direction can be either down-to-up or up-to-down. The transmitter can be mounted with 90° revolution according to the requirement of installation.

4.3 Sensor Installation



4.2.3 Basic requirements:

The installation of the FCKD should decrease the tortuosity of the process connection. Meanwhile, do not support the pipeline by the sensor of the FCKD. (Shown in Picture 4)

4.2.4 Installation of the FCKD -150 Sensor:

It is better to support the sensor of FCKD using rubber connector as the buffer.

4.4 Wiring

4.2.5 Basic requirements:

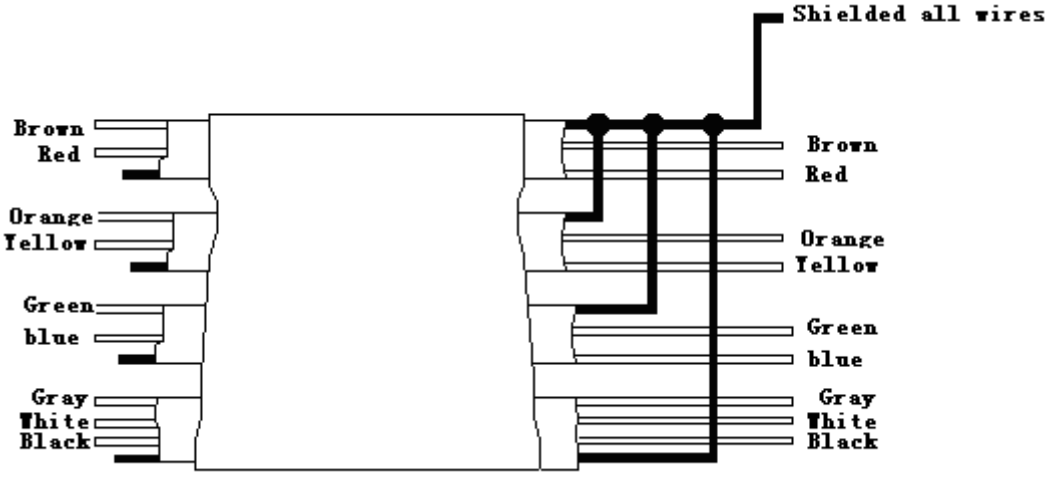
If the sensor of FCKD is installed integrally with the transmitter, it will be OK that the power of transmitter is connected. If the sensor of FCKD is installed separately with the transmitter, it will be required that the transmitter is connected with the sensor through special nine-core cable. If the FCKD -150 (DN150mm) is installed, it is required that the drive-amplifier of sensor is supplied with power connection.

4.2.6 Junction box

If the sensor and the transmitter are installed separately, the sensor and transmitter have been respectively matched with junction box for connecting the special nine-core cable.

4.4.3 Cable connection

If the sensor and the transmitter are installed separately, signal lines are 9-core cables between transmitters and mass flow sensors.



Caution

Cut off power before connecting cables. The power voltage must match that indicated in the junction box of the transmitter and the earth connector must be well connected with earth wire to ensure its intrinsic safety performance.

Line NO.	Line Color	Function
1	brown	The left coil+
2	red	The left coil-
3	orange	The left coil+

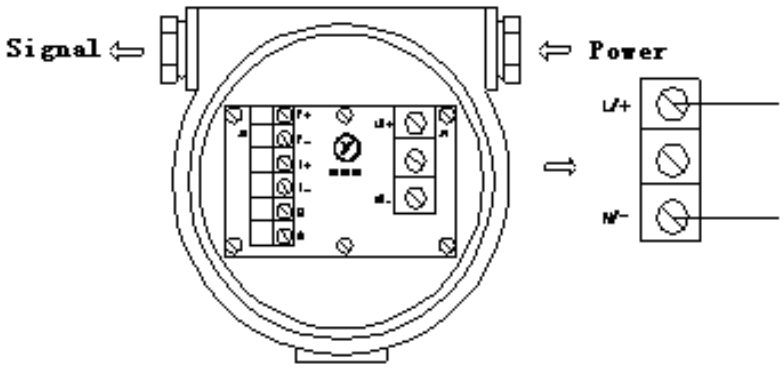
4	yellow	The left coil-
5	green	Driving coil+
6	blue	Driving coil-
7	Gray	Temperature+
8	white	Temperature-
9	black	Temperature Compensation

4.4.4 Earthing:

Both of the sensor and the transmitter have to be earthed correctly, otherwise the measurement error will occur and even the FCKD may not work. If the pipeline is connected with the ground, the transmitter can be earthed through the pipeline; if the pipeline is not connected with the ground, the transmitter should be earthed independently.

