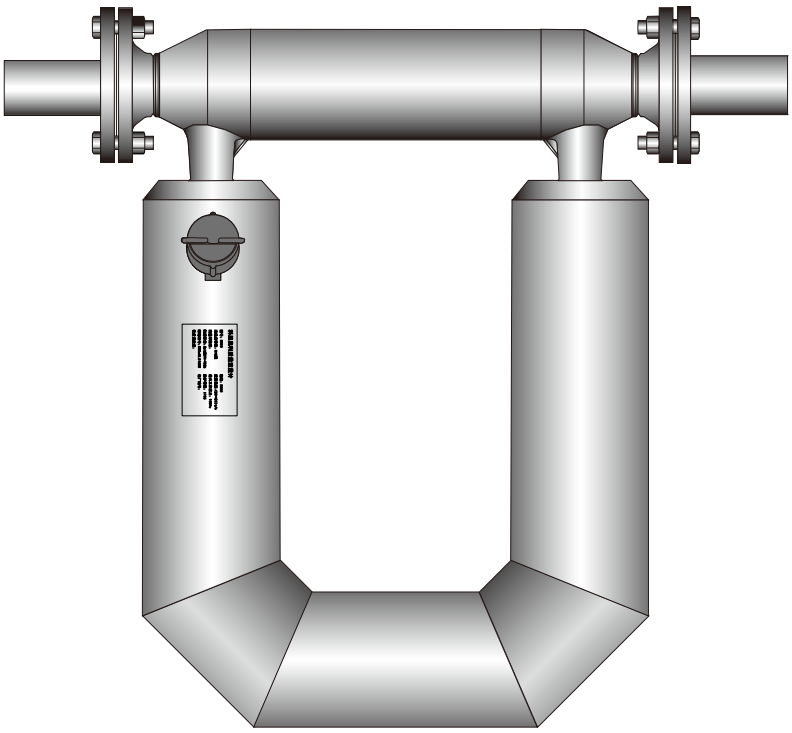


K-Series mass flowmeter

user's manual

CONTENT

1. General

1.1 Introduction

K Series Mass Flowmeter (hereafter we call K) is designed according to the Coriolis Principle.It has been widely 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 measurement and accepted by many customers home and abroad.

1.2 Principle

K 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, K 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 K 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

Main Technical Specifications

DN(mm)	25 ~ 100
Medium	Liquid, gas, slurry
Type / Medium Temp.	Integrate type: (-40 ~ 125) ℃ Remote type: (-40 ~ 204) ℃
Sensor	Triangle type, U-type
Transmitter	DSP
Certification	Ex-proof
Power Supply	DC24V、AC220V
Output Port	RS485
Pressure (MPa)	1.6、2.5、4.0、6.3; Customized for high pressure: 10.0, 16.0, 26.0
Output Signal	4~20mA, pulse
Accuracy	0.15%,0.2%
Hygienic Type	Customized
Process Connection	Customized

2.1.1 Flow Range

Table 1: Flow Range for liquid

DN(mm)	Allowable Flow Range (kg/h)	Normal Flow Range for Accuracy 0.15% (kg/h)	Normal Flow Range for Accuracy 0.2% (kg/h)	Stability of Zero Point(kg/h)
25	200～20000	2000～20000	1000～20000	0.68
40	400～40000	4000 ～40000	2000 ～40000	2.18
50	600～60000	6000 ～60000	3000 ～60000	2.18
80	1200～120000	20000 ～120000	12000 ～120000	6.8
100	1800～180000	20000 ～180000	18000 ～180000	6.8

2.1.2. Mass Flow Measuring

2.1.2.1 For liquid: Conversion of Maximum Error for Mass flow (Table 2)

0.15%	0.2%
$\pm 0.15\% \pm (\frac{1}{2} \times \frac{\text{Stability of Zero Point}}{\text{Instantaneous Flow}} \times 100\%)$	$\pm 0.2\% \pm (\frac{1}{2} \times \frac{\text{Stability of Zero Point}}{\text{Instantaneous Flow}} \times 100\%)$
Accuracy is calculated based on the water measurement under the condition of +10℃～25℃ and 0.1MP~0.3MPa.	

2.1.2.2 Repeatability (Table 3)

Accuracy	0.15%for liquid	0.2% for liquid
Repeatability	±0.075%	±0.1%
Accuracy is calculated based on the water measurement under the condition of +10℃ ~ 25℃ and 0.1MPa ~ 0.3MPa.		

2.1.3 Density Measuring (Table 4)

Density Range	(0.2 ~ 2.0)g/cm^3
Basic Error	±0.001g/cm^3
Repeatability	±0.0005g/cm^3

2.1.4 Temperature Measuring (Table 5)

Temperature Range	(-40 ~ + 80)℃	Integrated Type
	(-40 ~ +204)℃	Separate Type
Basic Error	≤±0.1℃	

2.2. Specification of Function

2.2.1 Current Output (Table 6)

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

Output Range	(4 ~ 20)mA
Resolving Power	0.000244mA
Basic Error	0.1%F.S
Temperature Influence	±0.005%F.S/℃
External resistor should be 250 ~ 750Ω	

2.2.2 Pulse/Frequency Output (Table 7)

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

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

2.2.3 RS485 Output

RS485-Modbus-RTU is optional for each set K.

2.2.4 Low Flow Cutoff

When the flow value measured is lower than the value of Low Flow Cutoff, the K will output zero flow and the totalizer will stop to accumulate. The value of Low Flow Cutoff is usually sets to be 0.3% of the maximum flowrate.

2.3 Environment Limitation

2.3.1 Environment vibration (Table 8)

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

2.3.2 Environment temperature (Table 9)

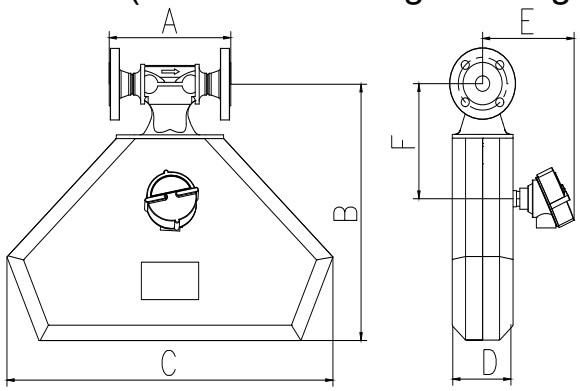
Working Temperature	(-40 ~ +55)℃
Storage Temperature	(-40 ~ +70)℃

2.3.3 Environment humidity (Table 10)

Working Humidity	< 90%	+25℃
Storage Humidity	< 95%	No condensation

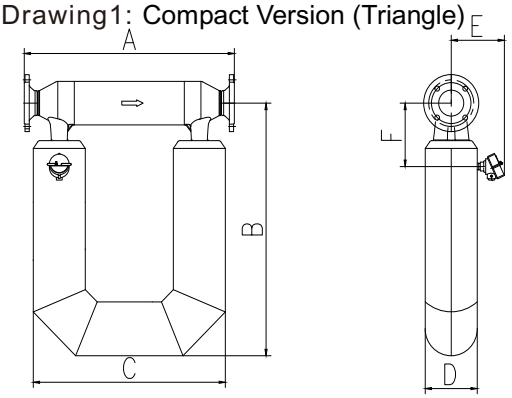
2.3.4 Enclosure Grade: IP67

2.4. Outline Dimension (See the following Drawings and Tables11)



D

Drawing1: Compact Version (Triangle)

