

1st Edition, 2013



渝制 00000856号

FlowMaster

ELECTROMAGNETIC FLOWMETER
Instruction Manual

Product development may involve changes in technical indicators without prior notice. The Company has the explanation right to any printing error herein.

Safety notes:

△ Please read “Instruction Manual” to understand how to use our product before operation.

Chongqing Chuanyi Automation Co., Ltd.
Flowmeter Branch

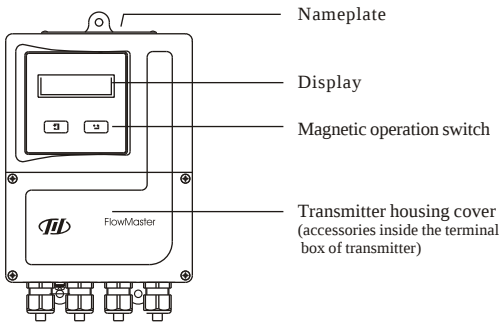
About product



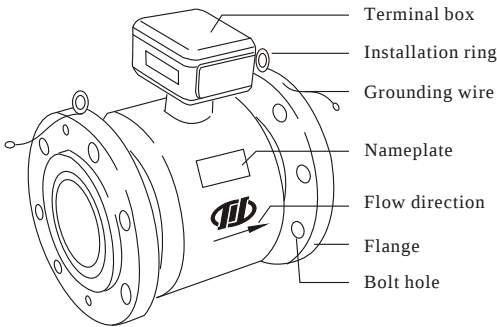
- FlowMaster series electromagnetic flowmeter must pass strict inspection before delivering from factory.
- Please check flowmeter's appearance to confirm whether it's damaged in the transportation after receiving it.
- Please refer to this chapter and confirm the accessories of flowmeter.

Confirm model code and specification

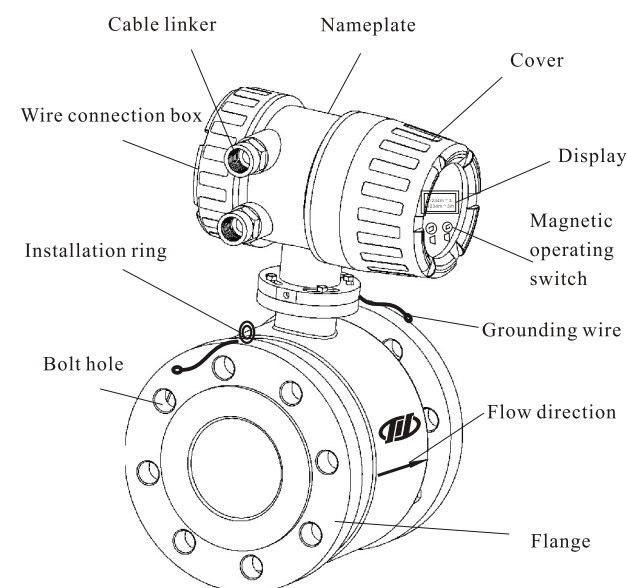
Read model code and specification from the nameplate and calibration report of electromagnetic flowmeter and confirm whether these information are the same with the product listed in purchased order.



ELECTROMAGNETIC FLOWMETER			
Model code		IP Code	IP
Standard		P.PROC	MPa
Serial No.		T.PROC	°C
Power supply		T.AMB	°C
Output		Load Impedance	0~750 Ω
FACT 1/2/3		Accuracy	Level
Chongqing Chuanyi Automation Co., Ltd. Flowmeter Branch No. 61, Huangshan Avenue, New North Zone, Chongqing, China			



Standard			
Q/LY 417	Electromagnetic Flowmeter		00000856
Model No.			
Serial No.		IP Code	
P.PROC	MPa	T.PROC	
FACT. 1		T.AMB	
FACT. 1/2/3		Accuracy	
 Chongqing Chuanyi Automation Co., Ltd. Flowmeter Branch No.61, Huangshan Avenue, New North Zone, Chongqing, China			
			



Explosion-proof Electromagnetic Flowmeter Ex MC License No:00000856			
Model No	Q/LY 417	IP Code	IP
Standard		P. MAX	MPa
Ex rating		T. PROC	°C
Ex certificate No.		T. AMB	°C
Serial No.		Accuracy	
Power supply		FACT.1	
Output		FACT.2/3	
Load impedance	0 ~ 750Ω		

Sichuan Instrument Complex Co., Ltd Flowmeter Branch
No.61, Middle Section, Huangshan Avenue,
New North Zone, Chongqing, China



When product has quality problem or user has question in operation, please inform us the specification and Serial No. of flowmeter by which we could solve problem quickly.

Confirm packing list

Please confirm the product according to following packing list after receiving it.

- Sensor (1 set) (when the selected flowmeter is integral type, the sensor is installed on transmitter)
- Transmitter (1 set) (when the selected flowmeter is integral type, the sensor is installed on transmitter)
- Instruction Manual (1 purchase.)
- Calibration Report (1 purchase.)
- Qualified certificate (1 purchase.)
- Cable (only for separate type flowmeter, the length of cable is confirmed by user itself)
- Matching flanges (supplied when ordered by user)
- Matching bolts and nuts (supplied when ordered by user)
- Sealing glue (1 set, filled into the terminal box of separate type flowmeter)

Notice for storage



The following notices should be complied if the instrument would be in storage for a long time after receiving it.

1. Keep the instrument being in its original packing box as well as it being the status of delivering from factory.
2. Select suitable position to store instrument referring following conditions.
 - Do not dispose instrument under the rain.
 - Do not put instrument in the place with continuous vibration.
 - Do not open the terminal box to avoid moisture.
 - Ambient temperature, humidity and atmospheric pressure must be as follows:
Ambient temperature: -20°C ~ 60°C
Relative humidity: 5%~90%
Atmospheric pressure: 86~106kPa

Part1:Flange-type Electromagnetic Flowmeter

Introduce

Measuring principal

The measuring principal below is based on Faraday electromagnetic induction rule, that is, when traveling vertically in the electric-liquid magnetic fields, the conductor generates inductive voltage, whose value is calculated through such formula as:

$$E=KB\bar{V}D$$

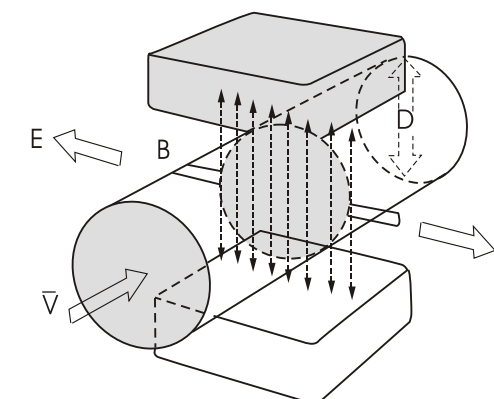
Thereinto: E--Inductive voltage

K--Instrument invariable

B--Magnetic induction intensity

$\bar{V}$ --Average flow velocity across the section of the measuring pipe

D--Inner diameter of the measuring pipe



When measuring the flow value, the liquid is flowing through the magnetic field vertical to the flowing direction, and the flowing electric liquid generates a voltage directly proportional to the average flow velocity, therefore the measured flowing liquid is demanded to have a minimum conductivity. The inductive voltage signal is conveyed through two electrodes directly contacting the flow liquid and is sent to the cable by the amplifier, and then exchange to an integrated output signal.

Installation

1. Process pipeline design

Design the process pipeline should satisfy following conditions:

(1) Position

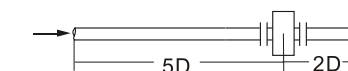
Install flowmeter in the place where the sunshine could not irradiate directly, the ambient temperature is -20~+60°C. If flowmeter is installed under heat radiation of heat source, please apply heat insulation device or ventilation device. And it's avoided to install flowmeter in environment and area filled full of strong corrosive air and explosive air (for non-explosion-proof type flowmeter). If the protection rating is IP67 (under water for 1m) or IP68 (under water for 5m), the flowmeter could be deposited under water. If the protection rating is IP65, the flowmeter could not be dipped into water.

(2) Avoiding electromagnetic field

The electromagnetic flowmeter could not be installed near the electromagnetic field, such as electromotor, transformer and other power.

(3) The length of straight pipe

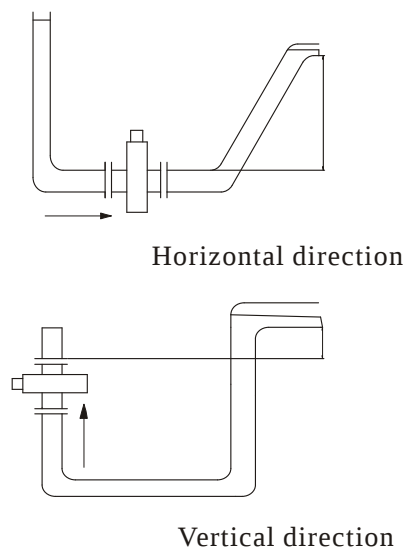
To ensure measurement accuracy of the flowmeter, the straight pipe of the flowmeter must assure 5D of the upstream part and 2D of the downstream part.



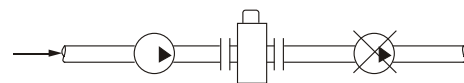
- (4) Space for maintaining
There should be enough space, around the flowmeter for maintaining.
- (5) Adopt disconnecting valve and by-path valve
Disconnecting valve and by-path valve to make maintaining and zero-adjusting more convenient.
- (6) The supports of flowmeter
The sensor can not be installed on free-vibrating pipes. The measuring pipe should be fixed with a installation foundation.
When underground installation, supporters should be installed in two ends of the pipeline.
And install metal protection plate over the flowmeter.

2. Installation requirement

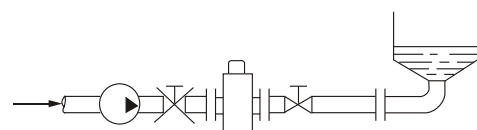
- (1) Flow direction
The flowmeter can self-check forward/reverse flow, and the flow arrow on the sensor is stipulated by the producer as forward flow direction. Users should make the flow arrow consistent with the process flow when installing the instrument.
- (2) Installation direction
The sensor could be linear or vertical installation.
- (3) Process medium fully filled in the pipe
The measuring pipe must be fully filled with process medium, assuring that the electrode completely immerse into the measured flow liquid to make the measurement reliable.



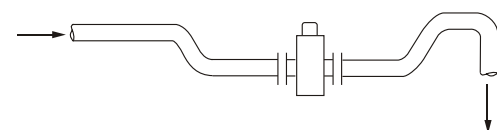
- (4) The flowmeter could not be installed at the pumping side.



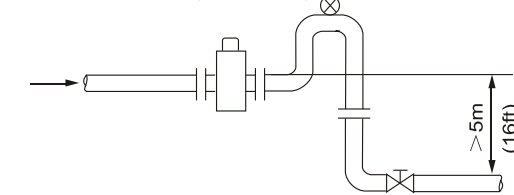
- (5) For the long pipeline, control valve is usually installed at downstream flowmeter.



