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Main Features

DH250 intelligent metal variable area flowmeter has local display type and intelligent remote type. Intelligent remote type provides customers with very flexible options such as pointer display, LCD display for instantaneous flowrate or total flow, standard two-wire 4~20mA current output, HART communication, etc. Besides, the meter adopts advanced microprocessor and high quality industrial components to ensure superior performance in various applications.

According to different installation pattern of measuring tube, when flow direction is from bottom to top, from left to right or from right to left, different installation type can be selected as per the customer requirements. Matching M6 indicator on the measuring tube will be the intelligent remote type. M6 indicator is the multifunction digital magnetic measurement transmitter designed for DH250 intelligent metal variable area flowmeter, which core is the MCU and adopts magnetic transducer to measure magnetic field change through digital signal processing technology such as digital filtering, software amendment, etc. Two-line LCD display provides a good interactive interface, and current signal output and Hart communication provide more selections for customers.

- Very suitable to small diameter and low velocity
- Simple structure , reliable performance, low maintenance and long service life
- Low requirements for straight pipe
- Wide turndown ratio: 10:1
- Local display type and intelligent remote type
- Single-axis sensitive indicator
- Non contact magnetic coupling system to ensure stable data transmission
- Can be used in flammable and explosive dangerous situations
- Protection grade: IP65

Main features of intelligent M6 indicator

- Measure the angle displacement of magnetic field
- LCD display for instantaneous flowrate or total flow alternately
- Parameter setting can be realized
- Data recovery function
- HART Communication
- Single-axis sensitive indicator
- Backlight LCD display
- Intrinsical safe type and flame proof type available

Measuring Principle

Detecting element of metal variable area flowmeter consists of a tapered tube extending from bottom to top and a float inbuilt in tapered measuring tube vertically. Working principle is shown as Fig. 1: when fluid flows upward into annular space between tapered tube and float, the float will move upward along the tube due to lifting force formed by differential pressure of up and down end of float. When the flowrate of fluid increases, the float will displace much more; on the contrary, when the flowrate of fluid decreases, the displacement of float will reduce correspondingly, too. Therefore, the position of float is decided by the flowrate of fluid, as well as the flowrate determines annular area between the maximum outside diameter of float and inner wall of tapered tube. When fluid keeps a stable flowrate, the float locates in a dynamic balance state, the annular area between float and tapered tube also keeps constant. At this moment, there are three forces acting on the float: downward weight W, upward floating force F and fluid dynamic force P, and these forces locate in balance. According to Bernoulli equation of hydrodynamics, force equilibrium equation and fluid continuity principle, we can calculate the average instantaneous flowrate flowing into the annular area, so the float flowmeter is also called variable area flowmeter.

A high-performance permanent magnet steel is embedded inside float. By this way, the magnetic field will be produced around the float. When flowrate of fluid tends to stable and float locates in dynamic balance state, the surrounding magnetic field distribution reaches stable, too.

By means of the flowrate indicator mechanically connected with tapered tube, the magnetic signal of the float will be transmitted in non-contact form. In another word, indicator is able to detect and process with the flowrate in the mode of magnetic transducer, and finally shows the flowrate by pointer on indicator scale board, or intelligently process to display instantaneous and total flow in LCD indicator and outputs a standard 4-20mA current signal.

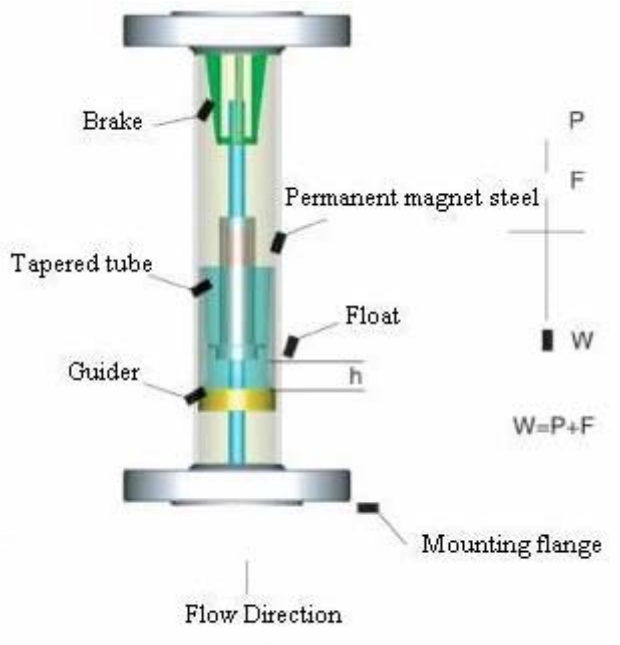


Fig. 1

Measuring Principle

Basic formula of volumetric flowmeter Q is:

$$Q = \alpha\varepsilon\triangle F\sqrt{\frac{2gV_f(\rho_f-\rho)}{\rho F_f}} \qquad m^3/s$$

If the float is hollow body, Q is:

$$Q = \alpha\varepsilon\triangle F\sqrt{\frac{2g(G_f-V_f\rho)}{\rho F_f}} \qquad m^3/s$$

Thereinto: α-------flowrate factor, determined by float shape

ε-------gas expansion parameter; ε= 1 for liquid

△F----annular flowing area, m^2

g-------local gravity acceleration, m/s^2

V_f------float volume, m^3

ρ_f-------density of float material, kg/m^3

ρ--------density of measured fluid; for gas, density of gas upstream of float, kg/m^3

F_f----------cross-sectional area of float at maximum diameter, m^2

G_f---------float weight, kg

The relationship between the annular area and lifting height of the float is shown as below, when structure design is confirmed, d and β are constants. Formula contains quadratic term of h, usually, this nonlinear term can not be neglected. Only when the tapered angle is little, it can be considered as linear approximately.

$$\triangle F = \pi\left(dh\,tg\frac{\beta}{2}+h^2tg^2\frac{\beta}{2}\right)=ah+bh^2 \qquad m^2$$

Thereinto: d-----------------Maximum diameter of the float, m

h-----------------Lifting height of float (starting from ID of tapered tube =D_{max} of float), m

β-----------------Tapered angle of the tapered tube

a, b--------------Constant

Measuring Principle

According to process mode of measuring signal, metal variable area flowmeter can be divided into:

a. Local display: rotate follow-up magnet in the local indicator by the magnetic coupling with magnet inbuilt in the float to drive the pointer to indicate the flowrate on scale directly (Fig. 2 as below).

b. Intelligent remote display: rotate follow-up magnet in the intelligent indicator by the magnetic coupling with magnet inbuilt in the float to drive the sensing magnet and pointer, at the same time the change of the magnetic field is converted to electrical signal by magnet transducer, and after process by A/D converter, digital filter, microprocessor processing, D/A converter, to LCD display instantaneous and total flowrate (Fig. 3 as below).

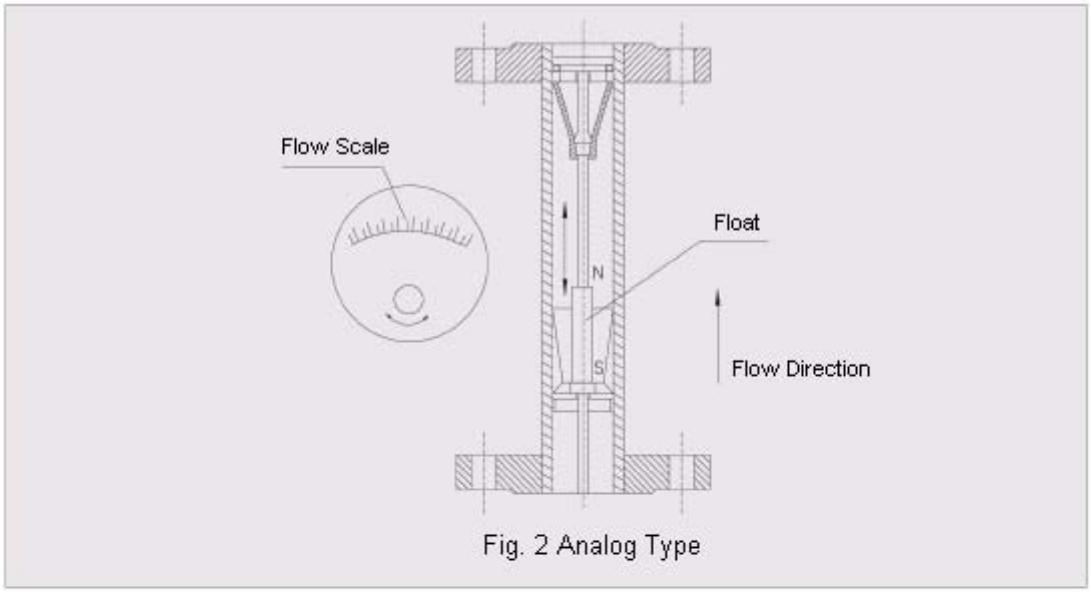


Fig. 2 Analog Type

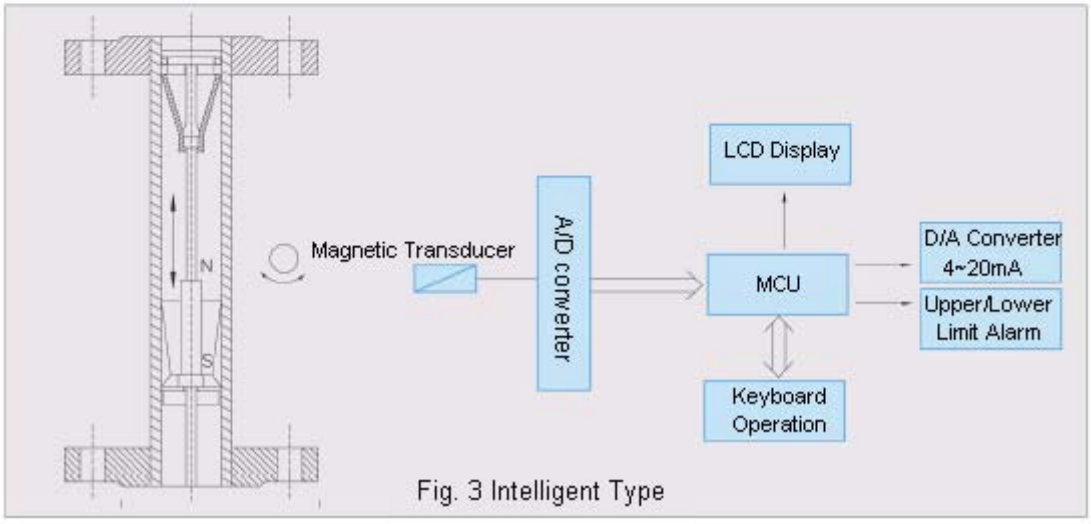


Fig. 3 Intelligent Type

Technical Parameter

- Measuring range

  Water (20℃) 10 ~ 300000 L/h

  Air (20℃, 0.1013MPa) 0.7 ~ 3000 m^3/h

  Refer to flowrate table, special flowrate can be ordered.
- Turndown ratio: 10:1 for standard
- Accuracy: ±1.5% for local, ±1.0% for remote
- Rated pressure: DN15 ~ DN50 4.0MPa (Max DN15: 32MPa, DN25: 25MPA, DN50: 20MPa)