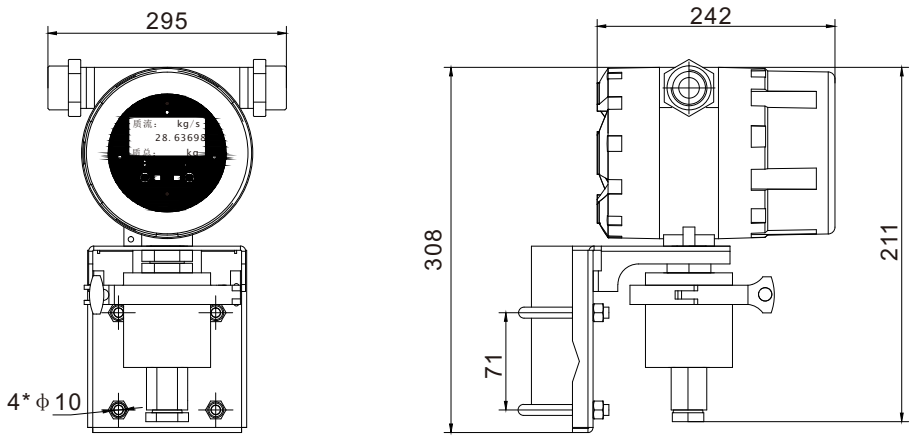


DN (40~100)

Unit:mm

Drawing 2: Compact Version (U- type)

K-	DN	PN	A	B	C	D	E	F
100	25	40	212	412	568	106	161	185
100	1"Class150		243					
100	1"Class300		256					
200	40	40	588	727	496	140	178	209
200	50	16	582					
200	50	40	588					
300	80	16	836	976	768	208	212	243
300	80	40	852					
300	100	16	840					
300	100	40	866					



Drawing 3: Dimensions for transmitter (unit: mm)

2.5. Weights

Table 11: net weights(table 12) Unit: kg

K-	100	200	300
Net weights	18.8±3	40±5	86±10

Note: transmitter is 5.6kg.

2.6. Model Selection (Coding/Part No.)

K — □□□ □ □ □ □ □ □

0 1 2 3 4 5 6 7

Note:

0 — K Series Mass Flowmeter

1 — Nominal Size(1 inch=25.4mm)

2 — Transmitter type: D-Digital Signal Processing type

3 — Power Supply: 1—24VDC 2—220VAC

4 — Output Interface: S—RS485 N—No

5 — Signal Output: F—Pulse Output I—(4 ~ 20)mA

6 — Accuracy: A—± 0.1% B—± 0.2%

7 — W- Hygeian or Sanitary; D-Customized

For example: K-100 D 1 S F B D

Meaning: K Series Mass Flowmeter, DN25mm, Digital Signal Processing type, 24VDC, RS485 Interface, Pulse Output, ±0.2% accuracy,Hygeian.

3. Introduction

3.1 About This Manual

This manual mainly introduces the installation, connection, startup, operation, and trouble-shooting of K. 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

K is made up of sensor and transmitter, which can be installed integrally or separately. When K 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 K 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 K 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 -40 ~ +60℃ 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 K for the installation of dangerous area.

4.1.7 Straight pipe: K 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 Nine-core cable is two merers long,can be customized

4.1.9 Working temperature of sensor: (shown in Table 13)

Integral Type	(-40 ~ +80)℃
Separate Type	(-40 ~ +204)℃

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

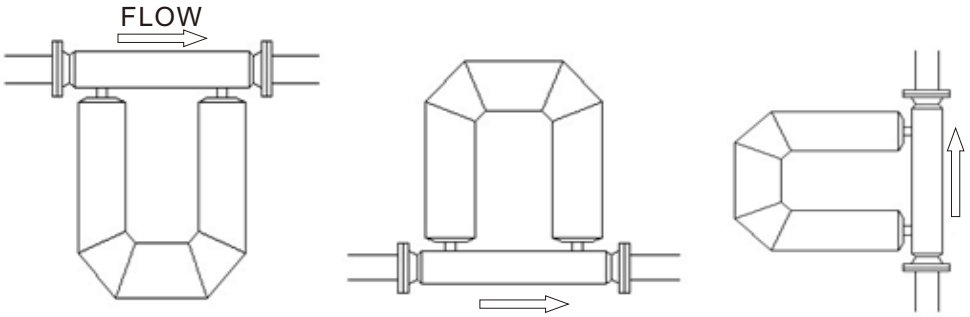
4.2 Direction

4.2.1 Basic requirement:

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

Basic requirements:

The installation of the K should decrease the tortuosity of the process connection. Meanwhile, do not support the pipeline by the sensor of the K.

4.4 Wiring

4.4.1 Basic requirements:

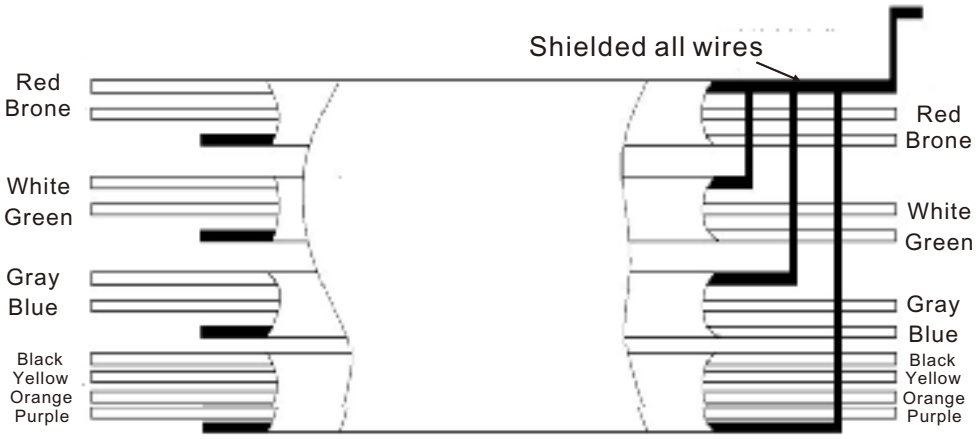
If the sensor of K is installed integrally with the transmitter, it will be OK that the power of transmitter is connected. If the sensor of K is installed separately with the transmitter, it will be required that the transmitter is connected with the sensor through special nine-core cable.

4.4.2 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	green	The left coil+
2	white	The left coil-
3	blue	The right coil+
4	gray	The right coil-
5	brown	Driving coil+
6	red	Driving coil-
7	yellow	Temperature+
8	orange	Temperature+
9	black	Temperature-
10	purple	Temperature-

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 K 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.

4.5 Start-up

4.5.1 Zero-point calibration

Please see 6.5.1 for details.

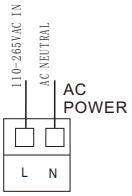
4.5.2 Instrument coefficient

Each set of the K has its own instrument coefficients, which have been set before delivery and shown on the nameplate. So the user does not need to set instrument coefficient except either the sensor or the transmitter is replaced. 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

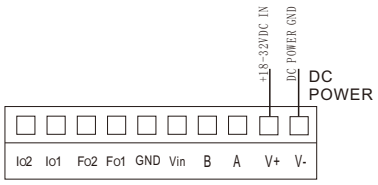
5. Power wiring

5.1 The basic requirement:

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



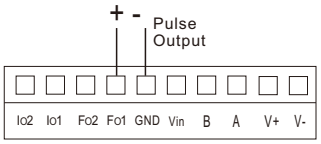
AC Power Wiring for DSP transmitter

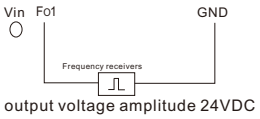


DC Power Wiring for DSP transmitter

5.2 Pulse output wiring (Passive mode)

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

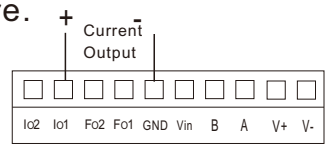


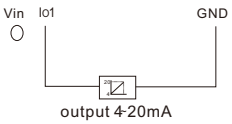


output voltage amplitude 24VDC

5.3 mA output wiring (Passive mode)

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





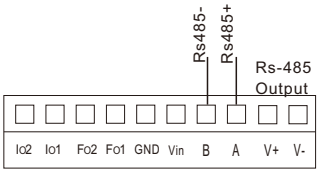
output 4-20mA

Remarks:

This is the correct connection mode according to the on-site informations. If change, please contact us.