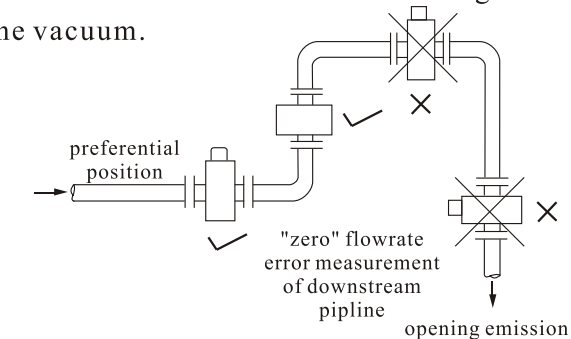
- (6) For the opening emission pipe, the flowmeter should be installed at the low pipeline part.



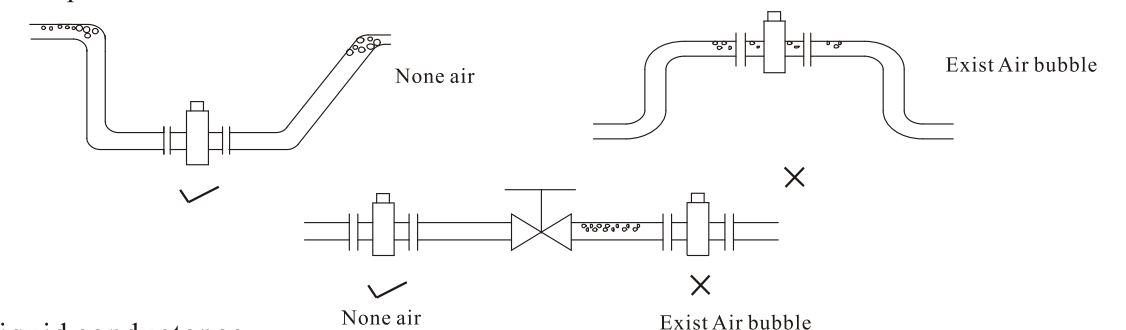
- (7) For pipe fall exceeding 5m, air valve (vacuum) should be installed at downstream flowmeter.



- (8) Avoiding measure deviation resulted from the additional gases and the damages against the lining resulted from the vacuum.



- (9) None air bubble in pipeline
Ensure air bubble could not be separated from liquid when design the pipeline.
Flowmeter should be installed at upstream before the valve. Due to the action of valve, the pressure inside the pipeline will decrease to cause the air bubble appear.
Simultaneity, flowmeter should be installed at the low pipeline part to decrease the effect from liquid which is mixed with air bubble.



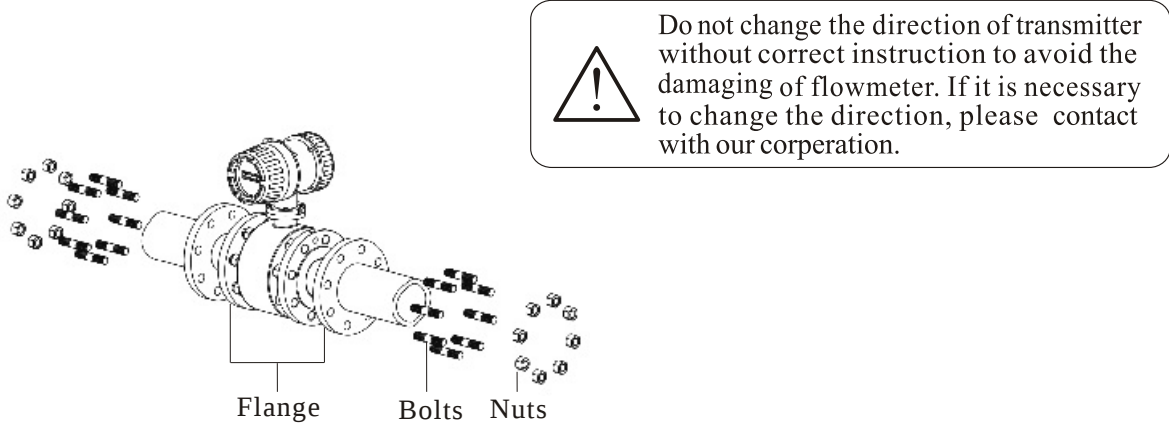
- (10) Liquid conductance
Don't install flowmeter at the place where conductance is unequable.
Fill chemical liquid at the upstream of pipeline will easily cause liquid's conductance unequable. And it will bring serious disturbance to the reading value of flowmeter. In this situation, we suggest filling chemical liquid at the downstream. If it's necessary to fill chemical liquid at the upstream, please ensure that the straight pipe of flowmeter is more than 5D of the upstream part. In this way, liquids could adequately mix at the upstream.

- (11) Earth connection
The inductive voltage of electromagnetic flowmeter is very faint and is easily affected by the noise or other electromagnetic signal from outside. Grounding rings should be selected and installed on flowmeter when customer uses non-metal pipe line. With them, the outer case/housing of flowmeter have a good connection with earth and become a shield space to avoiding the external interference. And the accuracy of measurement increases. Please select grounding ring by remark when ordered.

3. Machine installation

3.1 Installation of process pipeline

- (1) Proofread the process pipeline before installing flowmeter to ensure the coaxiality between pipeline and flowmeter.
- (2) Normally, the new pipeline exist dross (for example welding dross) inside. It is necessary to remove dross before installing flowmeter so as to avoiding lining dama ge and the measuring error caused by dross inside the pipeline.



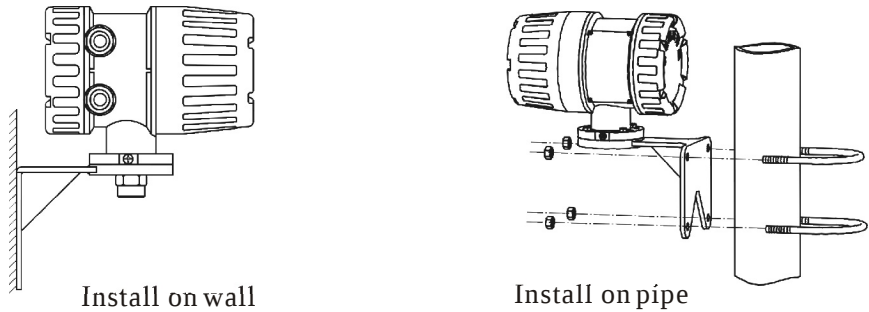
3.2 Notice items

Before installation, please read following items carefully.

- (1) Be careful to avoid flowmeter damage when open the package. It is best to open the package after products arriving at jobsite. Hang flowmeter by installation ring,do not hang the measuring pipe of flowmeter by stick or rope.
- (2) Avoiding vibration
Do not break or press flowmeter, specially do not press the surface of lining. (If the lining damaged, the flowmeter maybe do not work normally)
- (3) Protection for flange surface
Pay attention on the protection of flange surface. Do not dispose flange on ground without any gasket or other disflat board.
- (4) Do not open the wire connection box before electric connection. After finish wire connection, please fill special sealing glue of our company into the wire connection box as soon as possible. And then close the cover and tighten the screws.
- (5) Non-use for a long time
After finishing the installation of flowmeter, it is not good to non-use flowmeter for a long time. If non-use flowmeter for a longish time, please execute the following steps:
 - A. Check the hermetical status of cover and wire connection box to ensure tha moisture and water could not enter the flowmeter.
 - B. Termly check. Check the steps mentioned above and the situation inside the wire connection box at least annually. Ifdoubt water enter flowmeter (e.g. After heavy rain, etc.), it is necessary check the flowmeter at once.

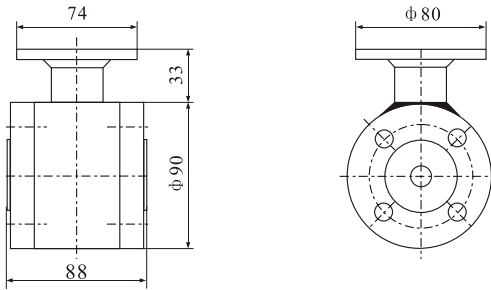
3.3 Installation of flowmeter

- (1) Installation direction
The direction of measured medium must be consistent with the flow arrow marked on the sensor.
- (2) Connection method
Connect flanges of sensor and pipeline with bolts and muts at jobsite. And termly tighten the bolts and nuts during the daily using.

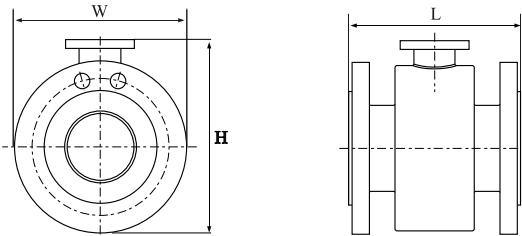


4. Figure dimensions of sensor

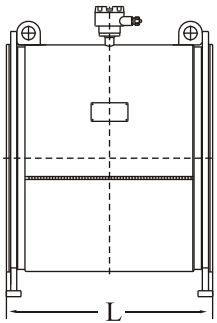
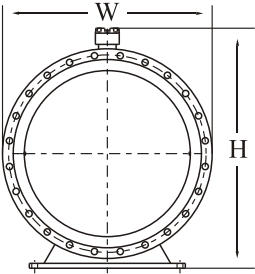
4.1 Sensor dimensions(Flange-type)



Nominal size (mm)	Dimension(mm)			Approx weight(kg)			
	L	W	H	1.0MPa	1.6MPa	2.5MPa	4.0MPa
2.5	88	90	123	3	3	3	3
5	88	90	123	3	3	3	3

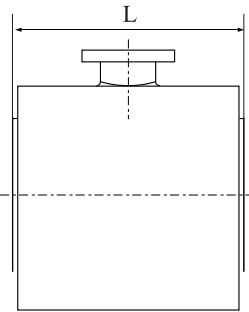
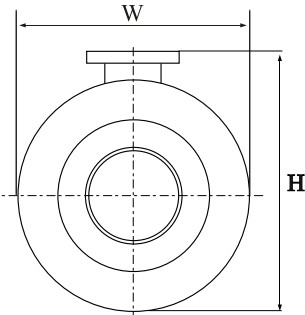


Nominal size (mm)	Dimension(mm)			Approx weight(kg)			
	L	W	H	1.0MPa	1.6MPa	2.5MPa	4.0MPa
10	134	90	123	3.5	3.5	3.5	3.5
15	134	95	126	4	4	4	4
20	200	128	137	4	4	4	4.5
25	200	128	147	5	5	5	5.5
32	200	128	155	7	7	7	8
40	200	128	165	7.5	7.5	8	8.5
50	200	165	187	9	9	9.5	10
65	200	185	202	11	11	12	14
80	200	200	223	14	14	15	19
100	250	220	249	19	19	20	24
125	250	250	278	24	24	25	30
150	300	285	303	32	32	35	42
200	350	340	358	41	41	46	56.5
250	450	405	418	68	68	73	85
300	500	460	468	89	89	97	113
350	550	562	560	97	97	124	—
400	600	596	614	122	122	157	—
450	600	640	656	161	161	200	—
500	600	715	715	180	180	243	—
600	600	810	810	241	241	285	—