  DN80 ~ DN250 1.6MPa (Max DN80: 10MPa, DN100: 6.4MPa, DN125: 4.0MPa,

  DN150: 4.0MPa, DN200: 2.5MPa, DN250: 2.5MPa)
- Pressure loss: 1.5 ~ 60kPa
- Viscosity: DN15: ＜30mPa · s

  DN25: ＜250mPa · s

  DN50 ~ DN250: ＜300mPa · s
- Fluid temperature: Local: -80 ~ +300℃

  Remote: -40 ~ +150℃ High temperature: 350℃
- Ambient temperature: Local: -40 ~ +80℃

  Remote: -40 ~ +50℃
- Storage temperature: -20 ~ +60℃
- Relative humidity: ≤85%
- Connection type: Standard: DIN2501

  Special: specified by user
- Protection grade: IP65
- Remote type

  Cable connector: M20*1.5

  Power supply: 24VDC

  Output signal: 4 ~ 20mA DC, HART

  LCD display: Numerical range for instantaneous flowrate: 0 ~ 50000

  Numerical range for total flow: 0 ~ 99999999

  Explosion proof: Intrinsical safe: Exia IIC T6

  Flameproof: Exd IIB T6

Transducer Type

Transducer is also named as measuring tube, consisting of tapered tube, float, guider, brake and mounting flange.

Classified by pipe installing type:

Vertical installing type: FA (Fig. 4), FAP (Fig. 5), FAPV (Fig. 6)

Horizontal installing type: FD (Fig. 7), FDPV (Fig. 8)

Classified by corrosive characteristics of measured fluid:

Standard type: FA, FD

Corrosion resistant type: FAP, FAPV, FATi, FDPV

Classified by state of measured fluid:

Liquid: Common type

Gas: FAZ gas damping type (Fig. 9)

Classified by temperature of measured fluid:

High temperature: Cooling jacket FAT (Fig. 10), FDT (Fig. 11)

Low temperature: Heating jacket FAT, FDT

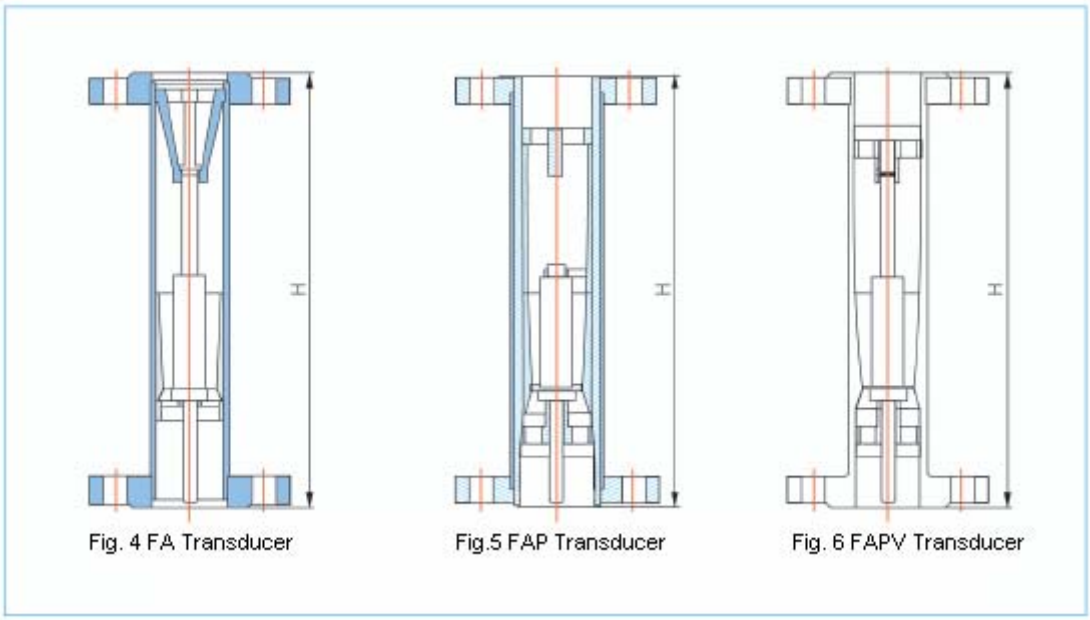


Fig. 4 FA Transducer　　Fig.5 FAP Transducer　　Fig. 6 FAPV Transducer

Transducer Type

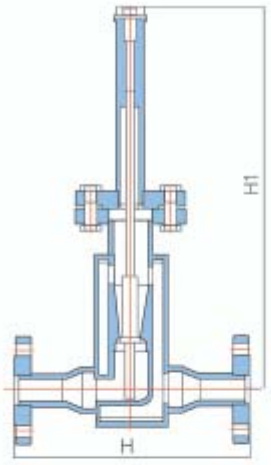


Fig. 7 FD Transducer

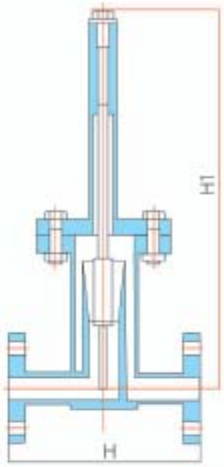


Fig. 8 FDPV Transducer

Fig. 9 FAZ Gas Damping Type

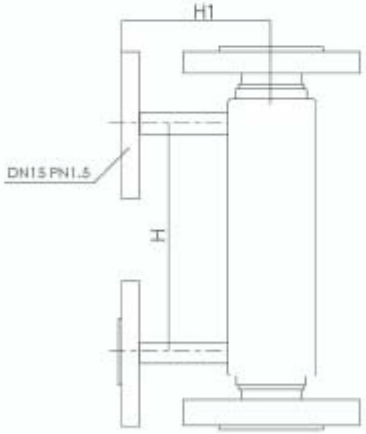


Fig. 10 FAT Transducer

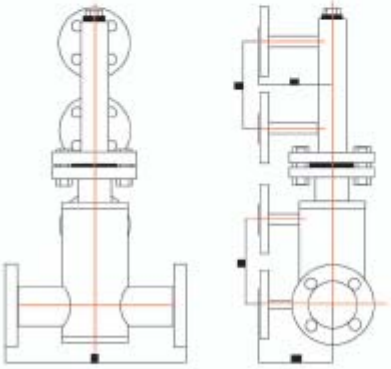


Fig. 11 FDT Transducer

Transducer Material

Model	Measuring Tube	Flange	Float	Tapered Tube
F/R	1Cr18Ni9Ti 0Cr18Ni12Mo2Ti 304, 304L, 316, 316L 317, 317L	1Cr18Ni9Ti 0Cr18Ni12Mo2Ti 304, 304L, 316, 316L 317, 317L	1Cr18Ni9Ti 0Cr18Ni12Mo2Ti 304, 304L, 316, 316L 317, 317L, Al, Ti	1Cr18Ni9Ti 0Cr18Ni12Mo2Ti 304, 304L, 316, 316L 317, 317L
F/P	1Cr18Ni9Ti with PTFE lining	1Cr18Ni9Ti	PTFE Nickel base alloy(276), B1, B2; Ti	PTFE
F/PV	PVDF	PVDF	PVDF 316, 316L, Ti	PVDF
F/Ti	Ti	Ti	Ti Nickel base alloy(276), B1, B2	Ti

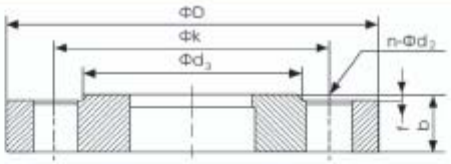


Fig. 12 Outline Dimension of Flange

Flange Dimension (ANSI B16.5 150 lb)							
DN	D	k	b	d_3	f	n	d_2
1/2"	88.9	60.5	11.2	35.1	1.6	4	15.7
1"	108.0	79.2	14.2	50.8	1.6	4	15.7
2"	152.4	120.7	19.1	91.9	1.6	4	19.1
3"	190.5	152.4	23.9	127.0	1.6	4	19.1
4"	228.6	190.5	23.9	157.2	1.6	8	19.1
5"	254.0	215.9	23.9	185.7	1.6	8	22.4
6"	279.4	241.3	25.4	215.9	1.6	8	22.4
8"	342.9	298.5	28.4	269.7	1.6	8	22.4
10"	428.4	362.0	30.2	323.9	1.6	12	25.4

DN/Pressure	Flange Dimension (Standard DIN2501)						
DN/PN	D	k	b	d_3	f	n	d_2
15/4.0	95	65	16	45	2	4	14
25/4.0	115	85	18	68	2	4	14
50/4.0	165	125	20	102	3	4	18
80/1.6	200	160	20	138	3	8	18
100/1.6	220	180	20	162	3	8	18
125/1.6	250	210	22	188	3	8	18
150/1.6	285	240	22	218	3	8	22
200/1.6	340	295	24	268	3	12	22
250/1.6	405	355	26	325	3	12	26

Note: unit: mm

Outline Dimension

Outline Dimension						
Transducer Type		FA, FAP, FAPV, FATi				
Dimension		H	H1	H2	h1	h2
DN	15	250	-	-	-	-
	25	250	-	-	-	-
	50	250	-	-	-	-
	80	250	-	-	-	-
	100	250	-	-	-	-
	125	400	-	-	-	-
	150	400	-	-	-	-
	200	500	-	-	-	-
	250	500	-	-	-	-

Outline Dimension						
Transducer Type		FD, FDPV				
Dimension		H	H1	H2	h1	h2
DN	15	250	400	-	-	-
	25	250	400	-	-	-
	50	300	400	-	-	-
	80	400	400	-	-	-
	100	400	400	-	-	-
	125	500	500	-	-	-
	150	500	500	-	-	-
	200	650	650	-	-	-
	250	750	800	-	-	-

Outline Dimension						
Transducer Type		FAT				
Dimension		H	H1	H2	h1	h2
DN	15	150	90	-	-	-
	25	150	100	-	-	-
	50	150	115	-	-	-
	80	150	132	-	-	-
	100	150	145	-	-	-
	125	-	-	-	-	-
	150	-	-	-	-	-
	200	-	-	-	-	-
	250	-	-	-	-	-

Outline Dimension						
Transducer Type		FDT				
Dimension		H	H1	H2	h1	h2
DN	15	250	100	100	110	120
	25	250	100	100	120	120
	50	300	118	115	150	120
	80	400	164	124	170	120
	100	400	164	130	200	120
	125	-	-	-	-	-
	150	-	-	-	-	-
	200	-	-	-	-	-
	250	-	-	-	-	-

Indicator

There are two kinds of indicators: local indicator and remote one. Local indicator means displaying the flowrate by means of mechanical pointer on site; for remote indicator, it can display on site and convert flowrate signal into 4-20mA current signal, so as to control the flowing process of fluid by connecting with control system.