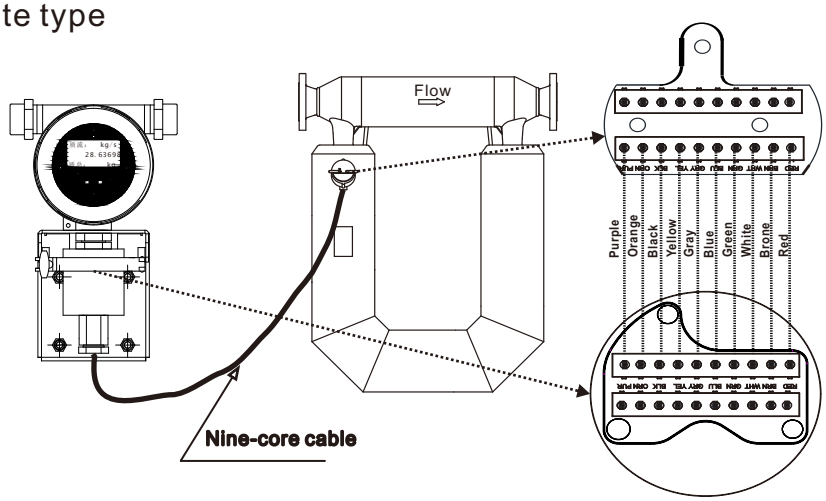
5.4 RS485 output wiring

Rs485 output obeys MODBUS protocol.



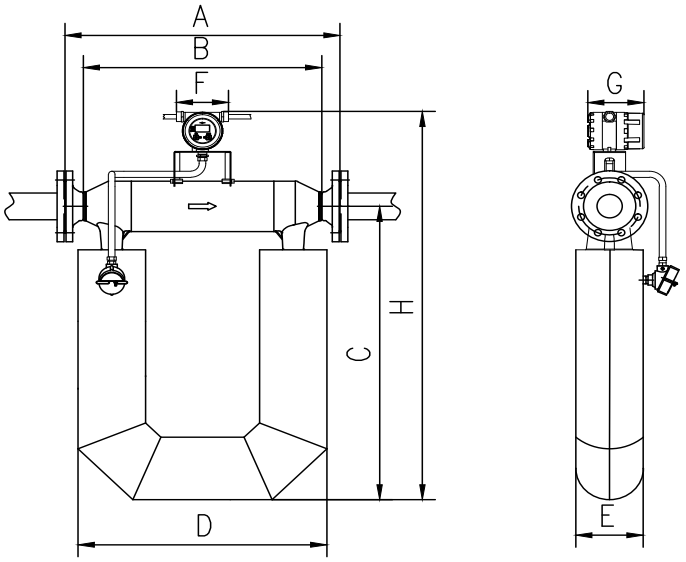
5.5 Connection between the sensor and transmitter

5.5.1 Separate type



Remarks:
The color on both sides of the patch panel must be one to one correspondence

5.5.2 Integral type



Unit: mm

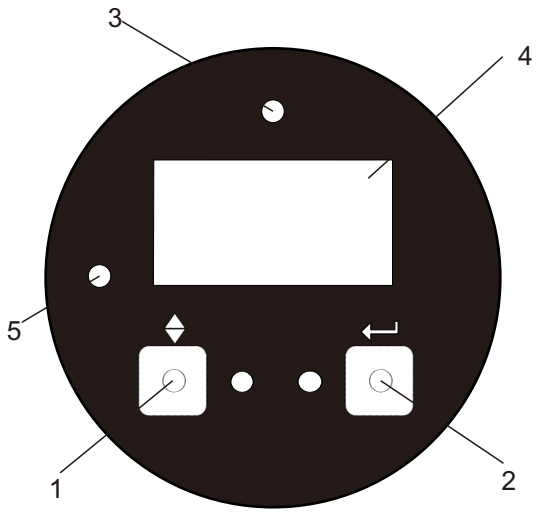
Model	Conn. Size/Rating	A	B	C	D	E	F	G	H
K200	DN40, PN40	580~606	492	727	496	140	161	174	1003
	DN50, PN16								
	DN50, PN40								
K300	DN80, PN16	832~930	736	976	768	208	161	174	1292
	DN80, PN40								
	DN100, PN16								
	DN100, PN40								

6. Operation instructions

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.

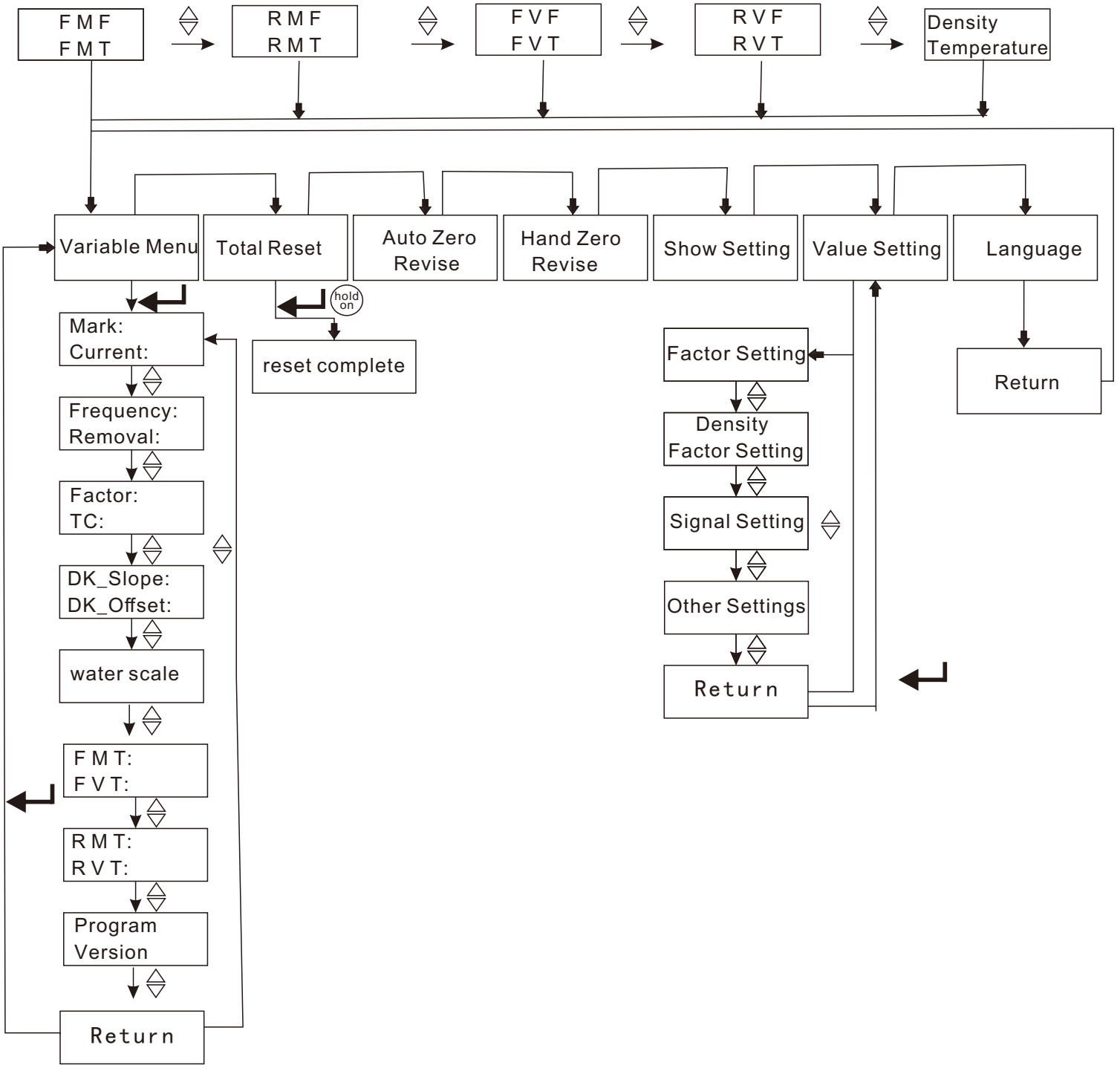
The panel of the transmitter is shown as below:



No.	Notes
1	L key: scroll
2	R key: select and enter
3	Light for working status
4	OLED
5	Keys for working status

⚠	Note : Operation point of Photoelectric Key is located right behind the glass panel. It is better to operate the photoelectric key in vertical direction, rather than horizontal direction.

6.2 The overall menu description

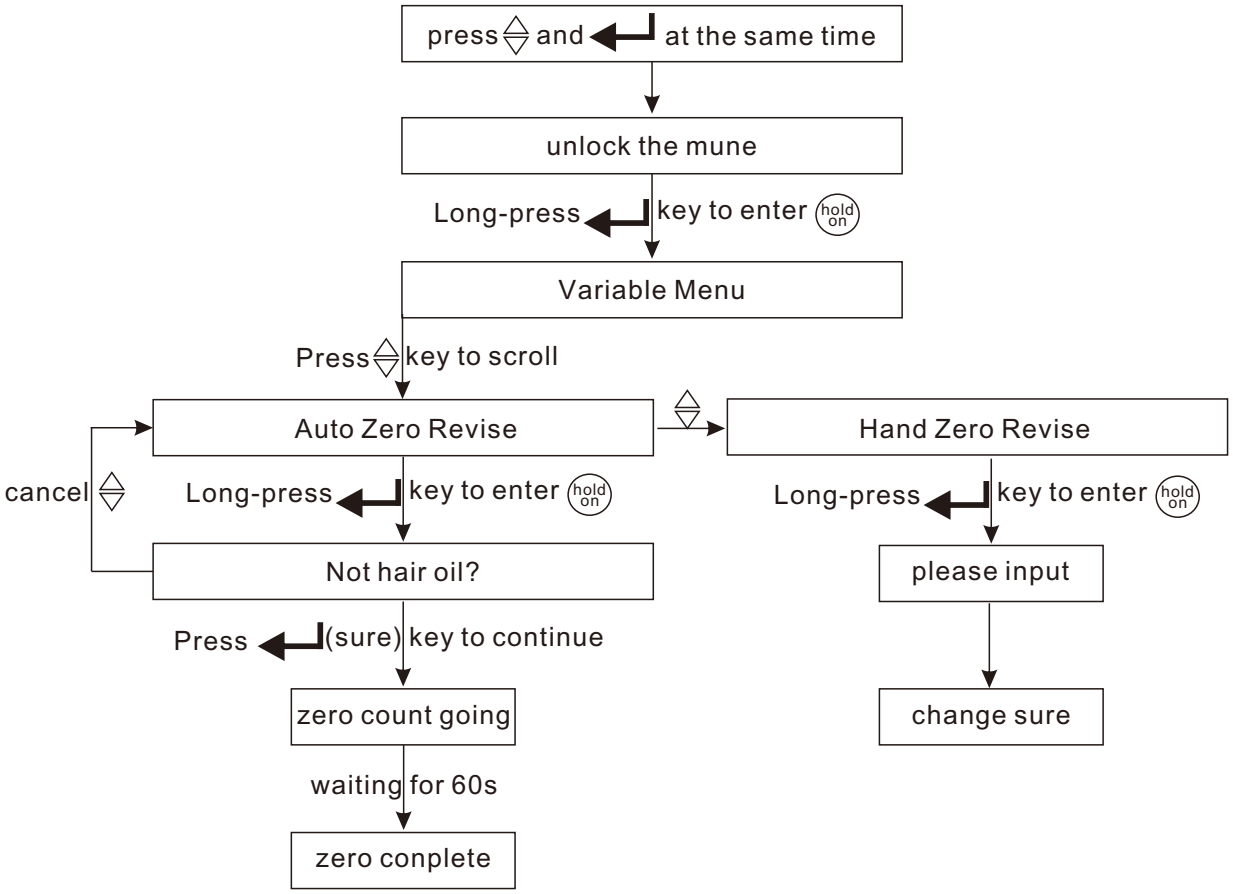


Remarks:

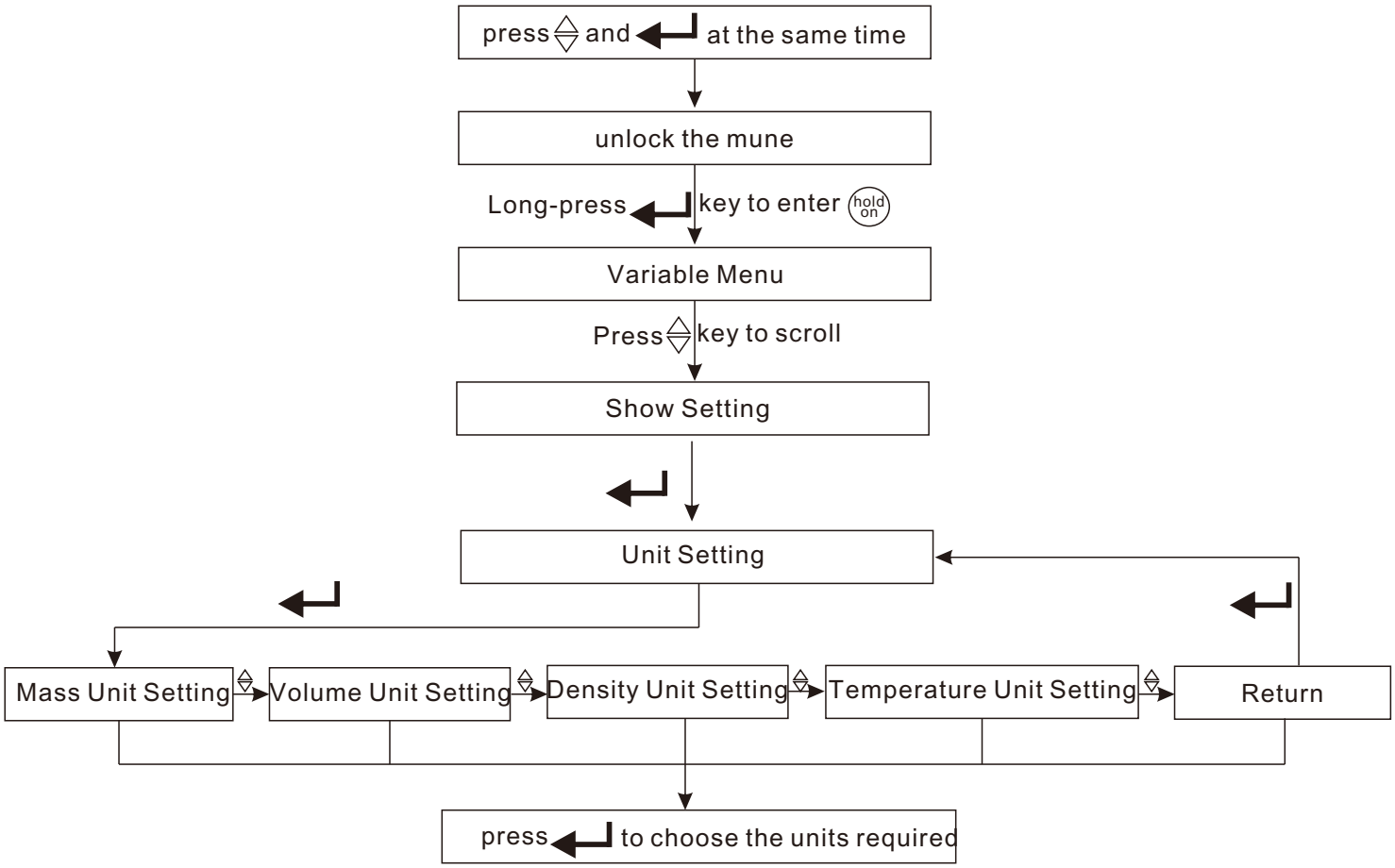
1. hold on means that you shoule hold down the key for at least 3 seconds.
2. To modify the data, press the left button to increase the number and press the right button to displacement.