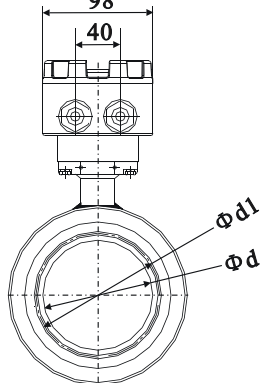
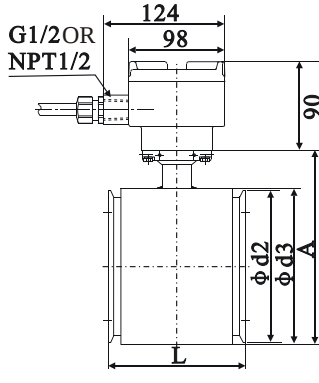
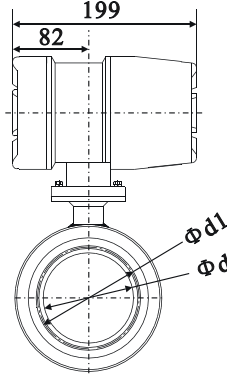
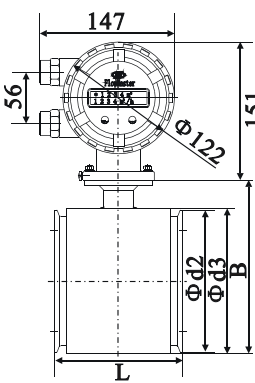
Nominal size (mm)	L	W	H	Approx weight(kg)
700	700	895	995	420
800	800	1015	1115	541
900	900	1115	1215	668
1000	1000	1230	1350	858
1200	1200	1405	1505	990
1400	1400	1630	1730	1362
1600	1600	1830	1930	1754
1800	1800	2045	2145	1890
2000	2000	2266	2365	2105
2200	2200	2475	2364	3210
2400	2400	2685	2564	3910

4.2 Sensor dimensions(wafer-type)

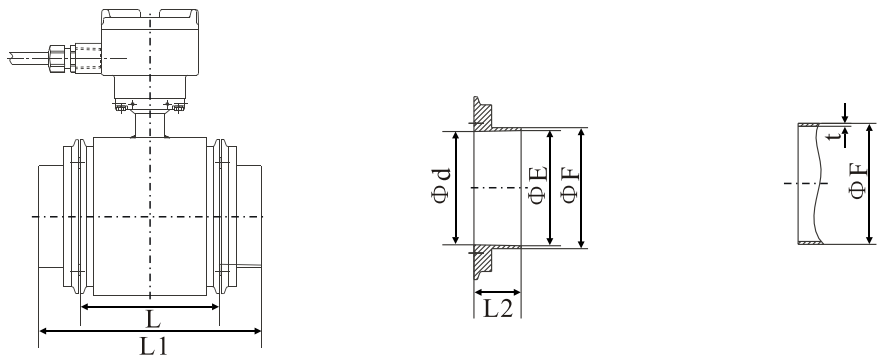


Nominal size (mm)	L	W	H	Pressure(MPa)
25	100	70	100	≤4.0
32	100	80	110	≤4.0
40	100	91	121	≤4.0
50	100	100	130	≤4.0
65	100	119	149	≤1.6
80	120	130	160	≤1.6
100	150	155	185	≤1.6
125	200	183	213	≤1.6
150	200	212	242	≤1.6
200	250	262	292	≤1.0
250	300	320	350	≤1.0
300	350	370	400	≤1.0

4.3 Sanitation sensor dimensions



Norminal size	DN25	DN32	DN40	DN50	DN65	DN80	DN100
L(Sensor overall length)	92				95	115	144
B(House length of integral type)	107	117	128	137	156	167	192
A(House length of separate pipe)	113	123	134	143	162	173	198
d3(House diameter)	74	84	95	104	123	134	159
d2(Chuck outer diameter)	77.5		91		119	130	155
d1(Center of curproof groove)	43.5			56.5	70.5	83.5	110
d(Inner diameter of sensor)	22.6	31.3	35.6	48.6	60.3	72.9	96

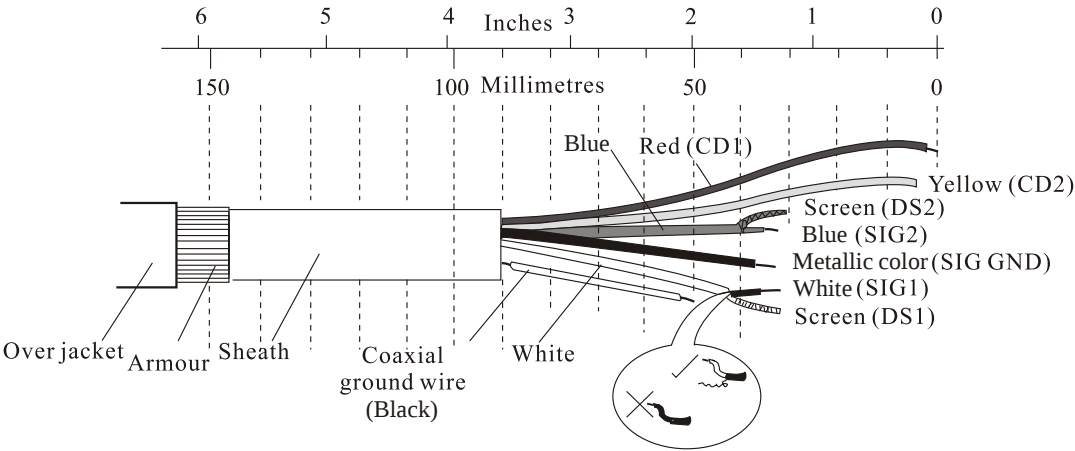


Nominal size	DN25	DN32	DN40	DN50	DN65	DN80	DN100
L1(Installation length)	156			159	199	228	
L(Sensor overall length)	92			95	115	144	
L2(Connector length)	30					40	
F(Outer diameter of connection pipe)	77.5		91	119	130	155	
E(DIN32676Inner diameter of connector)	26	32	38	50	66	81	100
E(ISO2852Inner diameter of connector)	22.6	31.3	35.6	48.6	60.3	72.9	97.6
d(Inner diameter of connector)	22.6	31.3	35.6	48.6	60.3	72.9	96

5. Electric connection

5.1 Cable

- (1) Working temperature: -25℃~70℃
- (2) Cable's specification and colour is as shown below:



- (3) The diameter of cable is 11.5±0.5mm.

5.2 Flowmeter grounded connection

(1) Sensor grounded connection

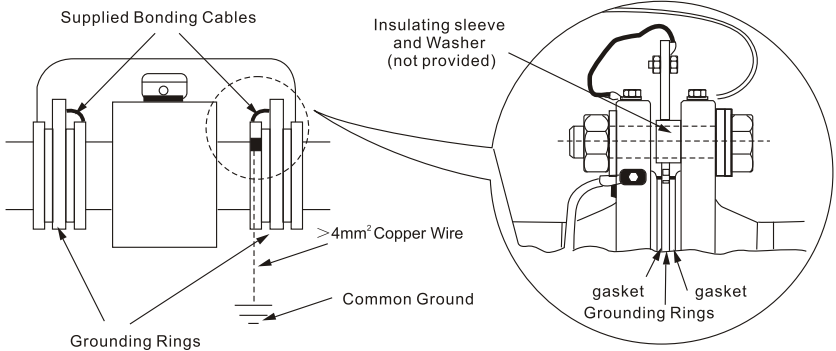
★Notice: As the inductive signal related to medium flow is very faint in the sensor of electromagnetic flowmeter, avoiding disturbing signal is of great importance, of which the most important is to have a good connection with the earth.

The following drawings are the grounded connection methods of sensor in different installation conditions.



A. Metal pipe grounding

B. Plastic pipe grounding



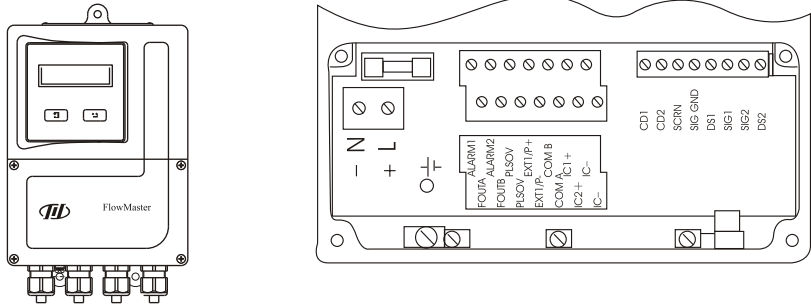
C. Pipelines with cathodic protection

(2) Transmitter grounded connection

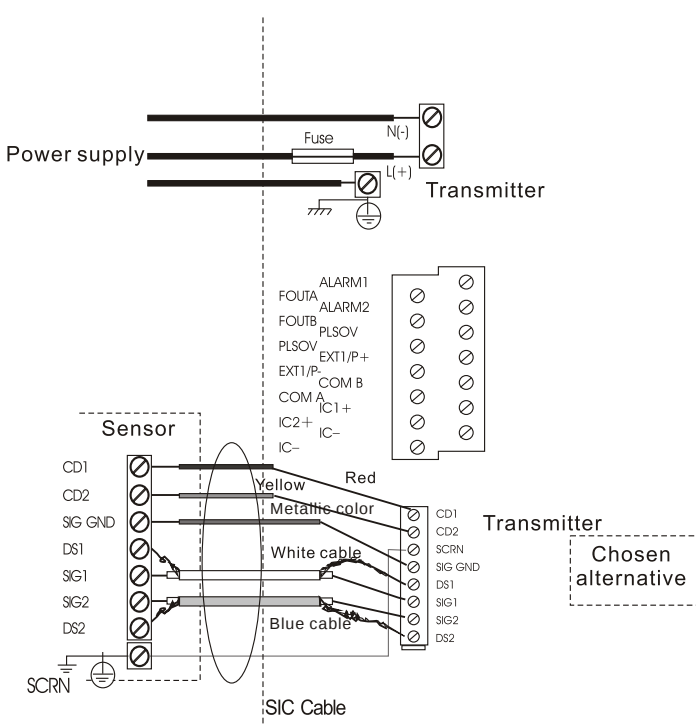
The grounded connection of the transmitter inside has been considered in the product design. For having a good grounded connection, user could only connect the housing of transmitter to the earth.

5.3 Normal transmitter connection (1)

- (1) Open the cover of transmitter, the connecting terminals are as shown right.



For the integral version, connections between sensor and transmitter are completed by the manufacturer. For the separation version, this connections refer toto the drawing below.