Local display indicator

Common local indicator M8 (Fig. 13)

Punch forming of stainless steel and polishing the surface, mechanical pointer indicates flowrate on site.

Remote indicator

Remote indicator M6 with function of HART communication (Fig. 14)

Intrinsical safe & flameproof available, mechanical pointer indicates flowrate on site, LCD display mode is: instantaneous flowrate, total flow with Hart communication function.

Fig. 13 M8 Indicator

Fig. 14 M6 Indicator

Note: Every kind of indicator can be freely combined with any transducer to be various flowmeters with different specifications.

Selection Methods

1. Collection of process data

- Ingredients, density and viscosity of measured fluid;
- Maximum flowrate, minimum flowrate and normal flowrate;
- Maximum operating pressure;
- Maximum temperature and minimum temperature.

2. Maximum flowrate and minimum flowrate must conform to the flowrate range of Table 1 and Table 2.

Table 1 Flowrate Table for Horizontal Installation

Float Material 1：CrNi Steel,Hc
2：PVDF,Ti

DN	Float No.	Water L/h (0.1013MPa abs, 20℃)		Air m^3/h (0.1013MPa abs, 20℃)	Pressure Loss kPa (Special order for low pressure loss)	
		1	2	1	1	2
15	F16.5	160	100	4.5	1.5	1.5
	F16.5a	200	120	6.0	1.5	1.5
	F16.6	250	160	7.5	2.0	2.0
	F16.6a	300	200	9.0	2.0	2.0
	F16.7	400	250	12	2.5	2.5
	F16.8	600	400	18	3.5	3.5
25	F26.1	1000	600	30	1.5	1.5
	F26.2	1600	1000	45	3.0	3.0
	F26.2a	2000	1200	60	3.0	3.0
	F26.3	2500	1600	75	3.5	3.5
	F26.3a	3000	2000	90	3.5	3.5
	F26.4	4000	2500	120	8.0	8.0
50	F56.1	6000	4000	180	3.0	3.0
	F56.1a	8000	5000	240	3.0	3.0
	F56.2	10000	6000	300	4.0	4.0
	F56.2a	12000	8000	360	4.0	4.0
	F56.3	16000	10000	480	8.0	8.0
80	F86.1	25000	16000	750	14.0	14.0
	F86.1a	30000	20000	900	14.0	14.0
	F86.2	40000	25000	1200	22.0	22.0
100	F106.1	60000	40000	1800	30.0	30.0
	F106.1a	80000	50000	2400	30.0	30.0
	F106.2	100000	60000	3000	44.0	44.0
120	F126.1	100000	80000	3000	45.0	45.0
	F126.2	125000	100000	-	48.0	48.0
150	F156.1	125000	100000	-	46.0	46.0
	F156.2	150000	125000	-	50.0	50.0
200	F206.1	200000	-	-	60.0	-

Selection Methods

Table 2 Flowrate Table for Vertical Installation

Float Material: 1：CrNi Steel,HC
2：PTFE,PVDF,Ti

DN	Float No.	Water L/h (0.1013MPa abs, 20°C)		Air m³/h (0.1013MPa abs, 20°C)	Pressure Loss kPa (Special order for low pressure loss)	
		1	2	1	1	2
15	F16.0	10	-	-	1.5	-
	F16.1	25	-	0.7	1.5	-
	F16.1a	30	-	0.9	1.5	-
	F16.2	40	25	1.2	1.5	1.5
	F16.2a	50	30	1.5	1.5	1.5
	F16.3	60	40	1.8	1.5	1.5
	F16.3a	80	50	2.4	1.5	1.5
	F16.4	100	60	2.8	1.5	1.5
	F16.4a	120	80	3.5	1.5	1.5
	F16.5	160	100	4.5	1.5	1.5
	F16.5a	200	120	6.0	1.5	1.5
	F16.6	250	160	7.5	3.0	1.5
	F16.6a	300	200	9.0	3.0	1.5
	F16.7	400	250	12	3.0	3.0
	F16.7a	500	300	15	3.0	3.0
	F16.8	600	400	18	3.5	3.0
20	F20.1	1000	600	30	1.5	1.5
	F20.2	1600	1000	45	2.0	2.0
	F20.2a	2000	-	60	3.5	-
25	F26.1	1000	600	30	1.5	1.5
	F26.1a	1200	800	35	1.5	1.5
	F26.2	1600	1000	45	3.0	1.5
	F26.2a	2000	1200	60	3.0	1.5
	F26.3	2500	1600	75	3.5	3.0
	F26.3a	3000	2000	90	3.5	3.0
	F26.4	4000	2500	120	8.0	3.5
	F26.4a	5000	3000	150	8.0	3.5
	F26.5	6000	-	180	16.0	-
32	F32.1	4000	2500	120	8.0	5.0
	F32.2	6000	4000	180	12.0	8.0
	F32.3	8000	-	240	16.0	-
40	F40.1	6000	4000	120	10.0	6.0
	F40.2	8000	6000	180	12.0	10.0
	F40.3	10000	-	240	14.0	-
50	F56.1	6000	4000	180	3.0	3.0
	F56.1a	8000	5000	240	3.0	3.0
	F56.2	10000	6000	300	4.0	3.0
	F56.2a	12000	8000	360	4.0	3.0
	F56.3	16000	10000	480	8.0	4.0
	F56.3a	20000	12000	600	8.0	4.0
65	F65.1	16000	10000	480	6.0	6.0
	F65.2	20000	16000	600	8.0	8.0
	F65.2a	25000	20000	750	10.0	12.0
	F65.3	30000	-	900	14.0	-
	F65.3a	35000	-	1000	20.0	-
80	F86.1	25000	16000	750	14.0	8.0
	F86.1a	30000	20000	900	14.0	8.0
	F86.2	40000	25000	1200	22.0	14.0
	F86.2a	50000	-	1500	22.0	-
100	F106.1	60000	40000	1800	30.0	25.0
	F106.1a	80000	50000	2400	30.0	25.0
	F106.2	100000	-	3000	44.0	-
125	F126.1	100000	80000	3000	45.0	35.0
	F126.2	125000	100000	-	48.0	40.0
150	F156.1	125000	100000	-	46.0	37.0
	F156.2	150000	125000	-	50.0	42.0
200	F206.1	200000	150000	-	60.0	60.0
250	F256.1	300000	200000	-	60.0	60.0

3. DN calculation

DN calculation for liquid

Volumetric flowrate of measured liquid Q_t (L/h)

Put density and maximum flowrate of measured liquid into Formula 1, and calculate the flowrate of water—standard medium; then, find out the corresponding diameter and float number from flowrate table and put the flowrate of water provided by standard float No. into Formula 1 again, accordingly, make out the flowrate of measured liquid; finally, adjust the flowrate into an integer so that to get the scale range of measured liquid.

$$Q_S = \sqrt{\frac{(\rho_f - \rho_s)\,\rho_t}{(\rho_f - \rho_t)\,\rho_s}} \times Q_t \qquad \cdots\cdots\cdots (1)$$

Mass flowrate of measured liquid Q_m (kg/h)

Calculation formula of scale range is as follows while calculation method is as above:

$$Q_S = \sqrt{\frac{(\rho_f - \rho_s)}{(\rho_f - \rho_t)\,\rho_t\,\rho_s}} \times Q_m \qquad \cdots\cdots\cdots (2)$$

Thereinto:

Q_t ------Max volumetric flowrate of measured liquid (L/h)
Q_m -----Max mass flowrate of measured liquid (kg/h)
Q_s ------Flowrate of standard medium water (L/h)
ρ_f-------Density of float (kg/m$^{3)}$
ρ_t-------Density of measured liquid (kg/m$^{3)}$
ρ_s-------Density of water (kg/m^3)

Float density of various materials as follows:

Material	CrNi Steel	PTFE	PVDF	Nickel-alloy	Ti	Al
Denstiy (t/m³)	7.85	3.4	3.8	8.3	2.1	2.7

Example

Some liquid to be measured, its operating density is 850 kg/m^3 and max. flowrate is 2400 L/h, please calculate its diameter, float No. and scale range.

Solution: density of float ρ_f = 7800 kg/m^3, density of water ρ_s = 1000 kg/m^3

Put ρ_f = 850 (kg/m^3) and Q_t = 2400 (L/h) into Formula 1 to get Q_s = 2188.86 L/h

Then, look up the flowrate table and find out: DN25, float No. F26.3, Q_s =2500

Put Q_s into Formula 1 again to get Q_t = 2741.23

Then adjust it into an integer, get the scale range of this fluid: 270 ~ 2700 L/h.

DN calculation for gas

Gas is easily affected by temperature and pressure and quite different from liquid. Therefore, at the time of calculating flowrate, we do not only consider the density factor, but also take account of the influences from temperature and pressure, so it is extremely important to provide correct temperature and pressure of gas to be measured under operating condition.