4.4.5 Power line wiring

The transmitter can be supplied with AC220V or DC24V. The power line more than 0.8mm^2 is recommended and the maximum length of power line should be 300m. For transmitter of FCKD -150, a single Driver amplifier is required supplied with AC220V power.



4.5 Start-up

4.5.1 Zero-point calibration

Zero-point calibration supplies the base point for the flowmeter. After the first installation or reinstallation, Zero-point calibration is required for the FCKD. Before zeroing, close the downstream valve of the flow sensor to make sure that no fluid is flowing through the pipe. The sensor should be filled with process fluid whose temperature change should not exceed ±10□. If the flow meter is zeroed when fluids are

flowing through, its measurement will be extremely smaller. At that time, stop using the meter or re-zero it before use.

4.5.2 Instrument coefficient

Each set of the FCKD has its own instrument coefficients, which have been set before delivery and shown on the calibration certificate. So the user does not need to set instrument coefficient except either the sensor or the transmitter is replaced. All the coefficients which can be found on the certificate on the sensor, are also typed on the name plate. Generally, the sensor and the transmitter are in couples, and the coefficient has been input into the transmitter. The meter can be used without additional change.

5. Power Supply and Signal output Wiring

5.1. Power wiring

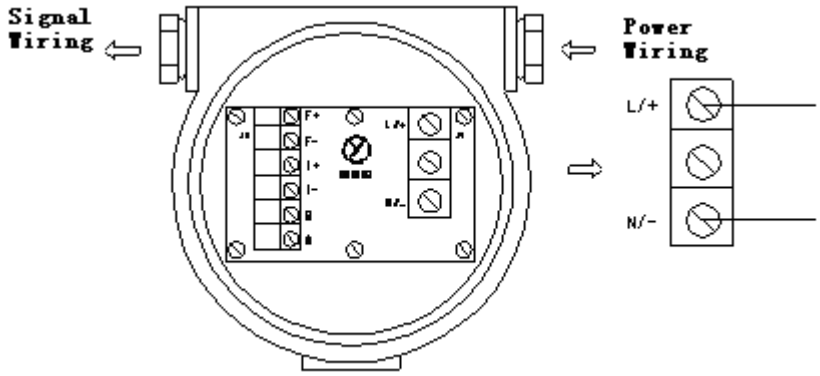
5.1.1 The basic requirement:

The transmitter can be connected to the AC220V or the DC24V power.

AC (85 to 265) V	Power Consume: Normal 10 W, MAX 15W
DC (18 to 30) V	Power Consume: Normal 10 W, MAX 15W

5.1.2 Power Cable

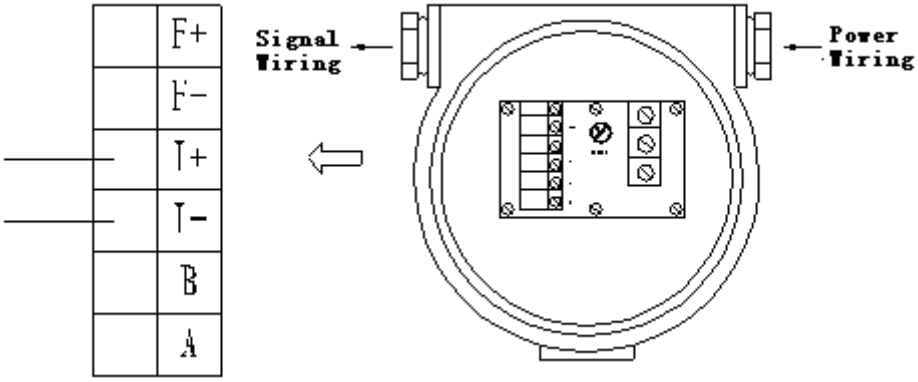
The power cable should choose 2-core cable and the area of each core >0.8 square millimeter. The maximum length of the power cable is 300m.



5.2 Current output wiring

5.2.1 4~20mA active output can be configured to mass flow or volume flow.