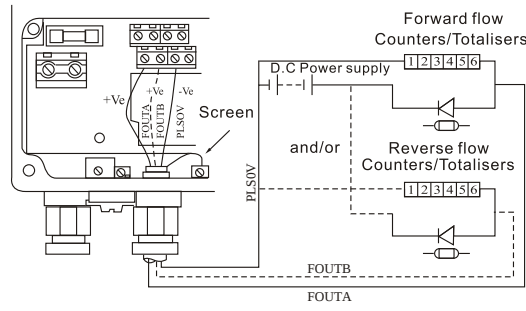


★Notice

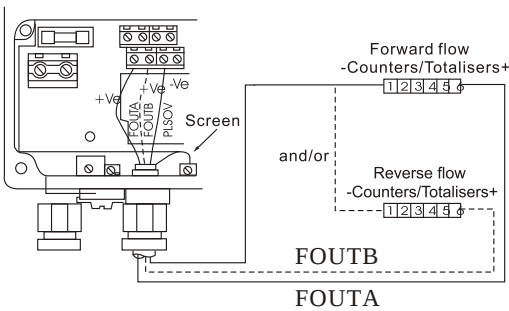
Notice the following issues when connect wires:

- (1) Connections between senso and transmitter should be correct, and contact well, free from short circuit and open circuit.
- (2) Do not connect wires outdoor in the rain day for avoiding moisture.
- (3) Fix the cable linker to the wire connection box after finishing connecting wires for separation type flowmeter.
- (4) Do not add other power supply to the 4~20mA output.

A. Frequency outputs

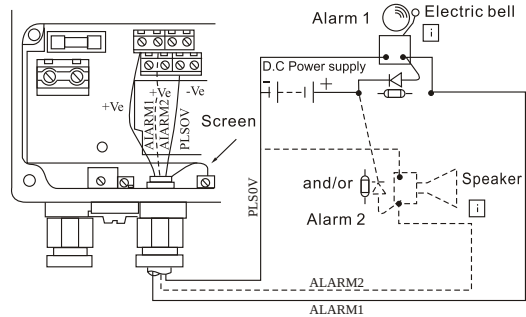


Electromagneticcounter connection

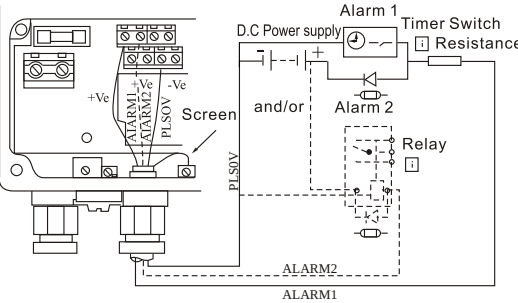


Telemetry, electronic counters etc.

B. Alarm output connections

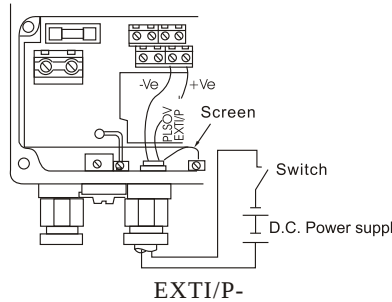


Alarms (1)

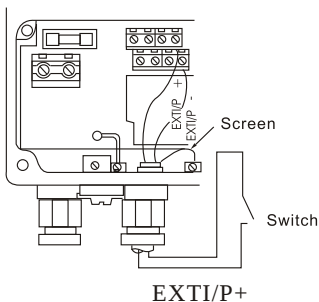


Alarms (2)

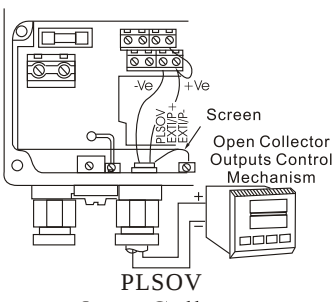
C. Contact input connections



Volt-free contact

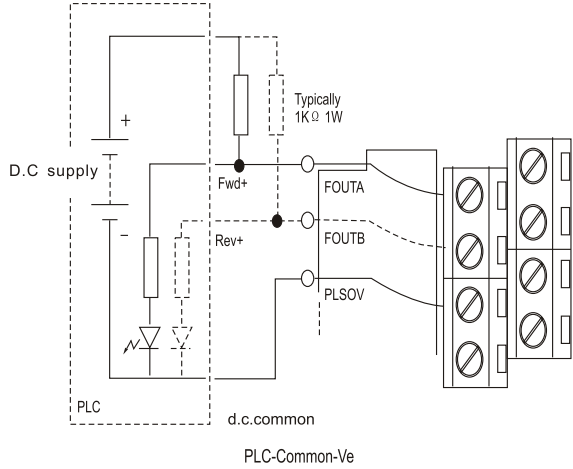


Voltage Signal or
Logic Signal

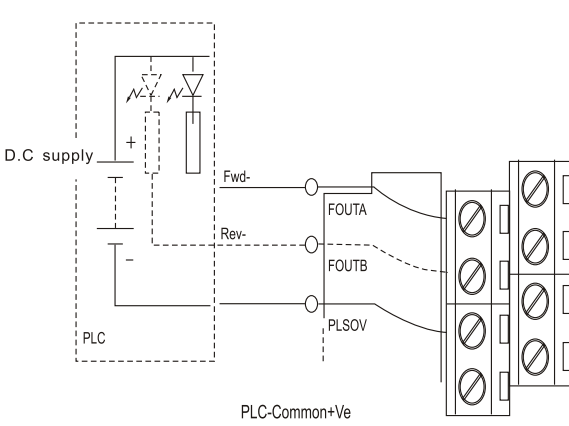


Open Collector
(or Grounded Contact)

D. PLC Interface

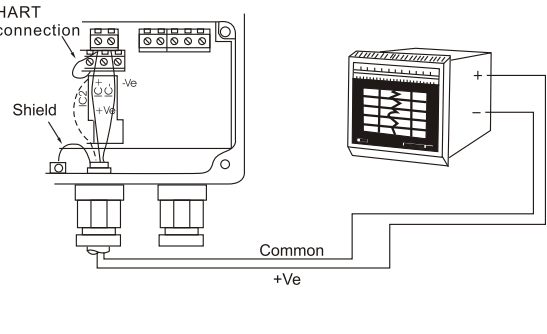


PLC Common -Ve

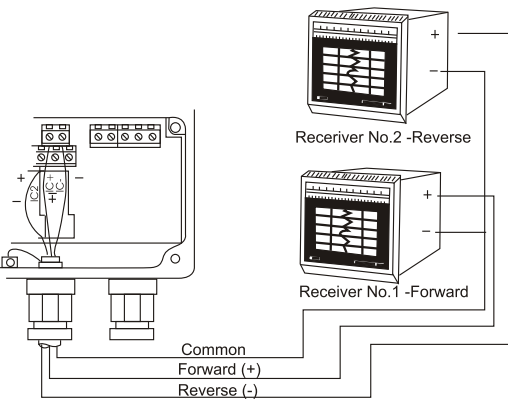


PLC Common +Ve

E. Current Output Connections

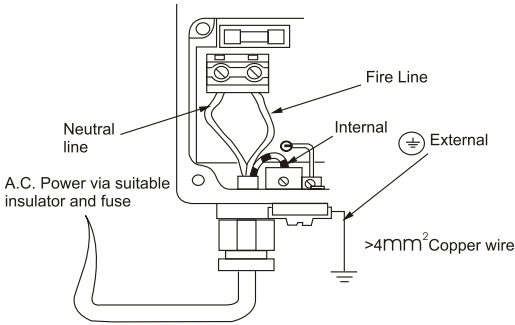


Current Output Connections:
Standard

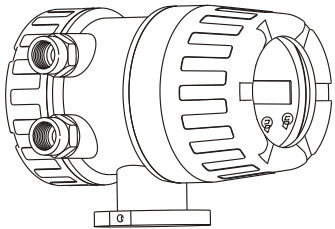


Current Output Connections:
Dual Current Option

F.Power Supply Connections



A.C. Power Supply Connections (AC220V)



5.4 Transmitter connection(2)

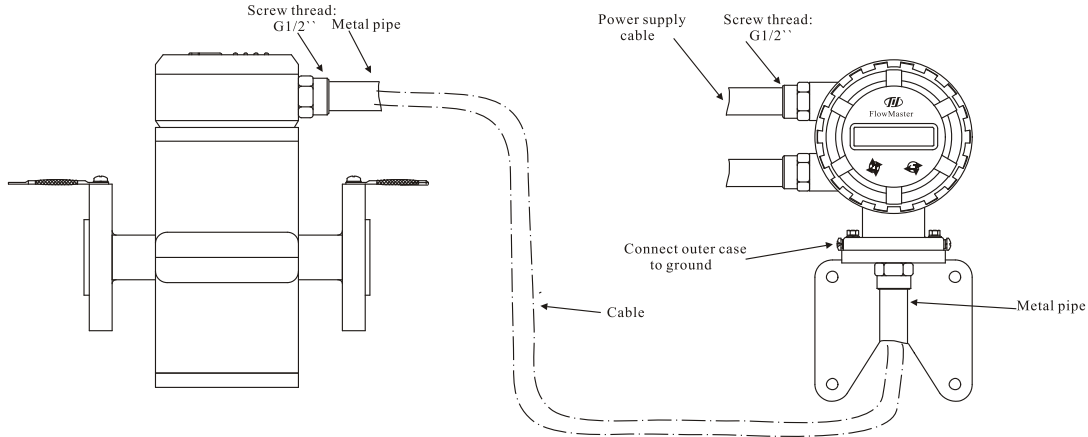
Transmitter connection

(1) Open the cover of wire connection box, the connecting terminals are as shown blow.

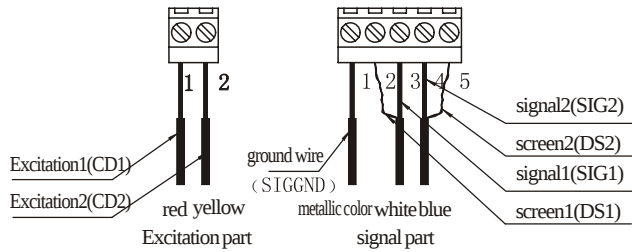
A. For the integral version, connections between sensor and transmitter are completed by the manufacturer. For the separation version, this connections but be done by using special SIC supplied cables. The wire connection box of sensor has been filled in with sealing glue before leaving factory. The cable connection on transmitter refer toto the drawing below.

B. Please use the cable (outer diameter is $\phi 10\pm0.5\text{mm}$) for power supply cable and other output signal cables (prepared by user).