Standard flowrate of measured gas Q_N (Nm^3/h)

$$Q_S = \sqrt{\frac{\rho_{st}}{\rho_s} \times \frac{P_s}{P_t} \times \frac{T_t}{T_s}} \times Q_N \quad \cdots\cdots (3)$$

Operating flowrate of measured gas Q_t (m^3/h)

$$Q_S = \sqrt{\frac{\rho_{st}}{\rho_s} \times \frac{P_t}{P_s} \times \frac{T_s}{T_t}} \times Q_t \quad \cdots\cdots (4)$$

Mass flowrate of measured gas Q_m(kg/h)

$$Q_S = \sqrt{\frac{1}{\rho_s \times \rho_t}} \times Q_m \quad \cdots\cdots (5)$$

Thereinto：

Q_N-----Max. volumetric flowrate of gas under standard condition (Nm^3/h)
Q_t------Max. volumetric flowrate of gas under operating condition (m^3/h)
Q_m-----Max. mass flowrate of gas under operating condition (kg/h)
Q_s -----Flowrate of standard medium air (m^3/h)
ρ_s ------Density of air under standard condition (kg/m^3)
ρ_{st} ------Density of gas under standard condition (kg/m^3)
ρ_t -------Density of gas under operating condition (kg/m^3)
Ps-------Absolute pressure of air under standard condition (0.1MPa)
Pt-------Absolute pressure of gas under operating condition (MPa)
Ts-------Absolute Temp. of air under standard condition (293.15K)
T_t--------Absolute Temp. of gas under operating condition (K)

Example

Some gas to be measured, oxygen, its average molecular weight: 32; process pressure: 0.4MPa (gauge pressure), process temperature: 25℃, Max. flowrate: 35Nm^3/h, please calculate its diameter, float No. and scale range.

Solution: ρ_s = 1.204kg/m^3, P_s = 0.1MPa, T_s = 293.15K

ρ_{st} = 1.331kg/m^3, P_t = 0.5MPa, T_t = 298.15K, Q_N = 35Nm^3/h

Put the acquired data into Formula 3 to get Q_s = 16.60 m^3/h

Look up flowrate table, find out: DN 15, Float No: F16.8, Q_s = 18

Put Q_s into Formula 3 again, make out Q_N = 37.96

Then adjust it into an integer and get scale range of measured fluid: 3.8 ~ 38 Nm^3/h

Electrical Connection

1. Mainboard of flowmeter with Hart function (Fig. 15)

Brief introduction

Mainboard of flowmeter with Hart function is a new kind of digital flow transmitter with Hart communication function. It can configure on site to display instantaneous or total flow on large screen of LCD.

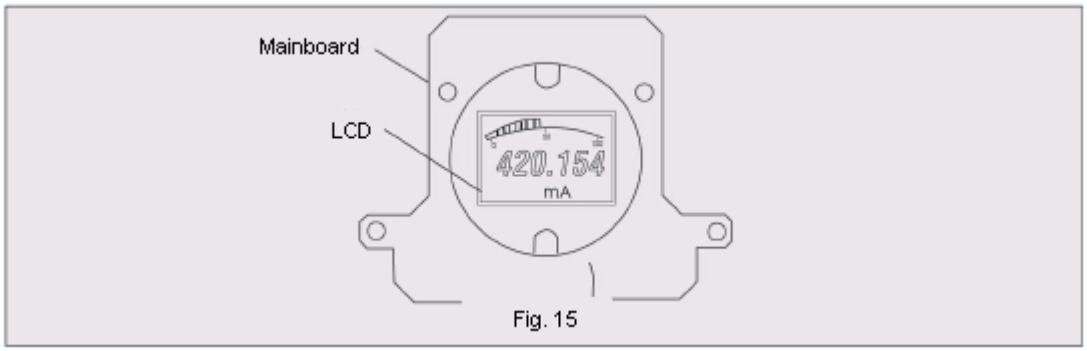


Fig. 15

Features

- Configurate by hand-held communicator or configuration software of PC
- 4 ~ 20 mA output with HART protocol digital communication (two wires)
- Communication meets HART protocol standard
- HART communication does not affect 4 ~ 20mA analog output
- Power supply of HART transmitter: 12 ~ 36 VDC
- Damping: 0 ~ 32s adjustable
- Ambient temperature: -20 ~ +70℃

Wiring

Open the front cover of indicator, a blue connecting terminal on top of the base (Fig. 16) can be seen, then carry out wiring according to wiring marks on terminal.

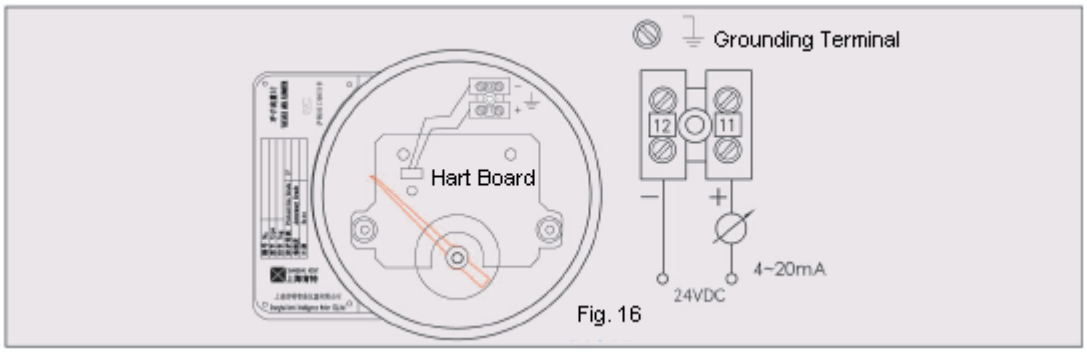


Fig. 16

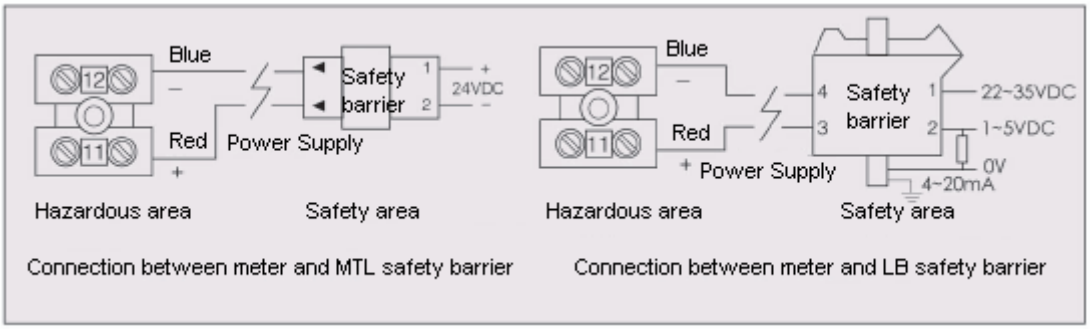
Meter adjustment on site

Flowmeter mainboard has two kinds of function modes: data setting mode and current minitrimming mode. Factory setting is data setting mode.

- Data setting mode can set configuration data, flowmeter data and reset total flow into zero.
- Current minitrimming mode can minitrim 4mA and 20mA current.

Electrical Connection

Connection between meter and safety barrier



2. K1, K2 limit alarm switch

Brief introduction

K1, K2 limit alarm switch is installed in the M6 indicator. K1 is lower limit, K2 is upper limit, alarm point can be set at will. K1, K2 alarm switch consists of two parts. One part is in the indicator and simply named KG22 which is composed of SJ3.5N transducer and cutting disc on the rotation axis (Fig. 17) and can set alarm point within the entire flow range at will and indicate on the dial by the positioning pointer. The other part is external isolated switching amplifier WE77/ Ex (Fig. 18: transistor relay).

WE77/ Ex is divided into WE77/ Ex-1 and WE77/ Ex-2. WE77/ Ex-1 (or WE77/ Ex-1-G) is only applicable to one KG22 and acts on K1 or K2; WE77/ Ex-2 (or WE77/ Ex-2-G) is applicable to two KG22 and acts on K1 and K2.

Fig. 17 K1, K2 Limit Alarm Switch

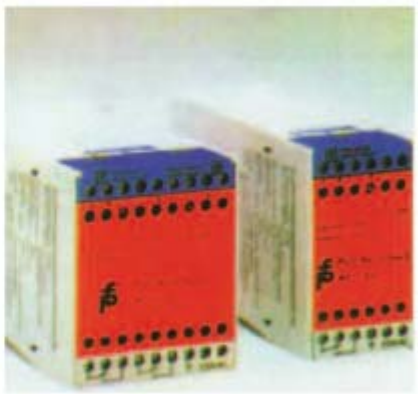


Fig. 18 WE77/ Ex Transistor Relay

Electrical Connection

KG22 technical data

Rated pressure	8VDC
Current loss Effective area open Effective area close	 ⩾ 3 mA ⩽ 1mA
Self inductance	160 μH is related to hazardous place
Self capacitance	20 nF is related to hazardous place
Ambient temperature	−25~+100℃
Protection grade	IP65

WE77 technical data

Technical data	AC Type	DC Type
	WE77/Ex-1 WE77/Ex-2	WE77/Ex-1-G WE77/Ex-2-G
Power supply		
Standard	220VAC/45~65Hz	
Special type	24、42、110、127VAC	15~70VDC
Power consumption	About 3.5VA	Max 6.3W
Input intrinsical safe type	DIN19243 or NAMUR	DIN19243 or NAMUR
Protection grade	[EEx ia] IIC or [EEx ib] IIC	[EEx ia] IIC or [EEx ib] IIC
Explosion proof	Ex-79/2043 X	Ex-81/2146 X
Open circuit voltage	8VDC (13.5VDC)	8VDC (12.7VDC)
Short circuit current	8 mA (31mA)	8 mA (21mA)
Safe distributed inductance / capacitance		
[EEx ia] IIC	3 mH/230 nF	2 mH/230 nF
[EEx ib] IIC	31 mH/609 nF	70 mH/800 nF
Output extrinsical safe type		
Switch type	WE77/ Ex-1: one switching terminal WE77/ Ex-2: two switchingl terminals	WE77/ Ex-1: one switching terminal WE77/ Ex-2: two switching terminals
Contact capacity	AC: 4A/250V/500A/cos=0.7	DC: 220V/0.1A; 60V/0.6A; 24V/4A
Display "relay working"	Use LED	Use LED
Meter housing		
Material	LY12	
Installation	Installed on standard bar (35mm) as per DIN46 227 or DIN 43 603 dimention	
Connection	Screw thread self-open type, tightly fix terminal, max cross-section area 2*1.5mm^2	
Protection type	IP20, as per DIN40 050	
Environment	Noise: as per DIN40 040, ambient temperature: -20~+60℃, max relative humidity75%	

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Electrical Connection

Adjustment of WE77/ Ex-1 & WE77/ Ex-2

Isolated switching amplifier includes power supply, transistor rectifier amplifier and output middle relay. WE77/ Ex-1 with a safety control circuit. WE77/ Ex-2 with two safety control circuit and its output is equipped with wiring terminal of open circuit. It is also easy to change wiring to become closed circuit operation or closed circuit operation with open circuit monitoring.