6.3 Common functionality

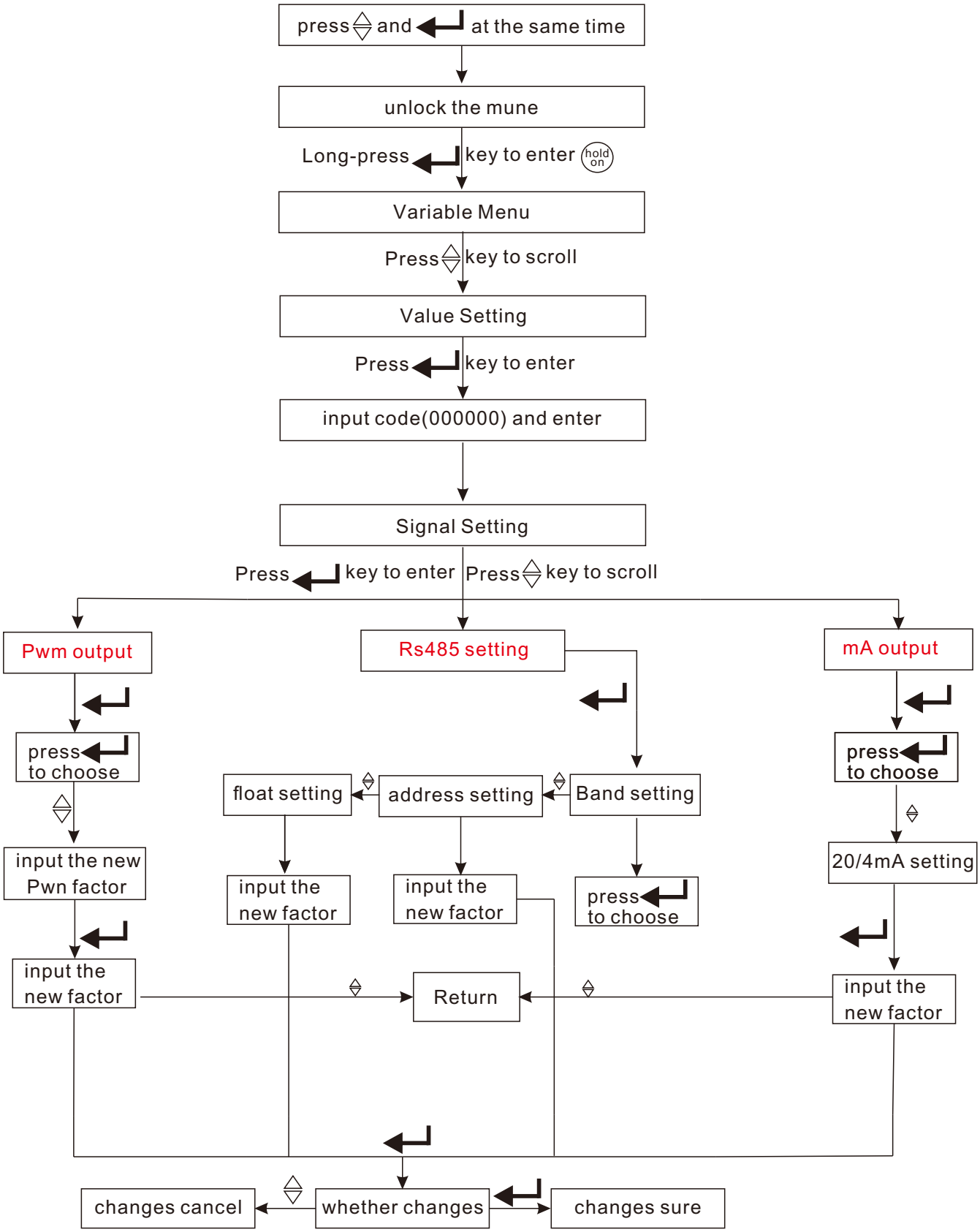
6.3.1 How to revise the zero-point (page 2 for details)



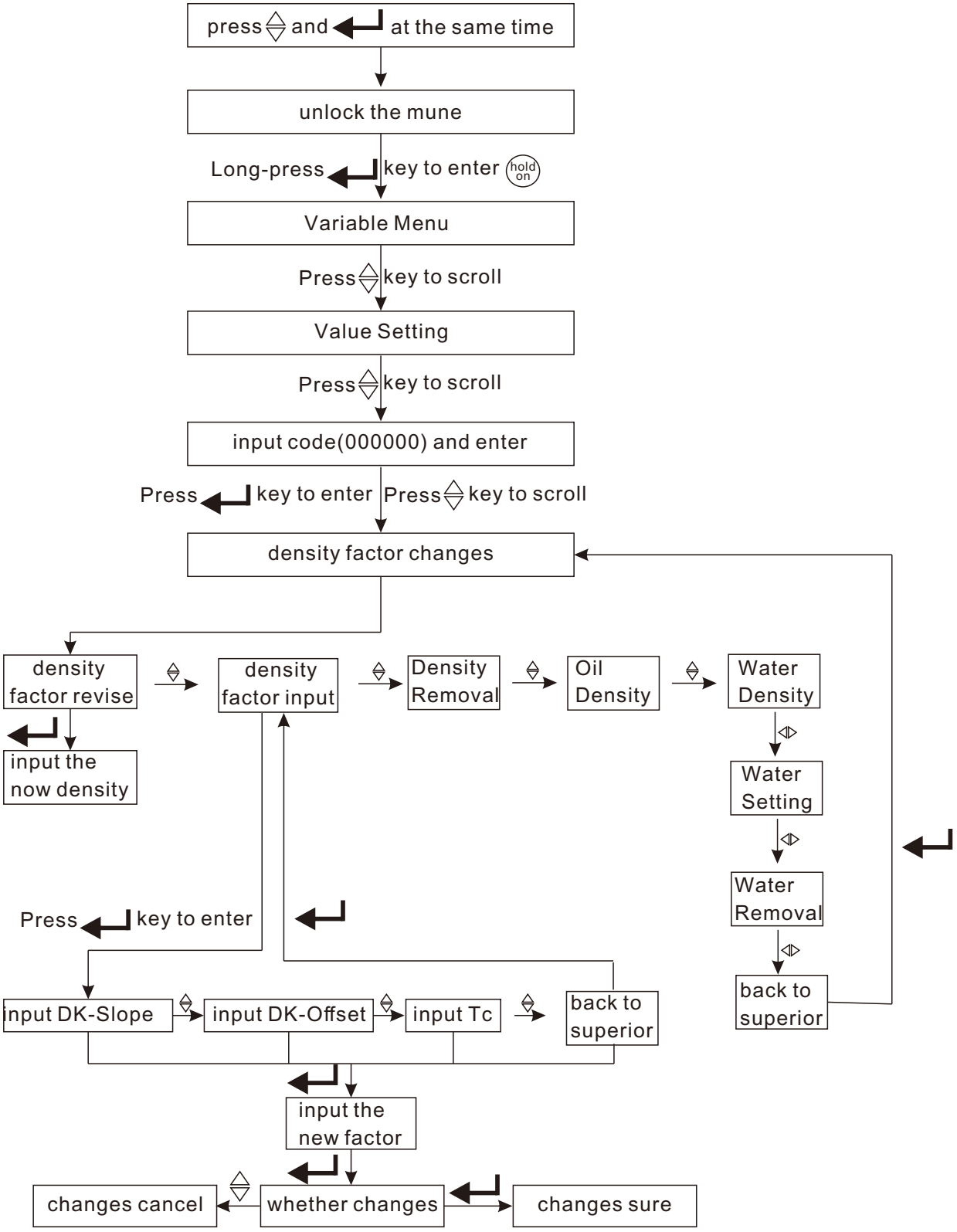
6.3.2 How to set the units (page3 for details)