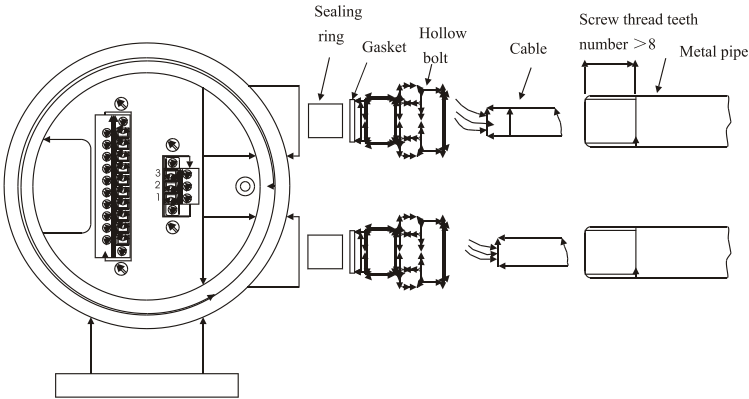
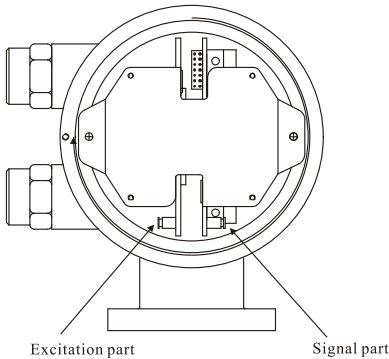
C. Cable connection drawing:



Metal pipe could be seamless steel tube and welded steel tube which is according to GB/T 14823.1 standard. The connecting section between tube and tie-in must be 5 thread engagement at least.

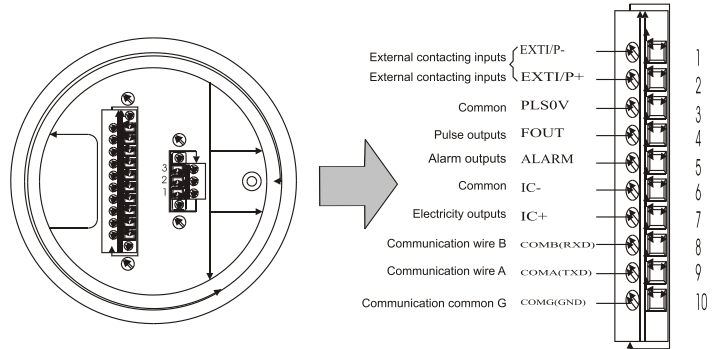


Explain: Connector code is printed on circuit board,wires can be connected accordingly.



★Note:
Flowmeter parameter revising or parts exchanging must only be carried out by professional personnel. Other personnel could not carry out the above operation.
Installing, using and maintaining flowmeter should be consistent with relative articles of GB3836.15-2000 "Electrical apparatus for explosive gas atmospheres Part15: Dangerous locale electric installation (Except colliery)" and GB50058-1992 "Electric power instrument design criterion in explosion and fire circumstance".

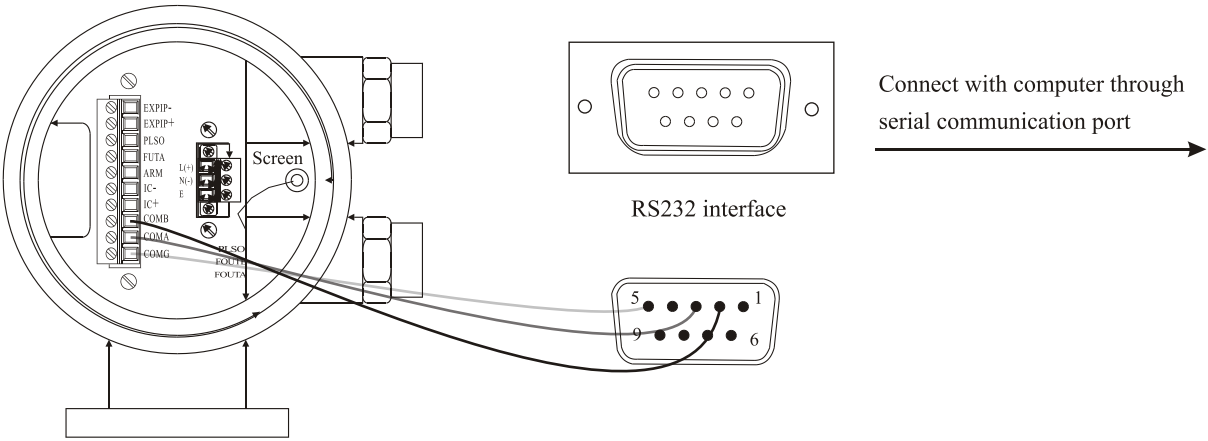
Have the cable been through the hollow bolt, gasket and sealing ring. Ensure the cable with enough length for connecting wires. Then screw down the hollow bolt after sealing ring and gasket being into cable leading hole. For explosion-proof transmitter, explosion-proof wire pipe should be installed to the cable.



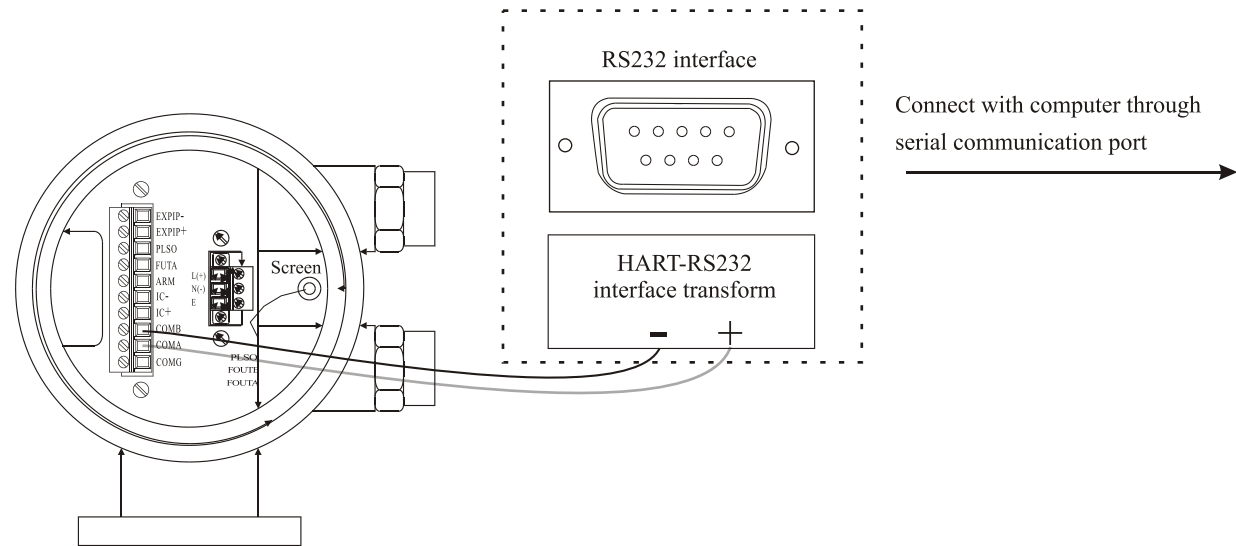
⚠️★Notice: Please cut off the power supply to avoid the explosion occur when connect wires in the volatile gas circumstance.

Transmitter connection

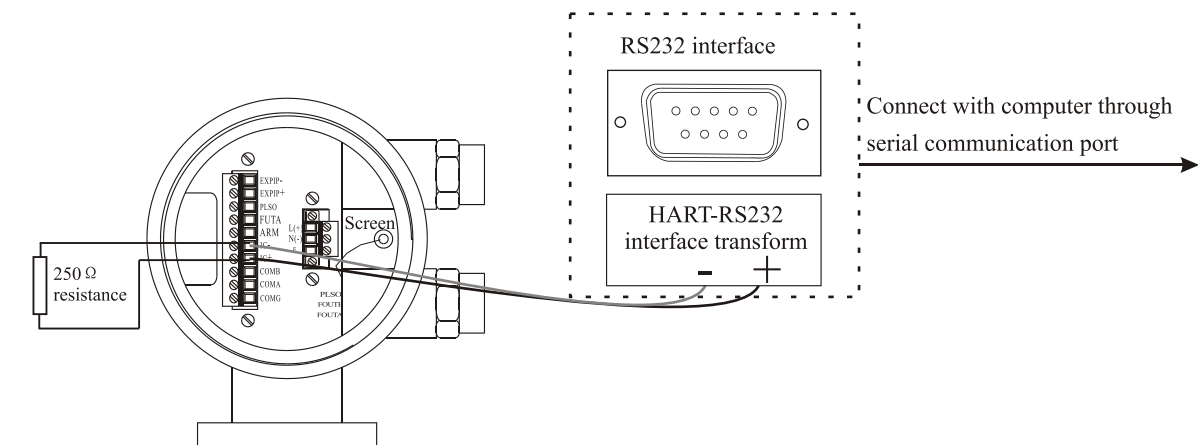
A. RS232 connections



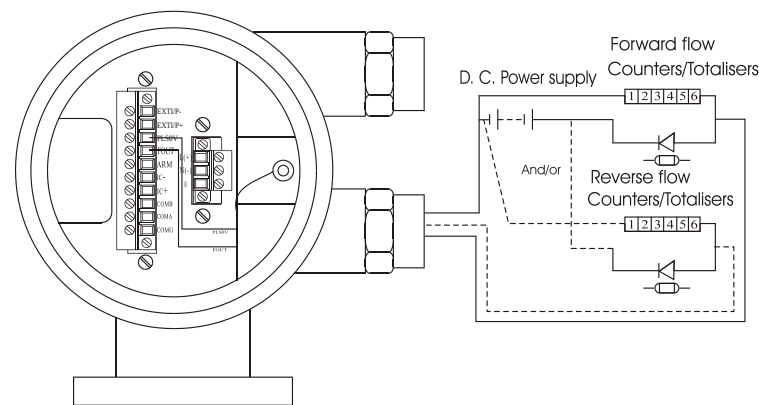
B. RS485 connections



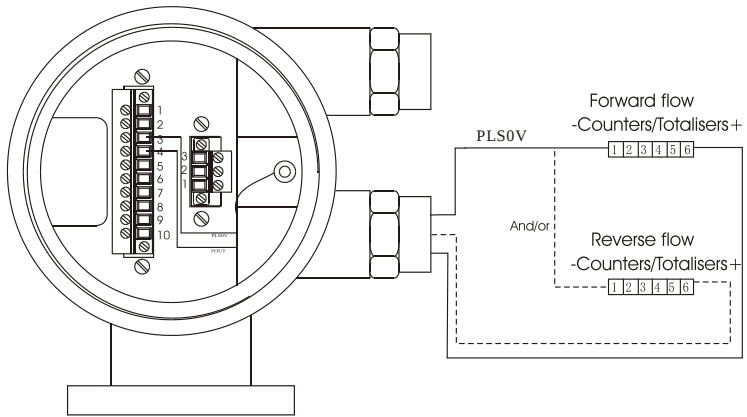
C. HART connections



D. Frequency outputs connections

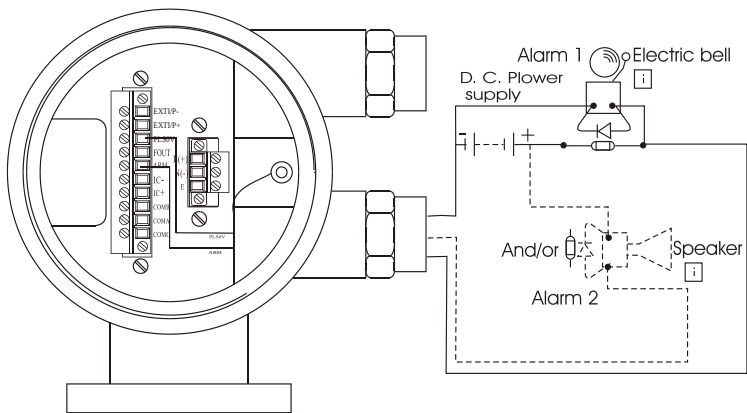


Electromagnetic counter connection



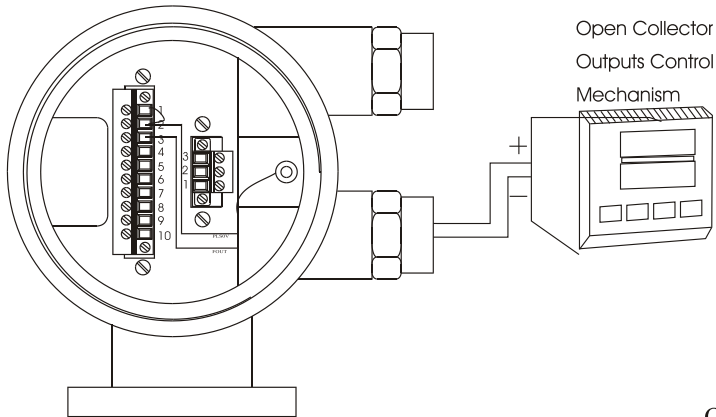
Telemetry, electronic counters etc.