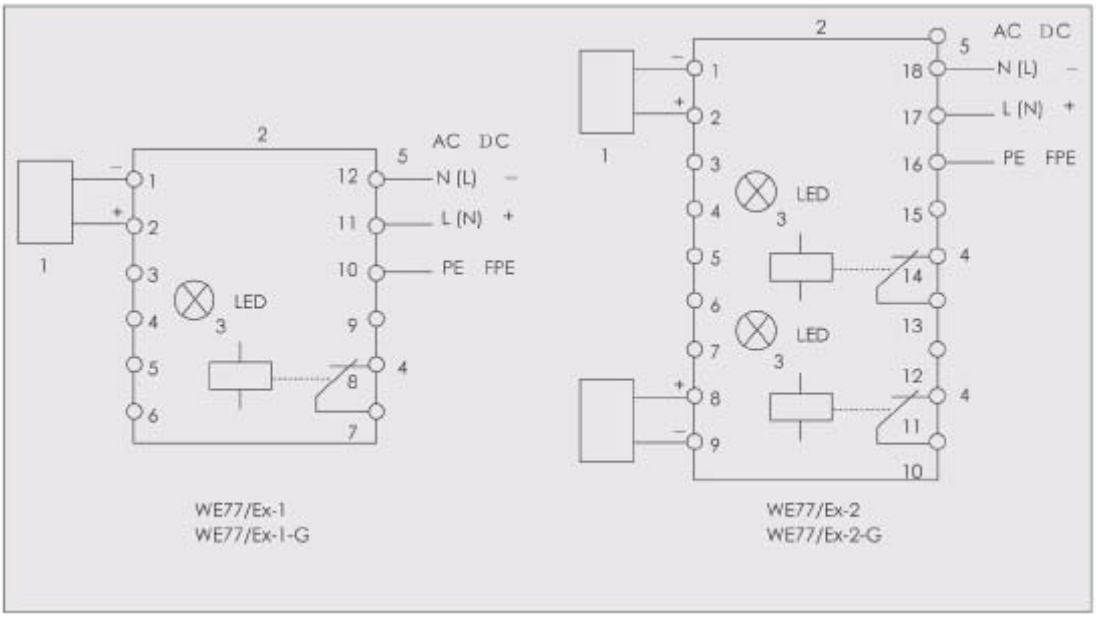
According to the following table, replace cable jumper to get various working condition. Indicate “relay closure” with one LED.

Circuit connection of KG22 with isolated switcher WE77/ Ex

Connecting circuit diagram

1 SJ3.5N transducer
2 Isolated switching amplifier
3 When relay operating, LED is light
4 Output of relay
5 Power supply 220 VAC

Functions as follows:
Closed circuit with open circuit monitoring (refer to the table of next page for mode conversion)
Normal close of relay



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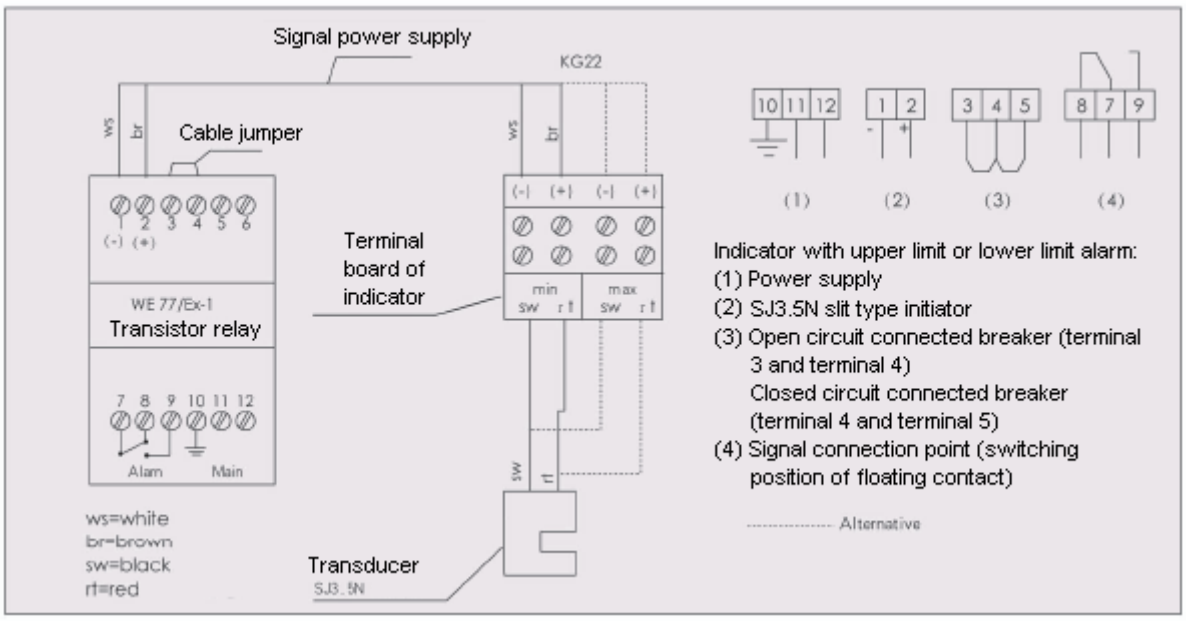
Electrical Connection

Function		AC Type		DC Type		Input		Output	Input		Output
		WE77/Ex1	WE77/Ex2	WE77/Ex1-G	WE77/Ex2-G	Initiator	Mechanical switch	Relay	Initiator	Mechanical switch	Relay
without open circuit Current monitoring	Function I	Connect terminal 3+4	Connect terminal 2+3 7+8	Switch position 2 connects terminal 1+3	Switch position 2 connects terminal 1+3 7+9	Blocked	Signal 0	No action	No blocked	Signal 1	Action
	Function II	Connect terminal 4+5	Connect terminal 3+4 6+7	Switch position 1 connects terminal 1+3	Switch postion 1 connects terminal 1+3 7+9	Blocked	Signal 0	Action	No blocked	Signal 1	No action
with open circuit Current monitoring	Power on	No connect	No connect	Switch position 1 no connect	No connect	Blocked	Signal 0 (residual current ≤150 μA)	Action	No blocked	Signal 1	No action
	Power off					Blocked	No signal	Action	No blocked	Signal 1	No action

Wiring diagram of KG22 with WE77/ Ex-1



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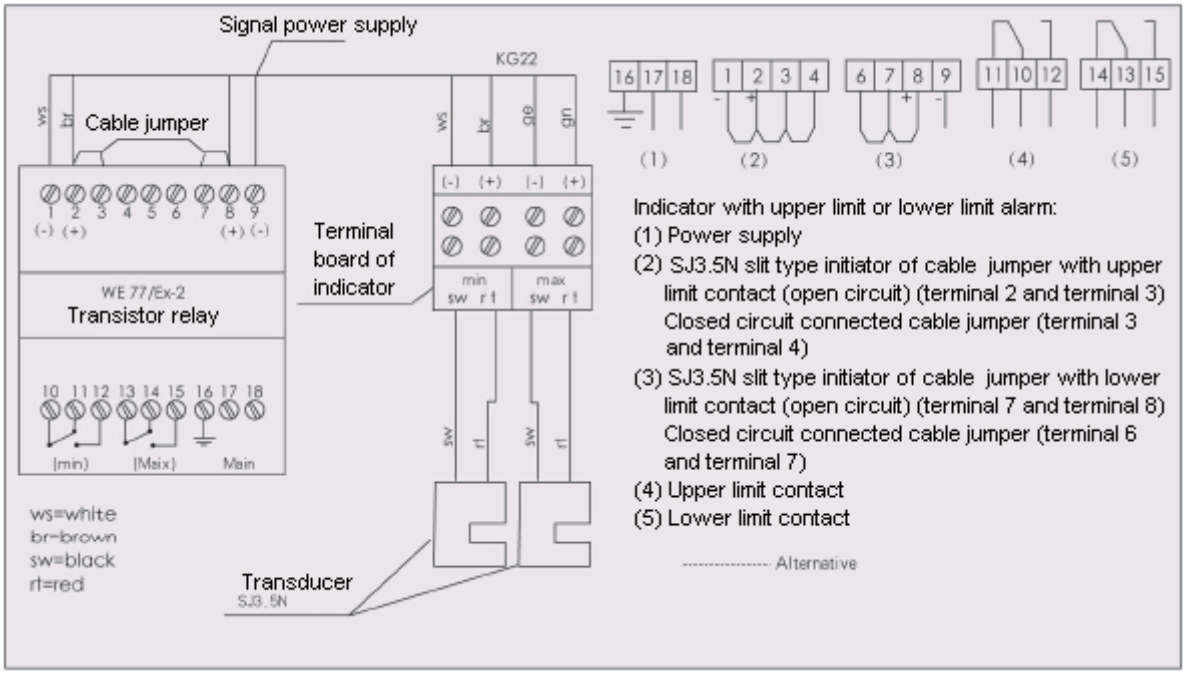
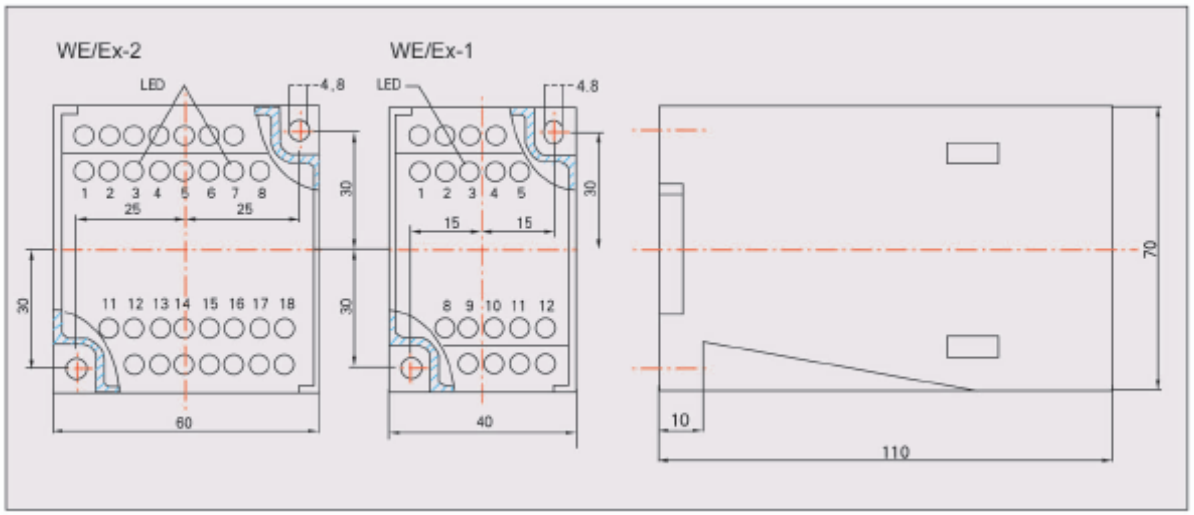
Electrical Connection