6.3.3 How to set the signal output (page 4 for details)



6.3.4 How to set the density factor (page 5 for details)



6.4 Calibration

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

Each set of K has its own instrumental coefficient, including one flow coefficient and three density coefficients which will be shown in Nameplate of Sensor.

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.

6.4.1 Zero Calibration

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

After correct installation, the K should be powered at least 30 minutes for warm-up and then make the liquid pass through the flowmeter until the temperature of K 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.

6.4.2 Flow Calibration

The mass measured by the K 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:

$$MF=M/Mt$$

Note:

MF flow calibration factor,
M Total mass flow of Master Meter,
Mt Total mass flow of Tested Meter.

7. Pressure Drop

Pressure drop of flow meter is the unrecoverable pressure loss resulting from the resistance of the flow. The flow path of the mass flow meter is relatively complex and always with reducing pipe. So the pressure drop is a very important factor and can‟t be ignored.

Pressure drop of mass flow meter is dependent upon the fluid characteristics, the flow state and the structural parameters of the sensor. When the fluid density, viscosity and flow rate are fixed, the pressure drop is only relevant to the structural factors of the sensor part, such as diameter, cross-sectional area of the flow tube, flow tube shape etc.

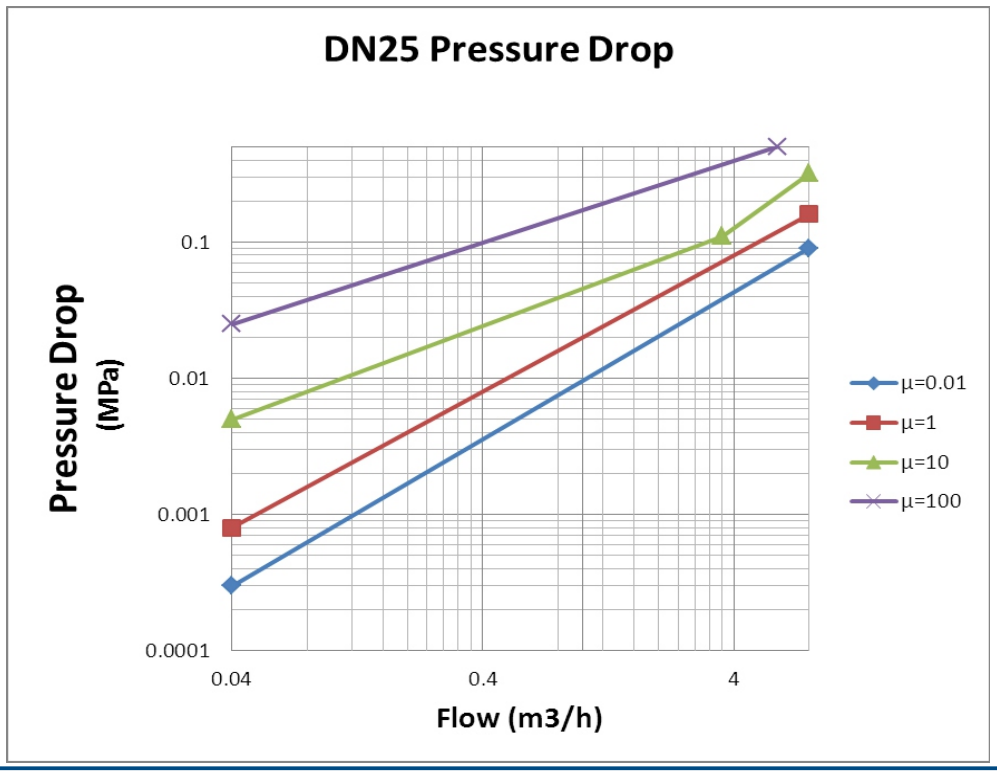
The reducing pipe is inevitable for the design and manufacture of the mass flow meter. The total cross-sectional area of the two flow tubes is less than the cross-sectional area of the flange. Thus the velocity increases when the fluid enters the mass flow meter. The maximum flow velocity is a very important factor for the industrial control, and the flow velocity affects the technological process and safety etc. As a result, some users may have the requirement of the upper limit of the flow velocity.