E. Alarm output outputs connections

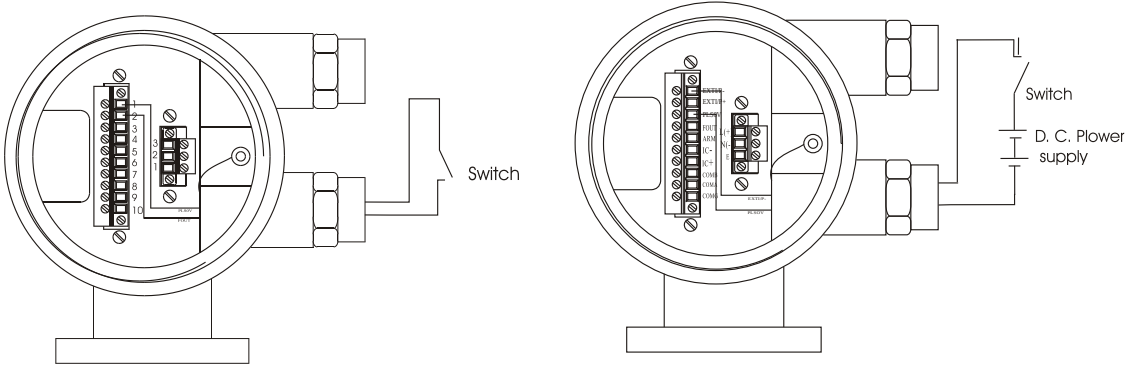


Telemetry, electronic counters etc.

F. Contact input connections



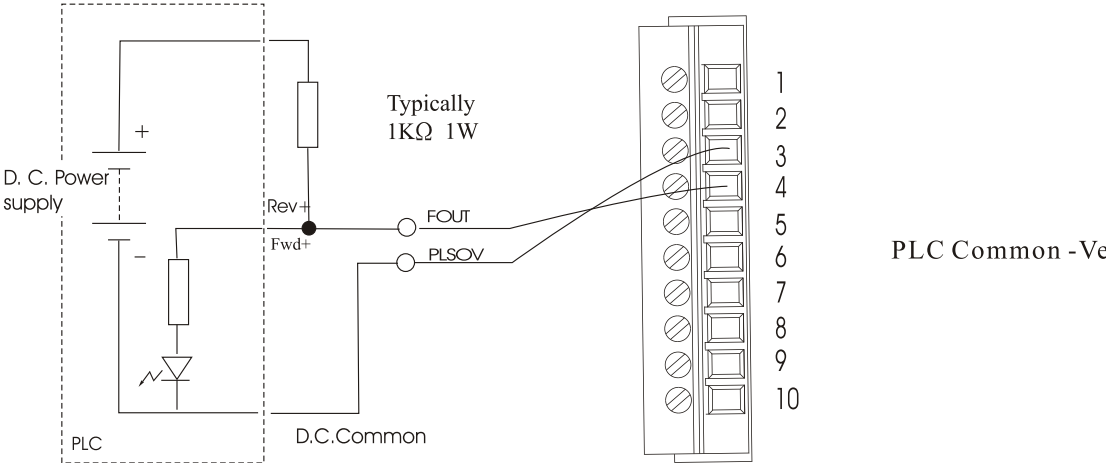
Open Collector (or Grounded Contact)



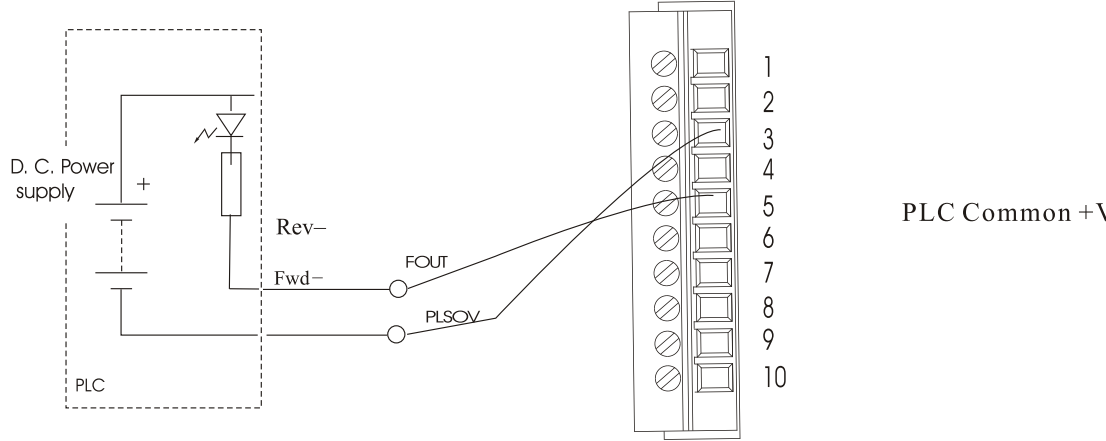
Volt-free contact

Voltage Signal or logic signal

G. PLC interface

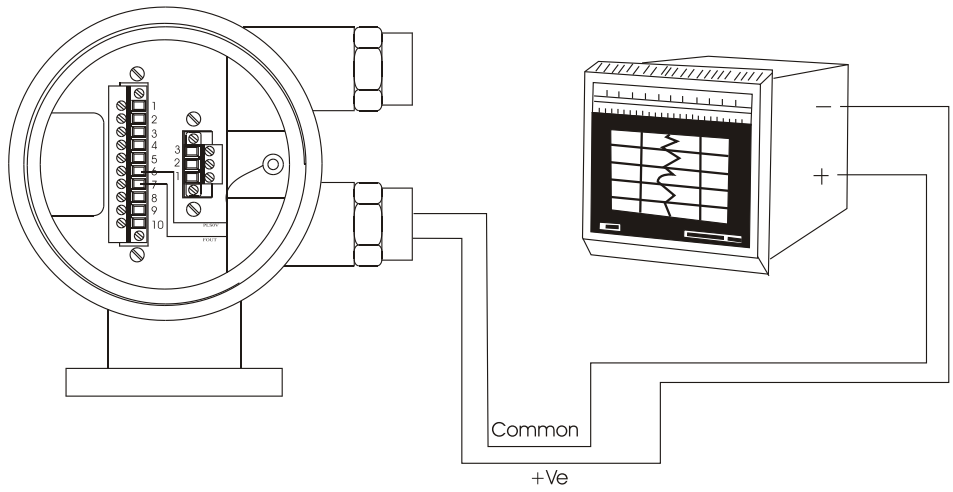


PLC Common -Ve



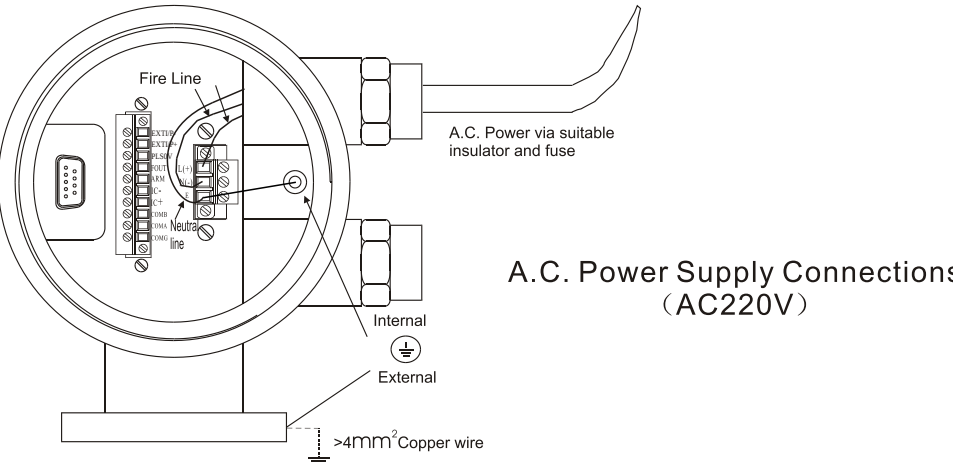
PLC Common +Ve

H. Current output connections



Current Output Connections: Standard

I. Power Supply connections

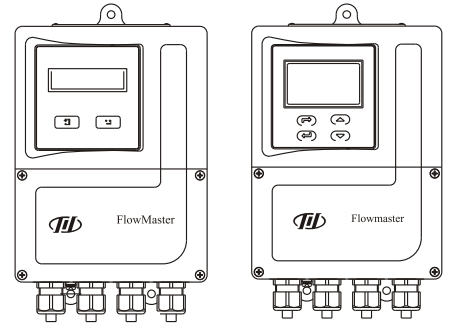


A.C. Power Supply Connections (AC220V)

Working parameter

1.1 Transmitter structure(1)

Electromagnetic flowmeter have two kinds of transmitter, one is two line LCD display with two magnetic operating switches, another is three line LCD display with four keypad, through which user can read parameters of flowmeter. User can read or modify measurement parameter and operation parameter of transmitter by SIC hand-held configuration device or PC through RS232 communication.



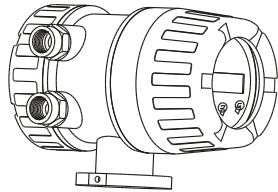
Two line LCD display Three line LCD display



When each electrical connection is correctly completed, the power supply can be switched on to avoid the damaging of flowmeter!

1.2 Transmitter structure(2)

Electromagnetic flowmeter uses two line LCD display and two magnetic operating switches, through which users can read measuring parameters of the flowmeter.