Wiring diagram of KG22 with WE77/ Ex-2



Installation and outline dimensional drawing



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Installation Precaution

To ensure meter operation performance and measuring accuracy, please pay attention to:

- The size of upstream and downstream pipe should be the same as meter size. Connecting flange or screw thread should also match with that of meter. The upstream straight pipe (h1) must be five times nominal diameter of meter. The downstream straight pipe is not less than 250mm;
- For vertical installation, fluids flow from bottom to top and verticality keeps less than 2º; for horizontal installation, the level angle should be less than 2º;
- When install flowmeter on process pipeline, bypass pipe should be installed to handle with malfunction conveniently or not to affect production during flushing;
- To ensure meter accuracy, more than 5D straight pipe should be at upstream and 250mm straight pipe at downstream;
- Require to equip magnetic filter if ferromagnetic material contained in fluids;
- Require to equip filter between valve and straight pipe once solid impurity exists in measured medium;
- For gas measurement, pipe pressure should be not less than 5 times pressure loss of meter to ensure float working stably;
- When the fluid temperature is high over 220℃ or so low as easy to crystallize, it needs to take measures of thermal insulation protection; jacket type should be applied for heating or cooling;
- It is necessary that all standards of the pipe flange, fastener, sealing gasket should conform to the standard of meter flange to ensure meter operation normally;
- Generally speaking, the metal variable area flowmeter do not require maintenance after normal operation. Some meter defects always happened during commissioning due to some dirty material in the pipe to cause float be blocked, and the pointer of indicator is stopped fixedly. At this time, first close the valves on both sides of the flowmeter, then disassemble the upper flange of the flowmeter, move out the float to clean and then reassemble. Please notice that the flange nuts should be tightened up evenly and hold the gasket;
- The flange on the process pipeline must be coaxial and parallel to the flange of the meter. To avoid the pipe vibration, suggest supporting the pipe. Control valve should be installed at the downstream of the flowmeter;
- Because the meter transmits signal by magnetic coupling, in order to ensure the meter performance, ferromagnetic matter should not exist around the meter 10m at least;
- Gas meter is calibrated under specified pressure. If the gas at the meter outlet is discharged into atmosphere directly, it would produce pressure loss at the float, and cause the data distortion. Therefore, require to install an exhausting valve at the meter outlet under this condition;
- For flowmeter with LCD display, ensure to avoid sun shining indicator directly during installation, or would reduce life of LCD.
- Pay attention to install meter with PTFE liner. PTFE will be distorted under uneven pressure, so flange nuts should not be tightened unevenly to avoid damaging PTFE liner.

  Table of Max. torque as below:

mm DN	kgf. m Max. Torch	Bipitch Bolt
15	0.93	4×M12
25	2.2	4×M12
50	5.5	4×M16
80	4.7	8×M16
100	4.9	8×M16
125	5.3	8×M18
150	6.8	8×M20

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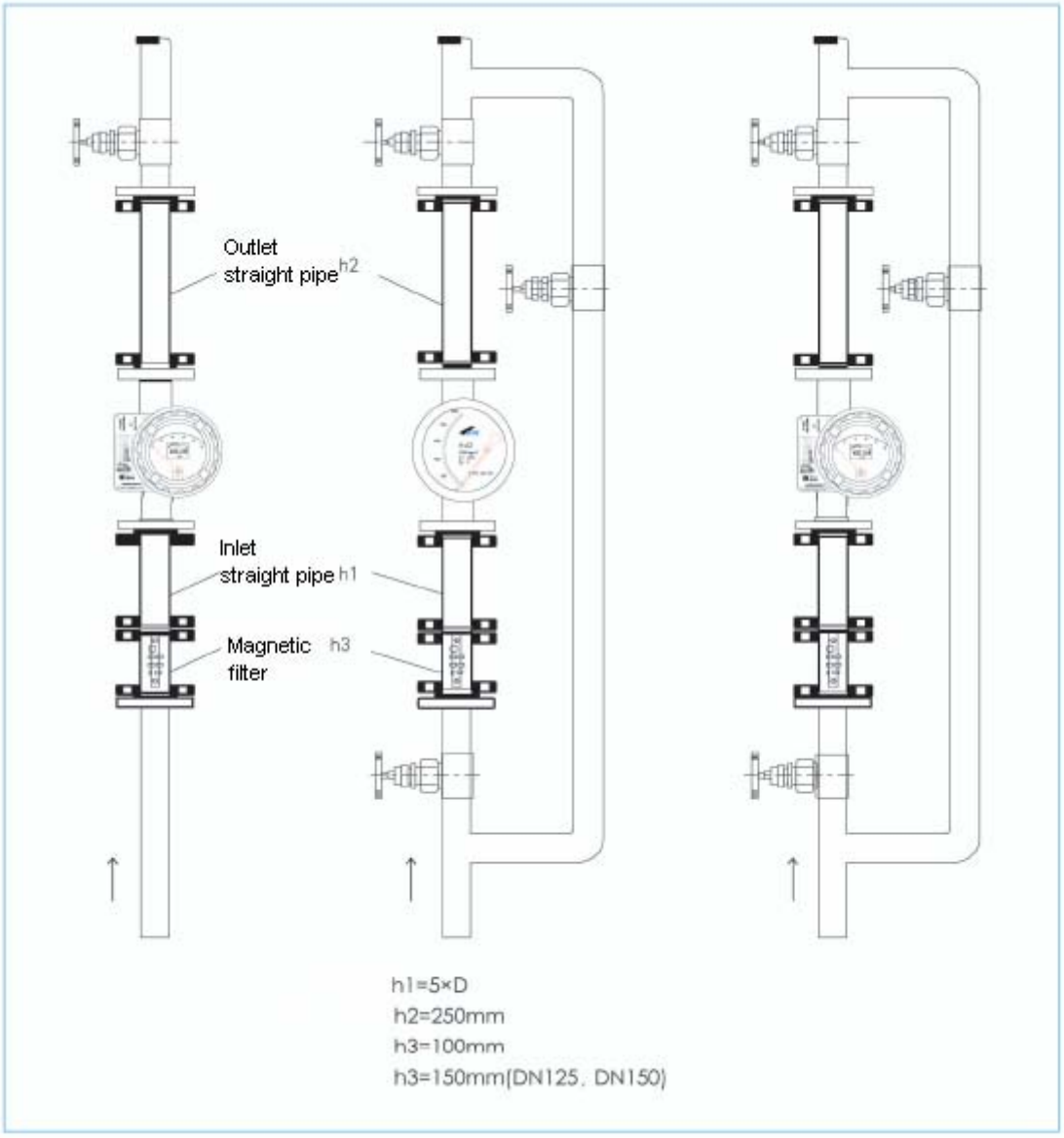
Installation Precaution



Meter Installation Drawing

Customer Maintenance

- Because the meter belongs to precise instrument, should handle with care during meter transportation, installation, storage and usage, and avoid overstress in installation; meanwhile, not change the relative position of indicator and transducer to ensure the meter accuracy;
- There will be ferromagnetic particles deposited on the float in operating; if impurity is too much, it will block float deadly or affect measuring accuracy. Therefore, please clean pipe and float regularly. If necessary, mount magnetic filter at the meter inlet and clean it regularly;
- Due to inside of indicator is electronic components, during disassembly the cover of housing, must tighten the screws of the cover and seal the housing to prevent harmful materials such as liquid ferromagnetic or corrosive gas from entering the meter. At the same time, ensure housing grounded reliably;
- When use the meter first time, should notice the following two points:
  Liquid measurement: open valve slowly to avoid water head attacking the meter;
  Gas measurement: before running, do not exert pressure on pipe, or if valve is opened suddenly, float would rush to brake to damage meter. Therefore, open valve slowly. Recommend a damping device to be equipped to reduce float vibration at utmost.
- For intelligent remote indicator, first, ensure correct wiring, check up and then power on meter. Otherwise, easy to damage meter. Key operation must conform to the manual. If operate blindly, it will cause data stored in EEPROM lost or damaged;
- Meter should be stored in the place with temperature -20℃ ~ +60℃, relative humidity ≤85%, no sunshine and corrosive gas;
- When open housing of explosion proof flowmeter to maintain on site, should turn off the power;
- When ambient temperature is lower than -30℃ or higher than 85℃, LCD may appears stasis or blind screen, however, LCD won't damage under this condition; when temperature reverts to normal range, LCD display normally.

Operating Instructions

Keyboard Instruction

Normally, double-key is for flowmeter operating model, K2S key and K1Z key all located on PCB, and need to open cover of LCD indicator to see.

K2S key (which is short for S key hereinafter)

- In operating mode, press S key for 3s to enter looking through configuration parameter mode and press S key to see about every parameter.
- In password input mode, press S key to enter parameter setting menu tree; on submenu set parameter revision state, it is setting parameter key, which also is data storage key on submenu set parameter storage state.

K1Z key (which is short for Z key hereinafter)

- In operating mode, press Z key for 3s to entering password setting mode;
- In setting mode, it is cursor moving key;
- In looking through configuration parameter mode, press Z key to return operating mode.

Data storage way

In data setting mode, after data setting, press S key when down arrow is twinkling to realize data storage function.

Setting of span, decimal point

Span and decimal point are set once out of factory, also can use S, Z key to reset.