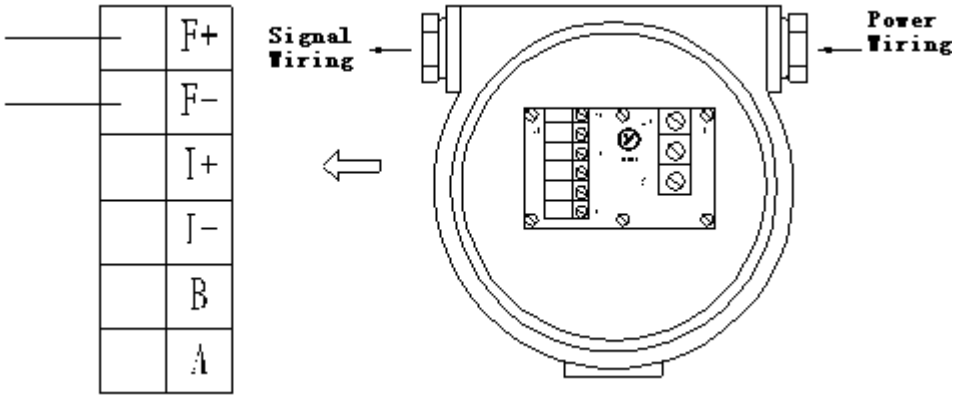
5.2.2 The cable should choose 2-core cable and the area of each core > 0.5 square millimeter.



5.3 Pulse output wiring

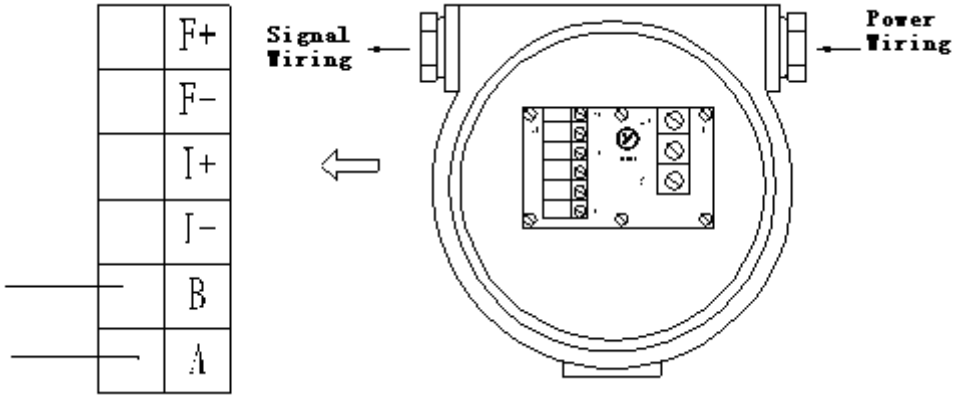
5.3.1 Active pulse output can be configured to mass flow or volume flow.

5.3.2 The cable should choose 2-core cable and the area of each core > 0.5 square millimeter. The maximum length of output line is 150m.



5.4 RS485 output wiring

RS485 output obeys MODBUS protocol. The maximum length of output line is ≤300m.



6 Configuration

6.1 General

Please use the operation panel of transmitter to set the configuration, such as basic configuration parameters, zero calibration, cutoff value of low flow and output range of current frequency, etc.

6.2 Configuration Parameter

Please review or set the configuration parameters according to the following indications (press ↓ to turn a page and press → to move the position of cursor or return):

6.2.1 Low Flow Cutoff

Configuration → E → Flow configuration → E → Zero-Calibration → ↓ → Low Flow Cutoff → → → (change the number among 0～9) → E → → → Yes → E → confirm the modification of low flow cutoff is successful.

6.2.2 Reset Totalizer

Configuration → E → Flow configuration → E → Zero-Calibration → ↓ → Low Flow Cutoff → → → Reset Totalizer → E → Input password to reset to zero.

6.2.3 Measurement Unit

Configuration → E → Unit configuration → E Mass Unit or MassFlow Unit or Volume Unit or VolumeFlow Unit or Density Uni ŧ → E → set their values.

6.2.4 Current Output

Configuration → E → Output configuration → E → Pulse equivalent weight → ↓ → 20mA Value → E → Input password to set their values.

6.2.5 Pulse Output

Configuration → E → Output configuration → E → Pulse equivalent weight → ↓ → 20mA Value → E → Pulse output → E → Input password to set their values.

6.2.6 RS485Output

Configuration → E → Output configuration → E → Pulse equivalent weight → ↓ → 20mA Value → E → Pulse output → E → Baud Rate → E → Input password to set its value.

Note: Default Password: "000000"

6.3 Calibration

Generally speaking, the FCKD does not need the field calibration for the user because it has been calibrated before delivery.

Each set of FCKD has its own instrumental coefficient, including one flow coefficient and four density coefficients (high density D1, high period K1, low density D2 and low period K2), which will be shown in Nameplate of Sensor or Calibration certificate.

The sensor and transmitter are usually delivered as a pair and instrumental coefficient has been set in transmitter so the user does not need to change any longer.

6.3.1 Zero Calibration

Zero calibration provides the datum mark of flowmeter for flow measurement. It is necessary to carry through zero calibration when the FCKD is finished to install for the first or a second time.