Before explosion-proof transmitter being installed in explosion-proof environment, users can use SIC hand-held configurators or PCs and through RS232 serial-port to watch and modify measuring parameters and working parameters of the flowmeter.



Do not use RS232 serial-port to avoid the explosion occur after transmitter being installed in explosion-proof environment!

2. Transmitter working parameter

2.1 (Take RS232 communication transmitter as an example)

For users using SIC hand-held configurators and PC operating menu structures, this FlowMaster sets the first level password as ‘user’ , permitting users to enter this level to regulate the parameters; sets the second passwordas ‘engineer’ ,permitting technical engineers to enter this level to regulate the parameters. Please not to modify user password in case of forgetting them and resulting in impossibility to operate the parameters.

The transmitter working parameter is shown as the following menu.

Main Menu	Sub-Menu	Third Menu	Parameters Description	Default
Read				
Read(1) Read menu	Read flow(1)>	-----	Flowrate	-----
	Read % (2)>	-----	Flowrate as the percentage of range	-----
	Read Fwd(3)>	-----	Accumulated total in forward totaliser	-----
	Read Rev(4)>	-----	Accumulated total in reverse totaliser	-----
	Read Net(5)>	-----	Net Total	-----
	Read Alm(6)>	-----	Alarm	-----
	Read Vel(7)>	-----	True flow Velocity	-----
	Read quit(q)>	-----	Quit and return to Main Menu	-----
Display options				
Disp(2) Display menu	Disp Mode(1)>	-----	(Disavailable)	2
	Disp Res(2)>	-----	Set number of decimal places required	3
	Disp quit(q)>	-----	Quit and return to Main Menu	-----
Passwords				
Login(3) Password menu	Login Login(1)>	-----	If password is right, level 2 could be available	engineer
	Login SetKey(2)>	-----	Change password	-----
	Login LogOut(3)>	-----	Quit login	-----

Main Menu	Sub-Menu	Third Menu	Parameters Description	Default
FLOW MEASUREMENT				
Flow(4) Flowmenu	Flow Ran(1)>	-----	Flow range (Corresponding Max value of 4-20mA output)	100
	Flow Unit(2)>	Flow Unit Ltr(1)>	Litres	0
		Flow Unit m^3(2)>	Cubic metre	1
		Flow Unit quit(q)>	Quit and return to Sub-Menu	-----
	Flow Mult(3)>	Flow Mult m(1)>	x 0.001	0
		Flow Mult c(2)>	x 0.01	0
		Flow Mult (3)>	x 1	1
		Flow Mult h(4)>	x 100	0
		Flow Mult k(5)>	x 1000	0
		Flow Mult M(6)>	x 1000000	0
		Flow Mult quit(q)>	Quit and return to Sub-Menu	-----
	Flow Time(4)>	Flow Time s(1)>	Seconds	0
		Flow Time Min(2)>	Minutes	0
		Flow Time Hr(3)>	Hours	1
		Flow Time Dy(4)>	Days	0
		Flow Time Wk(5)>	Weeks	0
		Flow Time quit(q)>	Quit and return to Sub-Menu	-----
	Flow rspns(5)>	Flow Rspns Rspns1(1)>	Nominal time constant	3
		Flow Rspns Rspns2(2)>	Response coefficient	0
		Flow Rspns Threes(3)>	Response limit	30
		Flow Rspns Value(4)>	Display response value	-----
		Flow Slow Time(5)>	Mutative rate time	1
		Flow Vary Limit(6)>	Mutative rate limit	30
		Flow Step Value(7)>	(Disavailable)	-----
		Flow Rspns quit(q)>	Quit and return to Sub-Menu	-----
	Flow Probe(6)>	Flow Probe Ins(1)>	(Disavailable)	-----
		Flow Probe Prof(2)>	(Disavailable)	-----
		Flow Probe quit(q)>	Quit and return to Sub-Menu	-----
	Flow %(7)>	-----	Display flowrate percentage	-----
	Flow Cutoff(8)>	-----	Flow velocity in mm/s below which all outputs are set to zero	5
	Flow quit(q)>	-----	Quit and return to Main Menu	-----

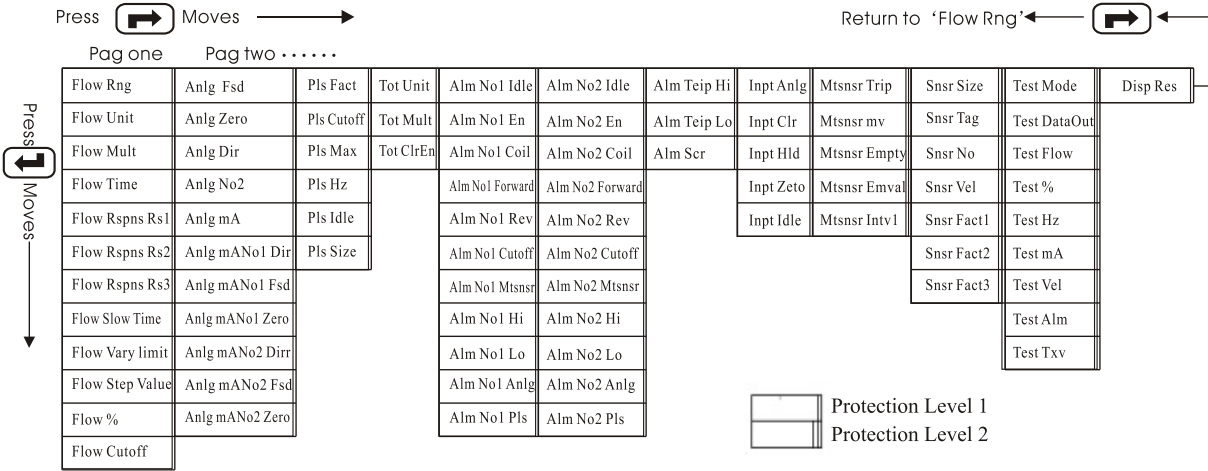
Main Menu	Sub-Menu	Third Menu	Parameters Description	Default
ANALOG OUTPUT				
Anlg(5) Analog menu	Anlg Fsd(1)>	-----	According to output current in mA for 100% flow range	20
	Anlg Zero(2)>	-----	According to output current in mA for 0% flow range	4
	Anlg Dir(3)>	Anlg Dir Fwd(1)>	Configure forward flow direction	1
		Anlg Dir Rev(2)>	Configure reverse flow direction	0
		Anlg Dir quit(q)>	Quit and return to Main Menu	-----
	Anlg No2(4)>	-----	Full scale flow range for second analogue range as percentage of main flow range (Disavailable)	100
	Anlg mA(5)>	-----	Present electric current output	-----
	Anlg mANo1(6)>	Anlg mANo1 Dir(1)>	Direction of No.1 electric current output	1
		Anlg mANo1 Fsd(2)>	Revised value of No.1 electric current output at full scale	0
		Anlg mANo1 Zero(3)>	Revised value of No.1 electric current output at zero	0
		Anlg mANo1 quit(q)>	Quit and return to Main Menu	-----
	Anlg mANo2(7)>	Anlg mANo2 Dir(1)>	Direction of No.2 electric current output	1
		Anlg mANo2 Fsd(2)>	Revised value of No.2 electric current output at full scale	0
		Anlg mANo2 Zero(3)>	Revised value of No.2 electric current output at zero	0
		Anlg mANo2 quit(q)>	Quit and return to Sub-Menu	-----
	Anlg quit(q)>	-----	Quit and return to Main Menu	-----
PULSE OUTPUT				
Pls(6) Pulse menu	Pls Fact(1)>	-----	Output pulses per flow volume unit	1
	Pls Cutoff(2)>	-----	Flow velocity in mm/s below which all outputs are set to zero (mm/s)	5
	Pls Max(3)>	-----	Max. output of frequency in Hz	800
	Pls Hz(4)>	-----	Present value output of frequency in Hz	-----
	Pls Idle(5)>	-----	Idle state for Pulse Output with no output pulse	0
	Pls Size(6)>	-----	Output pulse width in ms.(Set to 0 for square wave output)	0
	Pls quit(q)>	-----	Quit and return to Main Menu	-----
TOTALIZER				
Tot(7) Total flow menu	Tot Unit(1)>	Tot Unit Ltr(1)>	Litres	0
		Tot Unit m^3(2)>	Cubic metres	1
		Tot Unit quit(q)>	Quit and return toSub-Menu	-----
	Tot Mult(2)>	Tot Mult m(1)>	X 0.001	0
		Tot Mult c(2)>	X 0.01	0
		Tot Mult (3)>	X 1	1
		Tot Mult h(4)>	X 100	0
		Tot Mult k(5)>	X 1000	0
		Tot Mult M(6)>	X 1000000	0
		Tot Mult quit(q)>	Quit and return toSub-Menu	-----
	Tot ClrEn(3)>	-----	Enter "1" to enable totaliser reset function to be used from keyboard terminal	0
	Tot quit(q)>	-----	Quit and return to Main Menu	-----

Main Menu	Sub-Menu	Third Menu	Parameters Description	Default
ALARMS				
Alm(8) Alarm menu	Alm No1(1)>	Alm No1 Idle(1)>	Idle state for alarm output	1
		Alm No1 En(2)>	0=Alarm output disabled; 1=Alarm output enabled	1
		Alm No1 Coil(3)>	Alarm occurs for exciation coil	1
		Alm No1 Fwd(4)>	Alarm occurs for forward flow	0
		Alm No1 Rev(5)>	Alarm occurs for reverse flow	0
		Alm No1 Cutoff(6)>	Alarm occurs for Cutoff	0
		Alm No1 Mtsnsr(7)>	Alarm occurs for empty sensor	1
		Alm No1 Hi(8)>	Alarm occurs for Flow $\geq$ "Alm Trip Hi"	0
		Alm No1 Lo(9)>	Alarm occurs for Flow $\leq$ "Alm Trip Lo"	0
		Alm No1 Anlg(A)>	Alarm occurs for current slop over	0
		Alm No1 Pls(B)>	Alarm occurs for Pulse slop over	0
		Alm No1 quit(q)>	Quit and return to Sub-Menu	-----
	Alm No2(2)>	Alm No2 Idle(1)>	Idle state for alarm output	1
		Alm No2 En(2)>	0=Alarm output disabled; 1=Alarm output enabled	1
		Alm No2 Coil(3)>	Alarm occurs for exciation coil	1
		Alm No2 Fwd(4)>	Alarm occurs for forward flow	0
		Alm No2 Rev(5)>	Alarm occurs for reverse flow	0
		Alm No2 Cutoff(6)>	Alarm occurs for Cutoff	0
		Alm No2 Mtsnsr(7)>	Alarm occurs for empty sensor	1
		Alm No2 Hi(8)>	Alarm occurs for Flow $\geq$ "Alm Trip Hi"	0
		Alm No2 Lo(9)>	Alarm occurs for Flow $\leq$ "Alm Trip Lo"	0
		Alm No2 Anlg(A)>	Alarm occurs for current slop over	0
		Alm No2 Pls(B)>	Alarm occurs for Pulse slop over	0
		Alm No2 quit(q)>	Quit and return to Sub-Menu	-----
	Alm Trip(3)>	Alm Trip Hi(1)>	High flow alarm trip point as % of range	110
		Alm Trip Lo(2)>	Low flow alarm trip point as % of range	0
		Alm Trip Hyst(3)>	(Disavailable)	-----
		Alm Trip quit(q)>	Quit and return to Sub-Menu	-----
	Alm Scr(4)>	-----	Alarm Display Enable	1
	Alm quit(q)>	-----	Quit and return to Main Menu	-----