Setting procedure is as follow:

- Press S key to enter data setting mode, meanwhile, sign bit become twinkling, it means that can amend sign bit.
- To press S key again can switch over positive & negative of data (plus is shown as up arrow)
- Press Z key, the first digit can be amended when it becomes twinkling, at this moment, press S key for a long time or for several times, setting data circulates from 0 ~ 9.
- Press Z key again, can set second to fifth digit by turns; setting method is the same as the setting for first digit.
- After setting the fifth digit, press Z key to set decimal point. Decimal point can be set when the four decimal points become twinkling at the same time, press S key now, decimal point will switch over circularly.
- After decimal point setting, press Z key, it can be stored once left down arrow becomes twinkling.
- Press S key, store setting; press Z key, sign bit becomes twinkling, it means that can reset parameter.

Operating Instructions

Operating State

When flowmeter is operating, it displays instantaneous flowrate, total flow by turns.

If total flow is more than 99998, it displays as × 1000, right of LCD displays as "× 1000"

Instantaneous flowrate

Total flow

Zero Clearing Operation of Total Flow

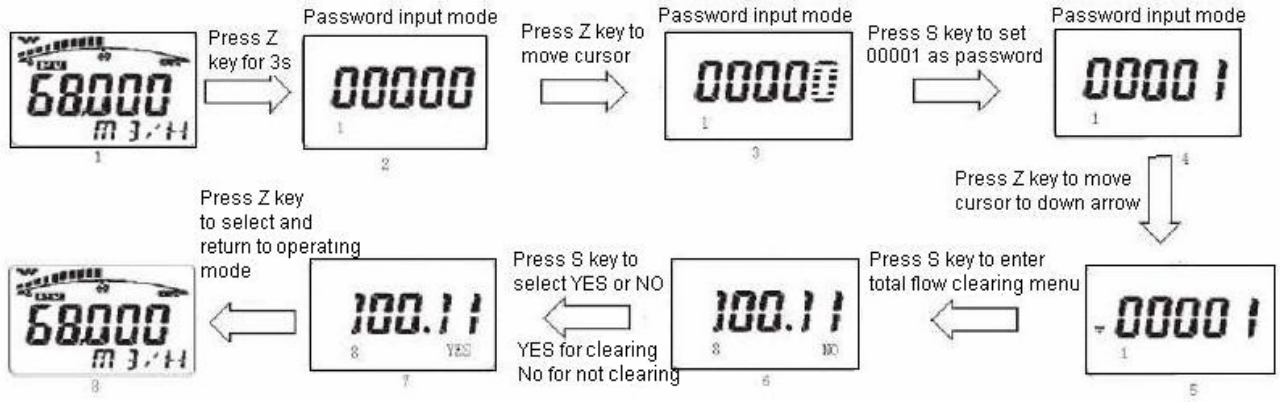
Operation content

In operating mode, enter password input mode, input password 00001 to enter total flow clearing mode, and select total flow clearing, after this to return operating mode.

Operation method

In operating mode, press Z to enter password input mode, combining Z key (cursor moving) with S key (data setting), input password 00001, press Z key to move cursor to down arrow of left screen, which down arrow is twinkling. Press S key to enter total flow clearing mode, press S key to select data of right down screen as YES (YES is for clearing, NO is for not clearing). Press Z key to carry out total flow clearing and return to operating mode.

Operation interface process



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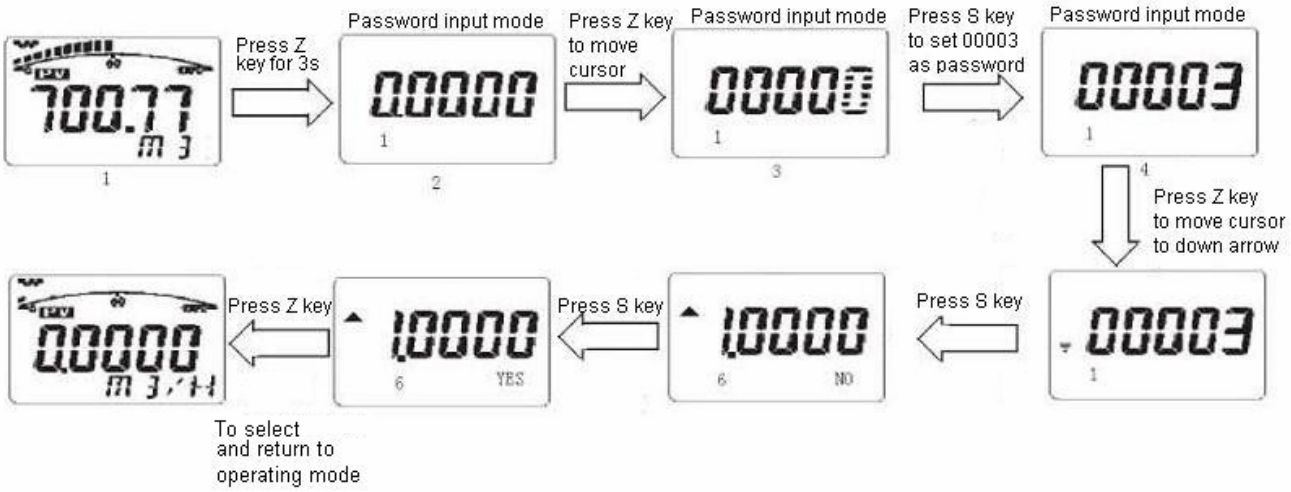
Operating Instructions

Process for Adjusting Zero of the Instantaneous Flowrate



Parameter Setting

Operation content

Submenus belonging to parameter setting tree are: instantaneous flowrate unit setting, lower limit of span setting, high limit of span setting, damping time, lower limit alarm setting, high limit alarm setting, media state selection, density setting, float density setting etc.

No.	Operation procedure	Menu tree content	Setting content
1	In operating mode, press Z key for 3s	Password input 00002	
2	Press S key	Instantaneous flowrate unit selection	m^3/h, T/h, L/h, kg/h, Nm^3/h, kg/m, m^3/m, L/m
3	Press Z key	Lower limit of span setting	
4	Press Z key	Upper limit of span setting	
5	Press Z key	Damping time	
6	Press Z key	Lower limit alarm setting	
7	Press Z key	Upper limit alarm setting	
8	Press Z key	Media state selection	Liq, Gas
9	Press Z key	Gas density	kg/m^3
10	Press Z key	Gas pressure	MPa
11	Press Z key	Gas temperature	K
12	Press Z key	Media density setting	kg/m^3
13	Press Z key	Float density setting	kg/m^3
14	Press Z key	Total flow display	Tow screens display alternatively, unit is as setting value
		Instantaneous flowrate display	Tow screens display alternatively, unit is as setting value
15	No pressing keys in 2m will return to running mode automatically		

Notice: 1. Media state selection is set by manufacturer before goods out of factory.
2. Gas pressure, gas density and gas temperature are set and displayed just for gas metal variable area flowmeter.
3. If upper & lower limit alarm function are not selected, they can not be set automatically, or measured value will be affected.

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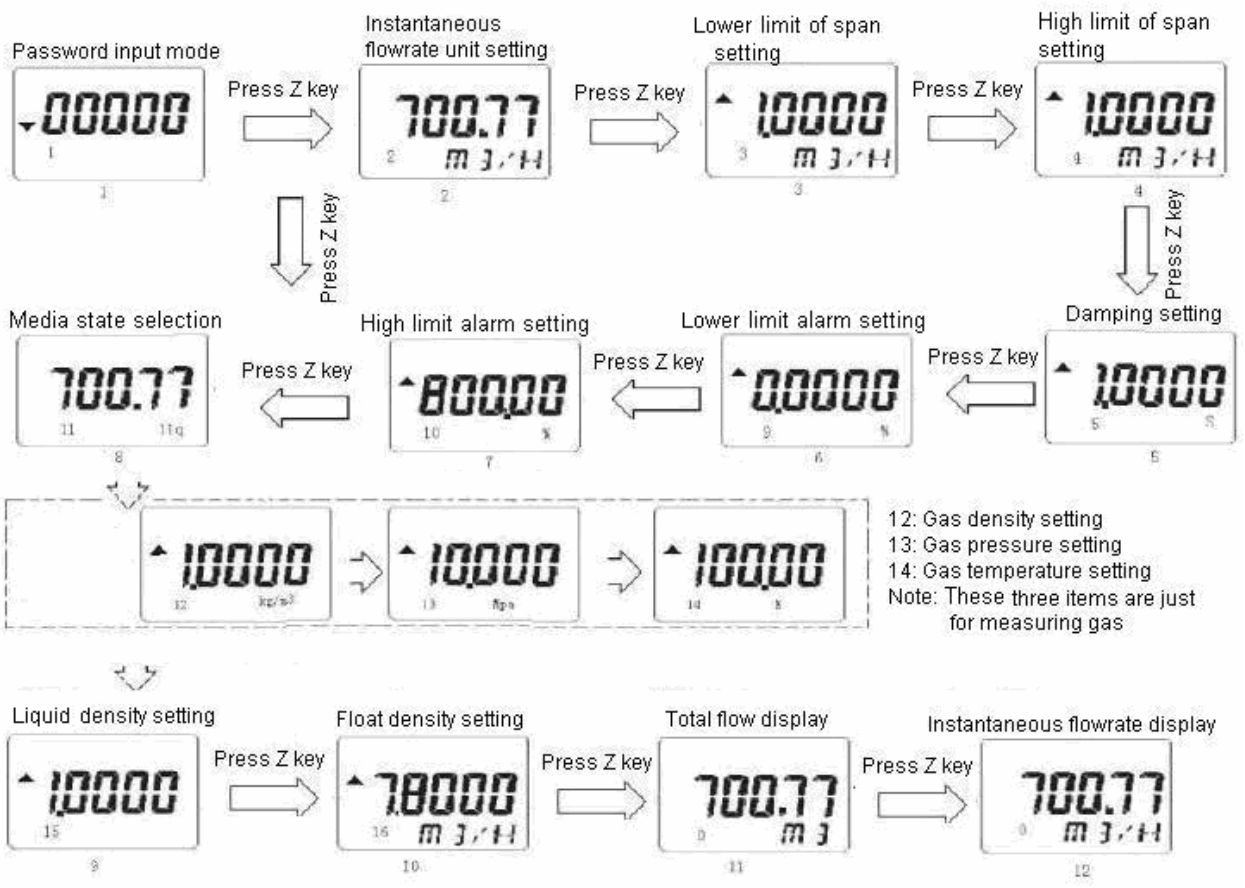
Operating Instructions

Operation method

In operating mode, press Z to enter password input mode, combining Z key (cursor moving) with S key (data setting), input password 00002, press Z key to move cursor to down arrow of left screen, which down arrow is twinkling. Press S key to enter the first item in parameter setting mode (instantaneous flowrate unit selection submenu), Press Z key to enter next submenu (lower limit of span setting), then, with the same method to enter next submenu. Operation for every content is shown as following operation interface process.