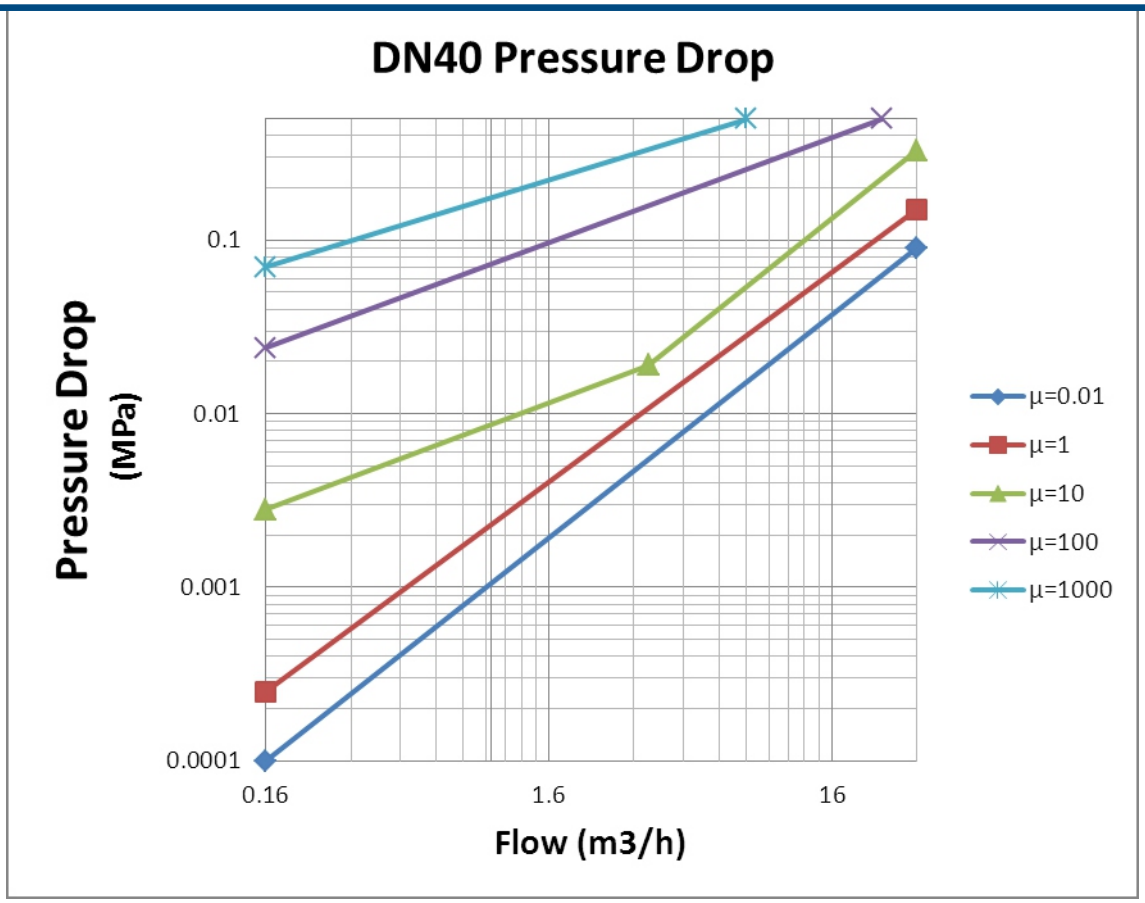
When the viscosity is between two adjacent Pressure Drop lines, the Pressure Drop can be calculated with following formula:

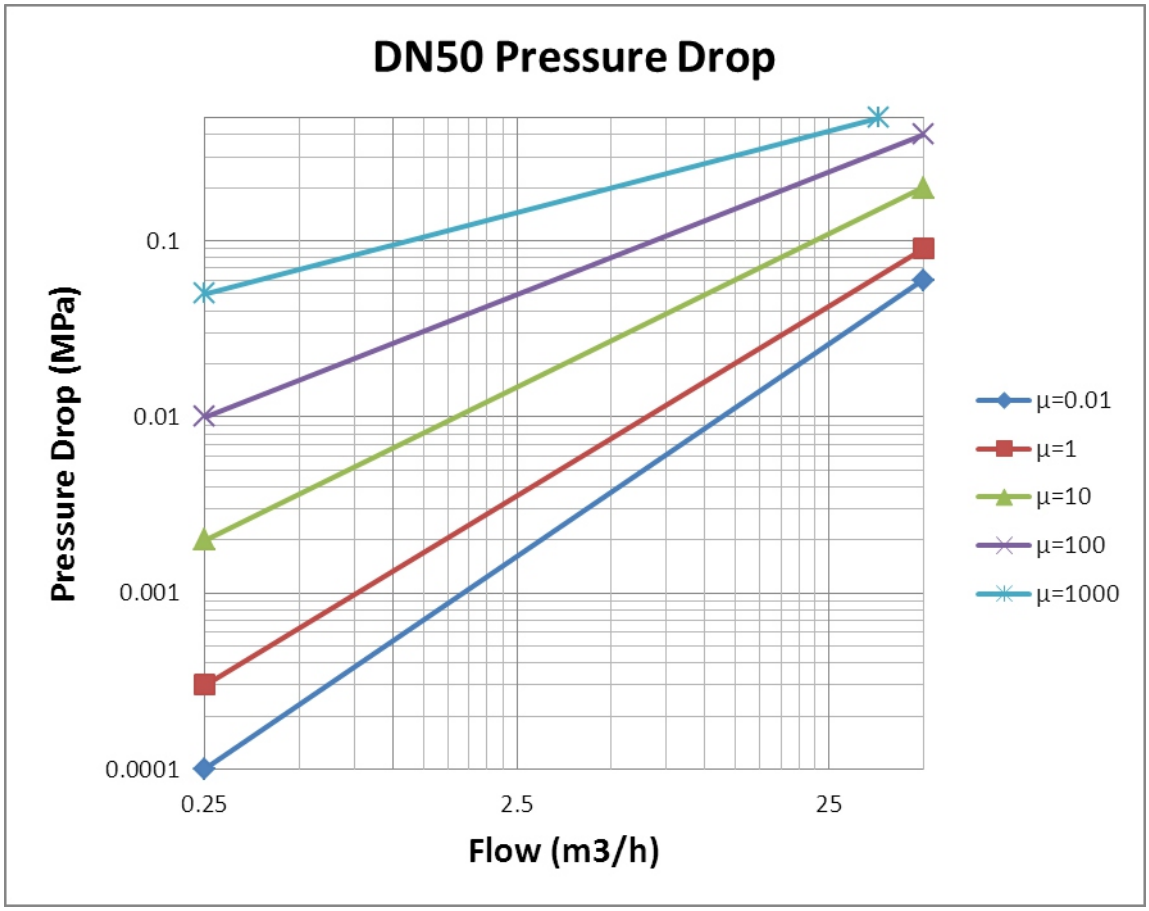
$$\Delta P = \Delta P_1 + \frac{\Delta P_2 - \Delta P_1}{\mu_2 - \mu_1} \times (\mu - \mu_1)$$

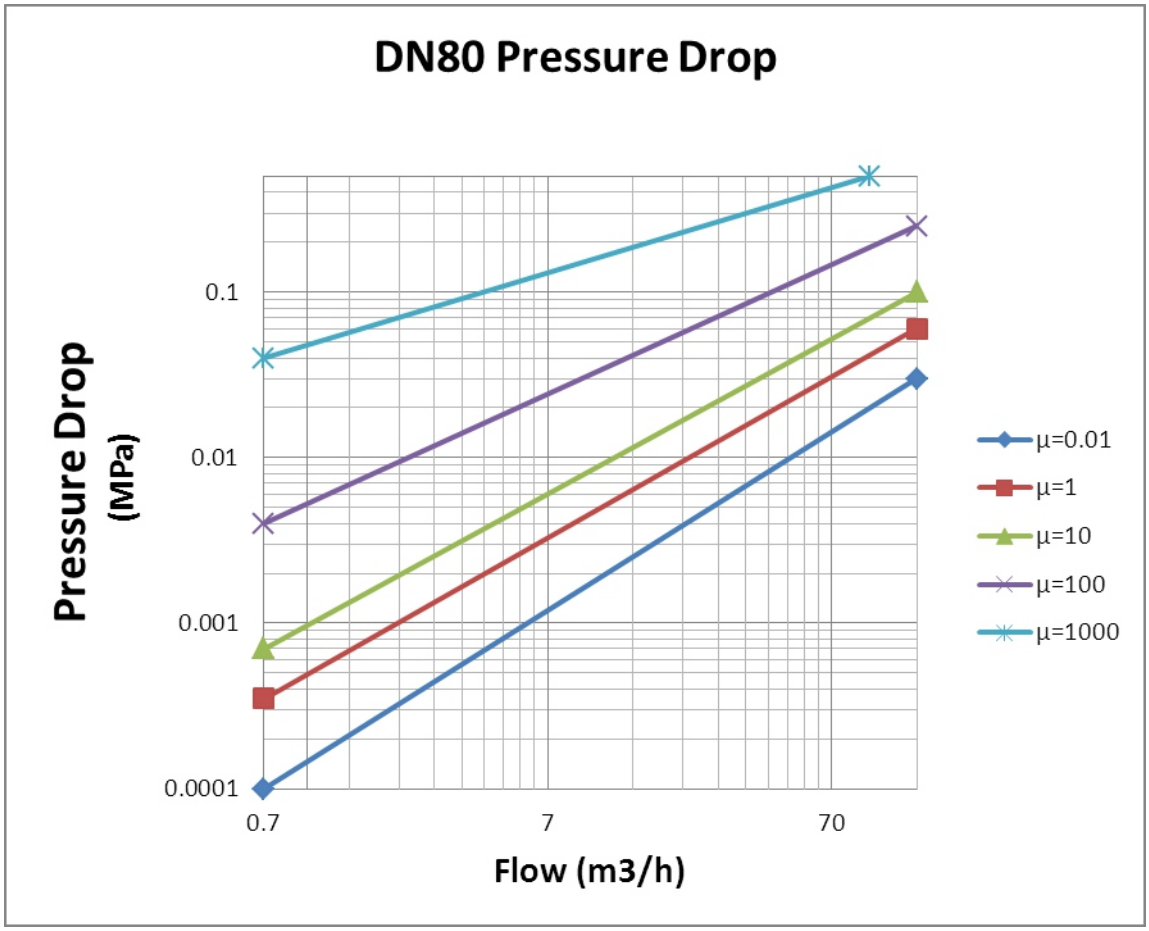
Note: the mass flow value should be converted to the volume flow value.