After correct installation, the FCKD should be powered at least 30 minutes for warm-up and then make the liquid pass through the flowmeter until the temperature of FCKD is same as working temperature of liquid. Afterward, close the downstream valve, make the liquid pass through the flowmeter under normal temperature, density and pressure and then close the upstream valve to assure the sensor is full of liquid during the process of zero calibration.

Finally, pres ↓ → Configuration → Zero-Cal → Flow configuration → Zero Correction → E → Input password to start zero calibration.

6.3.2 Flow Calibration

The mass measured by the FCKD is resulted from the multiplication of detected signals' time difference between two circuits and flow calibration factor. When the accuracy is not up to grade after long-term service, please modify the flow calibration factor according to the following formula:

K1=K0×[1+(M-Mt) / Mt]=K0×M/Mt

Note:

K1 New flow calibration factor,

K0 Old flow calibration factor,

M Total mass flow of Master Meter,

Mt Total mass flow of Tested Meter.

7. Trouble Shooting

7.1 Overview

During the first installation and use, if there is something abnormal related to the working of flowmeter, generally speaking, it should be resulted from either the application or the flowmeter system. Application is usually complex, which involves the measurement error of fluctuation caused by technology, change of medium, so it should be analyzed according to the actual application while this chapter mainly focuses on the causes and solutions of flowmeter system malfunctions.

7.2 Diagnostic Tool

For the flowmeter fault diagnosis, the user can judge by the LED indicator and LCD displays, LED lights of different colors and brightness contrast on the panel, which represent the working condition of flowmeter. Meanwhile, LCD displays can show the self-diagnostic alarming information of the transmitter, which is favorable for user's judgment and defining the malfunctions.

In addition, it is necessary to use handheld digital multimeter when testing the static resistance values and cables of the sensor.

7.3 Sensor

When testing the malfunction of the flowmeter, first of all, detect the coils resistance of sensor according to Table 13 and check if their values are fallen within the normal range.

Loop	Line color	Sensor port	Normal resistance range
Left coil	Brown, red	1, 2	(60～75) Ω
Right coil	Orange, yellow	3, 4	(60～75) Ω
Drive coil	Blue, green	5, 6	(6～30) Ω
Temperature	Gray, white	7, 8	(75～175) Ω
Temperature	Gray, black	7, 9	(75～175) Ω

7.4 Power and connection

The first installation of electricity, power should be checked to ensure that effective the following elements:

Choose the correct voltage for power supply, connect the power cable correctly, open insulating layer of two ends of the cable and pinch them firmly;

Power cable should be not connected with same output port of FCKD Transmitter with signal cables of input/output;

Transmitter should be earthed firmly and the earth resistance should be less than 1 Ω, (use the copper wire with area more than 2.5 mm2).

7.5 LED-Indicator

The proportion of light and dark shown by LED indicator represents the working condition of the flowmeter.

LED condition	**Working condition**
Always light at beginning	Impassable self-test
Always light afterward	Wrong zero-calibration
Light for 1/4second, dark for 3/4 second	Malfunction alarm
Light for 3/4second, dark for 1/4 second	Slug flow excesses

8. Explosion-proof

8.1 The explosion-proof classification of FCKD Series Mass flowmeter are as follows:

FCKD -Model		**Explosion-proof Class**
Integrate Type	FCKD -010～200	Exdib Ⅱ CT4～T6(Ⅱ C contains hydrogen only)
Separate Type	FCKD -010～080	Ex ib Ⅱ CT3～T6
	FCKD -100～200	Exdib Ⅱ CT3～T6(Ⅱ C contains hydrogen only)

8.2 The separate type sensor of FCKD must be matched with separate type transmitter of FCKD DSFG and its connection should be adopted with 9-core lines. The 9-core line should be less than 300m and the bending radius of wiring installation should be more than 120mm.

8.3 The ambient temperature range is (-20～40)℃.

8.4 The FCKD contains the earth terminal which must be earthed when put into service.

8.5 The user should not change the electric parameters and standard model of explosion-proof parts in the sensor random.

8.6 The cable jacket can be divided into two kinds of Φ8.5 and Φ12 according to the inner hole of cable gasket ring while the outside diameters of cables are respectively Φ8～Φ8.5 and Φ8.5～Φ12. Please change the cable and gasket ring once they aging or wear out.

8.7 Be sure that there is no gases which erode aluminum alloy.

8.8 Be sure that the maintenance or repair should be in safe place without flammable gases.

8.9 The correspondences between working temperature of medium and maximum surface temperature of flowmeter body are as follows:

	T3	T4	T5	T6
Working temperature	200℃	135℃	100℃	85℃
Surface temperature	195℃	130℃	95℃	80℃

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