Enter parameter setting operation interface process



Notice: 1.11 and 12 wil show alternately. In parameter setting mode, without any pressing keys in 2m will exit from setting mode and return to operating mode.

2. Dashed line part is just for gas flowmeter.

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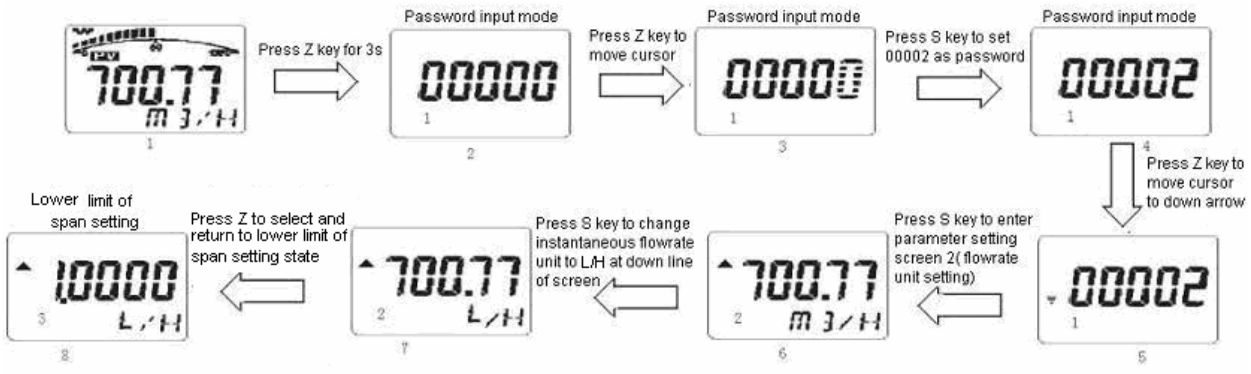
Operating Instructions

Example for parameter setting

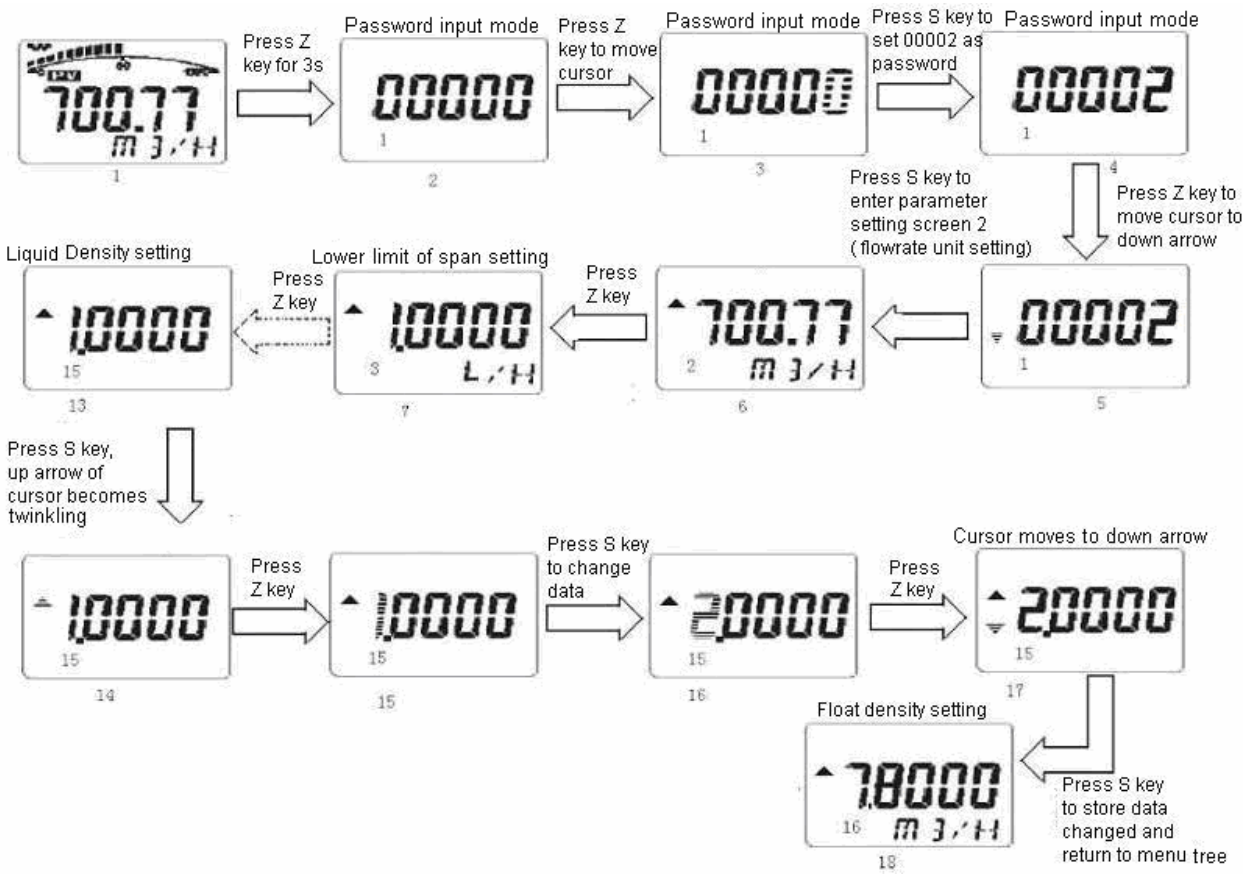
Set L/H as instantaneous flowrate unit, operation process is shown as below:



Notice: 1. Press Z key to select after setting.
2. Setting method of medium state selection is the same as above.
3. After entering configuration data setting, it will return to normal display without any key pressing in 2m.

Operating Instructions

Set 2.0000kg/m^3 as liquid density, operation procedure is shown as below:



Notice: 1. After setting, press Z key, move cursor to left down arrow, then left down arrow becomes twinkling, it means setting can be stored. Press S key to store setting.

2. Upper & lower limit of span, damping, upper & lower limit alarm, gas density, gas pressure, gas temperature and float density, which setting methods are the same as above.

3. After entering configuration data setting, it will return to normal display without any key pressing in 2m.

4. If setting data is over limit, LCD displays "OVER", press S key or Z key to reset

Looking Through Setting Parameter

In operating mode, press S key for 3s to look through setting parameter quickly, looking through sequence is the same as parameter setting operation interface process.

Corresponding Relationship between Instantaneous Flowrate Unit and Total Flow Unit:

Instantaneous flowrate unit	Total flow unit
Nm^3/H、Hm^3/H、m^3/H、m^3/m、SPEC	m^3
L/H、L/m	L
T/H、T/m	T
KG/H	KG
G/H	G

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Operating Instructions

Fault	Reason	Treatment
Dithering Slight	Medium fluctuation	Increase damping
Dithering Moderate	Medium flow state	Install pressure or current stabilizer or increase damping
Dithering Severe	Medium pulse and atmospheric pressure are instable or user's parameter doesn't conform to the actual	Provide correct parameter
Pointer stops moving	Block of float	Adjust guider of float and brake to be concentric
Large measurement error	Incorrect installation	Reinstall
	Liquid density changes greatly	Calculate compensation factor
	Gas affected by temperature and pressure	Temperature and pressure compensation
	Loose parts	Push the pointer with finger to calibrate, if incorrect, adjust the location of parts
No current output	Incorrect wiring	Rewiring
	Bad output board	Change PCB
	Calibration value is lost	Data recovery
No display on the spot	Incorrect wiring	Rewiring
	Incorrect power supply	Check power supply
	Poor contact of LCD module	Reinstall LCD module
LCD always displays zero or full span on the spot	Incorrect parameter setting of span and zero	Reset
	PCB fault	Change PCB
Incorrect total flow output	Incorrect parameter setting	Reset
	PCB fault	Change PCB

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Appendix 1 Relationship Between Velocity and Flowrate

DN (mm)	Velocity (m/s)									
	0.01	0.10	0.30	0.50	1.00	2.00	3.00	4.00	5.00	10.00
	Flowrate (m³/h)									
10	0.00283	0.02827	0.08482	0.14137	0.28274	0.56549	0.84823	1.13097	1.41372	2.82743
12	0.00636	0.06362	0.19085	0.31807	0.63617	1.27235	1.90852	2.54469	3.18086	6.36173
20	0.01131	0.11309	0.33929	0.56549	1.13097	2.26195	3.39292	4.52389	5.65487	11.3097
25	0.01767	0.17672	0.53014	0.88357	1.76715	3.53429	5.30144	7.06858	8.83573	17.6715
32	0.2895	0.28953	0.86859	1.44765	2.89529	5.79058	8.68588	11.5812	14.4765	28.9529
40	0.04524	0.45239	1.35717	2.26195	4.52389	9.04779	13.5717	18.0956	22.6195	45.2389
50	0.07069	0.70687	2.12058	3.53429	7.06858	14.1372	21.2058	28.2743	35.3429	70.6858
65	0.11945	1.19459	3.58377	5.97295	11.9459	23.8918	35.8377	47.7356	59.7295	119.459
80	0.18096	1.80956	5.42867	9.04779	18.0956	36.1911	54.2867	72.3823	90.4779	190.956
100	0.28274	2.82743	8.4823	14.1372	28.2743	56.5487	84.823	113.097	141.372	282.743
125	0.44178	4.41786	13.2536	22.0893	44.1786	88.3573	132.536	176.715	220.893	441.786
150	0.63617	6.36173	19.0852	31.8086	63.6173	127.2345	190.852	254.469	318.086	636.173
200	1.13097	11.3097	33.9292	56.5487	113.097	226.195	339.292	452.389	565.487	1130.973
250	1.76715	17.6715	53.0144	88.3573	176.715	353.429	530.144	706.585	883.573	1767.15

Appendix 2 Manufacture Standard of Metal Variable Area Flowmeter

GB/T 6844-93 Metal Variable Area Flowmeter
JJG 257-94 Verification Regulations of Rotameter
GB/T 15464-1995 General Technical Specifications of Instruments Packing

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