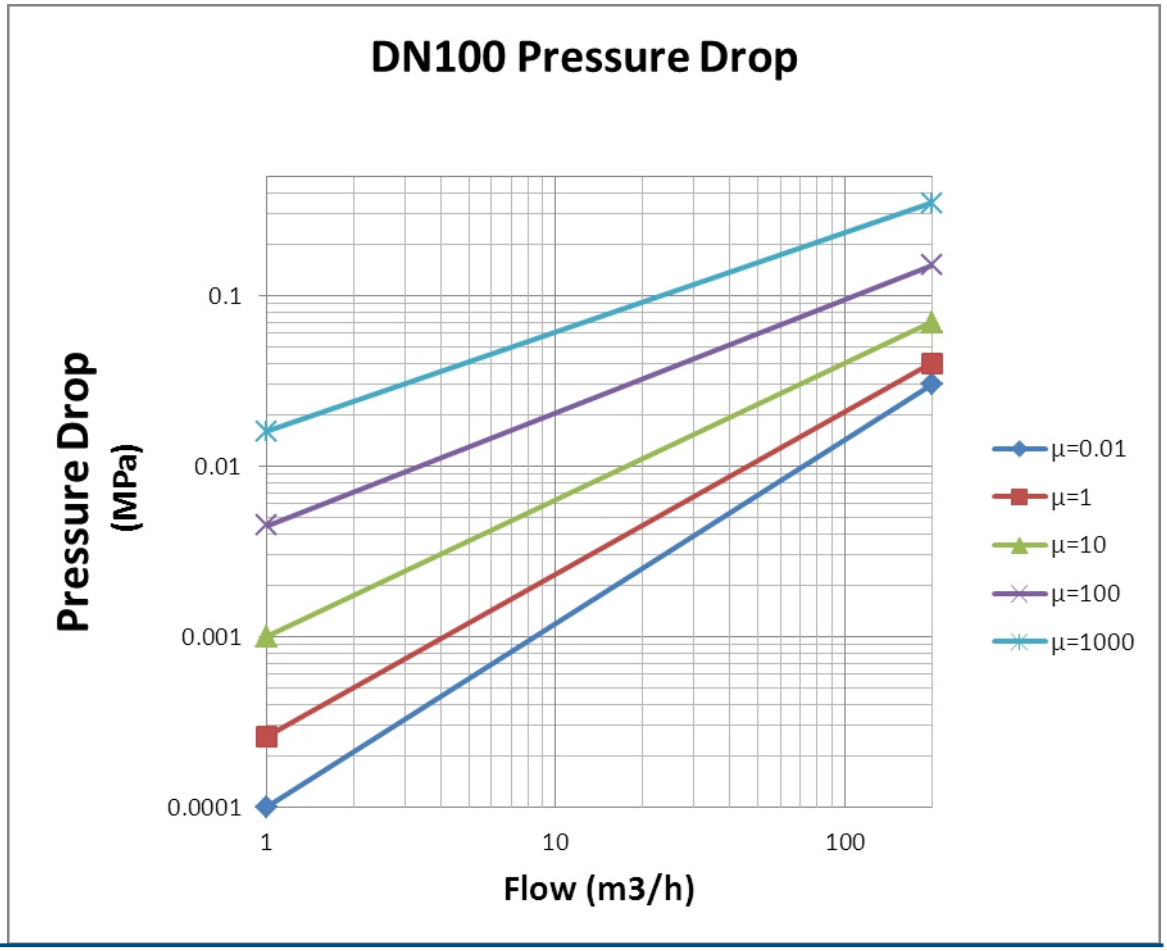
The pressure drop of Mass Flow Meter can be checked from following Pressure Drop Chart (including Pressure Drop, flow, and viscosity parameters).




DN40 Pressure Drop
Pressure Drop (MPa)
0.1
0.01
0.001
0.0001
0.16
1.6
16
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN50 Pressure Drop
Pressure Drop (MPa)
0.1
0.01
0.001
0.0001
0.25
2.5
25
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN80 Pressure Drop
Pressure Drop (MPa)
0.1
0.01
0.001
0.0001
0.7
7
70
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000


DN100 Pressure Drop
Pressure Drop (MPa)
0.1
0.01
0.001
0.0001
1
10
100
Flow (m3/h)
μ=0.01
μ=1
μ=10
μ=100
μ=1000

8. Trouble Shooting

8.1 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.

8.2 Diagnostic Tool

For the flowmeter fault diagnosis, the user can judge by the LED indicator and LCD displays, LED lights of different colors 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.

8.3 Sensor

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

Loop	Line color	Sensor type	Normal resistancerange
Left coil	White, green	K	(12-20)Ω
Right coil	Gray,blue	K	(12-20)Ω
Drive coil	Red, brown	K300/K200	(45-65)Ω
		K100	(12-20)Ω
Temperature	Orange,black	K	(60-175)Ω
Temperature	Yellow,brown	K	(60-175)Ω
Temperature	Yellow,orange	K	(0 - 1.0)Ω

8.4 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 K 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).

8.5 LED-Indicator

The colour of the LED indicator represents the working condition of the flowmeter.

LED colour	Working condition
Green	Working properly
Red	Malfunction alarm

9. Explosion-proof

9.1 The explosion-proof classification of K Series Mass flowmeter is approved by NEPSI as follows:

Equipment Type	Explosion-proof Class
K300	Ex ib IIC T1~T6 Gb
K200	Ex ib IIC T1~T6 Gb
K100	Ex ib IIC T1~T6 Gb
BPM-B Transmitter	Ex d [ib] IIC T4 Gb

9.2 The K contains the earth terminal which must be earthed when put into service.

9.3 The K must be matched with transmitter of K and its connection should be adopted with 9-core lines.

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

9.5 It is necessary to disconnect power supply before opening the cover in hazardous application.

9.6 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 Φ 8～ϕ8.5 and ϕ 8.5～ϕ12. Please change the cable and gasket ring once aging or wearing out.

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

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

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

	T1	T2	T3	T4	T5	T6
Working temperature	450℃	300℃	200℃	135℃	100℃	85℃
Surface temperature	445℃	295℃	195℃	130℃	95℃	80℃