Main Menu	Sub-Menu	Third Menu	Parameters Description	Default
INPUT CONTACT				
Inpt(9) Input menu	Inpt Anlg(1)>	-----	switch to the second flow range	1
	Inpt Clr(2)>	-----	Reset totaliser	0
	Inpt Hld(3)>	-----	Hold flowmeter output value	0
	Inpt Zero(4)>	-----	Set flowrate output to zero	0
	Inpt Idle(5)>	-----	Configure external control status	0(EXTI/P+ act when short circuit) 1(EXTI/P- act when open circuit)
	Inpt quit(q)>	-----	Quit and return to Main Menu	-----
EMPTY PIPE DETECTION				
Mtsnsr(A) Empty pipe menu	Mtsnsr Trip(1)>	-----	(Disavailable)	50
	Mtsnsr mv(2)>	-----	(Disavailable)	-----
	Mtsnsr Empty(3)>	-----	Set resistance limit of Empty sensor	3000
	Mtsnsr EmVal(4)>	-----	Displayed Empty sensor real time resistance value	-----
	Mtsnsr Intvl(5)>	-----	Inspected time of Empty sensor in min	5
	Mtsnsr quit(q)>	-----	Quit and return to Main Menu	-----
SENSOR DATA AND CALIBRATION				
Snsr(B) Sensor menu	Snsr No(1)>	-----	Serial No	Requirement from customer
	Snsr Tag(2)>	-----	Tag No	0
	Snsr Size(3)>	-----	Nominal Diameter in mm	Requirement from customer
	Snsr Vel(4)>	-----	Current velocity in the sensor	-----
	Snsr Fact(5)>	Snsr Fact Lout(1)>	Slope	Fact1
		Snsr Fact Offset(2)>	Offset in mm/s at zero	Fact2
		Snsr Fact Wave(3)>	Type of exciation wave	0
		Snsr Fact Pro(4)>	(Disavailable)	1
		Snsr Fact quit(q)>	Quit and return to Sub-Menu	-----
	Snsr quit(q)>	-----	Quit and return to Main Menu	-----
SYSTEM TEST				
Test(C) Test menu	Test Mode(1)>	-----	If setting 1, the transmitter is in Test Mode	0
	Test DataOut(2)>	-----	Data output	0
	Test Flow(3)>	-----	Simulate input flow	100
	Test %(4)>	-----	Show Flowrate as a percentage	-----
	Test Hz(5)>	-----	Show Pulse Output frequency	-----
	Test mA(6)>	-----	Show Output frequency	-----
	Test Vel(7)>	-----	Show flow velocity in sensor	-----
	Test Alm(8)>	-----	Show currently active alarms	-----
	Test Txv(9)>	-----	(Disavailable)	-----
	Test quit(q)>	-----	Quit and return to Main Menu	-----

- Note: 1. '-----' = 'None'.
- Default value '1' means that this option is selected;
Default value '0' means that this option is not selected.
 - When watching menu from the display of transmitter, user should circularly operate through two magnetic operating switches according to the prompt from transmitter display.
 - Each item of menu is corresponding with a digit or a letter shown as keyword in the table above. User could enter the corresponding keyword to enter the menu step by step.

2.2 Working parameter of 3 line display transmitter



Security setting:

Note: the password of level 1 and level 2 is all a 5-digit security code. Only inputting password is right, can you enter the parameter setting interface.

Keypad version FlowMaster sets the first level password as ‘02041’ ,permitting users to enter this level to regulate the parameters; Sets the second password as ‘04121’ , permitting engineers to enter this level to regulate the parameters.

Enter password:

After entering the login interface, press  membrane switch to the digit needed to be revised, and then press either  or  switches to reach the required digit. Continue until all digits have been set, and press  switch to enter the complete code.

If an correct value is entered, display login success information, and then access to Parameter change interface. If an incorrect value is entered, display login fault information, and return to primal interface.

3. MODBUS(RS485)Communication protocol

3.1 MODBUS(RS485)Communication protocol

Flow Master electromagnetic flowmeter can support remote computer (PC, Industrial Control Computer, PLC) carrying out instrument system programming, data collection, field monitoring functions on it through its RS485 data interface. These functions include instantaneous flow rate, forward/reverse total flow, net flow, flow percentage, current, frequency, alarm, etc. Flowmeter has the following characters.

- RS485 data interface (differential, half-duplex)
- Electric energy pulse output, optical couple output of open collector
- Communication parameter can be configured, such as address, baud-rate, data formats.

3.2 MODBUS communication protocol introduce

MODBUS protocol is a master/slave point-to-point communication protocol, including RTU protocol and ASCII protocol. Our company selects ModBus RTU communication protocol which allows one master communicates with some slaves and is widely applied in many instruments. In the communication system, master is computer (PC, Industrial Control Computer, PLC) and slave is Flow Master electromagnetic flowmeter. This distributed communication system is allowed to connect up to 128 instruments and network length of 1200 meters. Communication method is master request and slave answer, that means master send request, slave receive and analyze data. If the data satisfies communication protocol, slave will make data answer.

In the communication between master and slave, the each frame of data sent by master includes the following information (Hexadecimal System).



Slave address (1 byte) is the device number of slave. Master identify slave according to slave address. It indicates the slave whose address is configured by customer will receive the information sent by master. Each slave must have a unique address code. Only slave address is corresponding to address code, can it make answer to master.

Command word (1 byte) is the function code sent by master. It tells slave which task should be done.

Information word (N bytes) includes data address, data length, data information which is communicated between master and slave.

Check word (2 bytes) is for checking whether data communication is wrong. It adopts cyclic redundancy check code 16(CRC16).

Notes: data address and data length is 2 bytes, data information is N bytes. The operation of reading point (holding register) can be carried out through communication command. Holding register is 16 bit (2 bytes) and Big-Endian. The data area is expressed by word address in register. Master should send word (word address) as command to register. The communication is mainly in word for Modbus communication system. Please refer to the example for details. This instrument supports the communication only in word address and not in byte address.

3.3 Application of digital interface

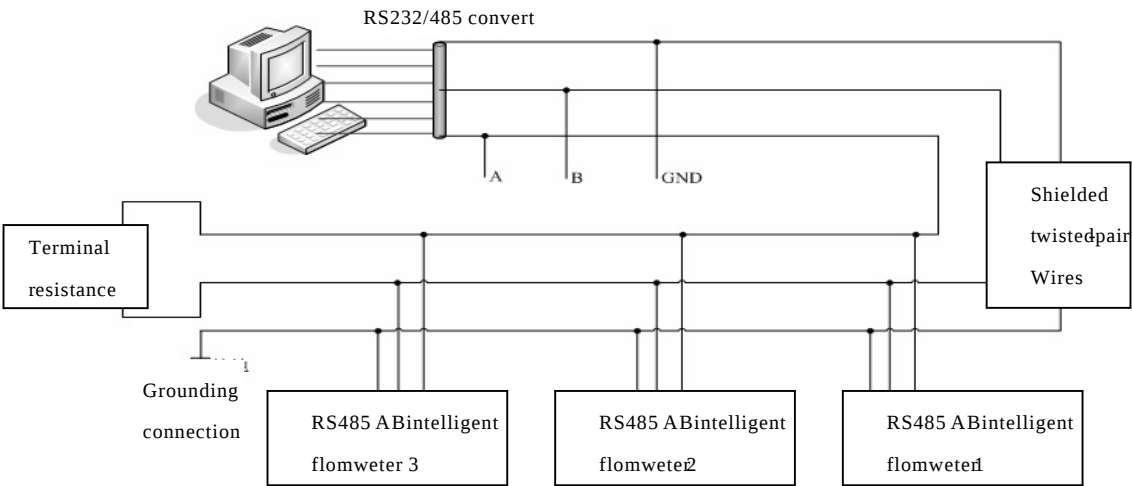
(1). Configuration of communication parameter: the following parameters can be configured through the keypad of instrument.

Instrument address: set the address number of slaver (instrument) in communication network. Address number could be 1~247. (Default value is 1)

Communication speed: set the communication speed of communication network. 4800, 9600, 19200, 38400 bps are available. (Default value is 38400 bps)

Data format: the data format is 1 start digit, 8 data digit, 1 stop digit and not parity digit.

(2). Network connection: connect the wires of instrument (RS485: A+, B-)



Notes: It's suggested choosing shielded twisted-pair wires as connection wire of which both terminal should be connected to earth in order to reduce the jamming from jobsite. Application of terminal resistance ($Z_0=120\Omega$) could reduce reflecting jamming. It's suggested to connect under the condition of quick communication speed (>9600) or long communication distance.

(3). Test the communcation by software

Connect communication interface (RS232/485), communication wire and instrument, run the test software "ModScan / Modbus Poll" and then set correct parameters. The communication (R232/485) can work well including instrument programe and data collection.

(4). Communication massage format

Command 03H: read N bytes

Master request: Address Command Data address Data length Check code

Slave response: Address Command Data length Date information Check code

(5). Example:

Question 1: Read flow velocity and flow flux of flowmeter for which the address is No. 2.
Method: Select correct parameters according to Address List and Command No. 3 and use communication method in word address.
Master request: 02H 03H 00H 00H 00H 04H 44H 3AH
Slave response: 02H 03H 08H BYTE1 BYTE2 BYTE3 BYTE4 BYTE5 ... CRC16
Explain: From the Address List, the address of current parameter WORD is 0, viz. 0000H. The data which will be read is 4x2 BYTE, viz. data length is 0004H. 44H 3AH is CRC16 code.
The response data is BYTE1, BYTE2, BYTE3, BYTE4 for flow velocity, and BYTE5, BYTE6, BYTE7, BYTE8 for flow flux. The data is totally 8 BYTES which meet the data criterion of IEEE-754 floating point data format.

Question 2: Set flow range of flowmeter for which the address is No. 1
Method: After calculating, the flow range is 200.000 (43H 48H 00H 00H), and select correct parameters according to Address List.
Master request: 01H 10H 00H 14H 00H 02H 04H 00H 00H 43H 48H F0H C5H
Slave response: 01H 10H 00H 14H 00H 02H 01H CCH
Explain: From the the Address List, the address of flow range is 0014H. The data total WORD length is 0002H (BYTE length is 04H). The inputted data is 43480000H. F0H C5H is CRC16 code.

(6). IEEE-754 data format

Float (floating-point) conforms to data criterion of IEEE-754, and have 7 effective digits in decimal numera. Float type data is four bytes (32 bits), and format is as shown blow in internal memory.

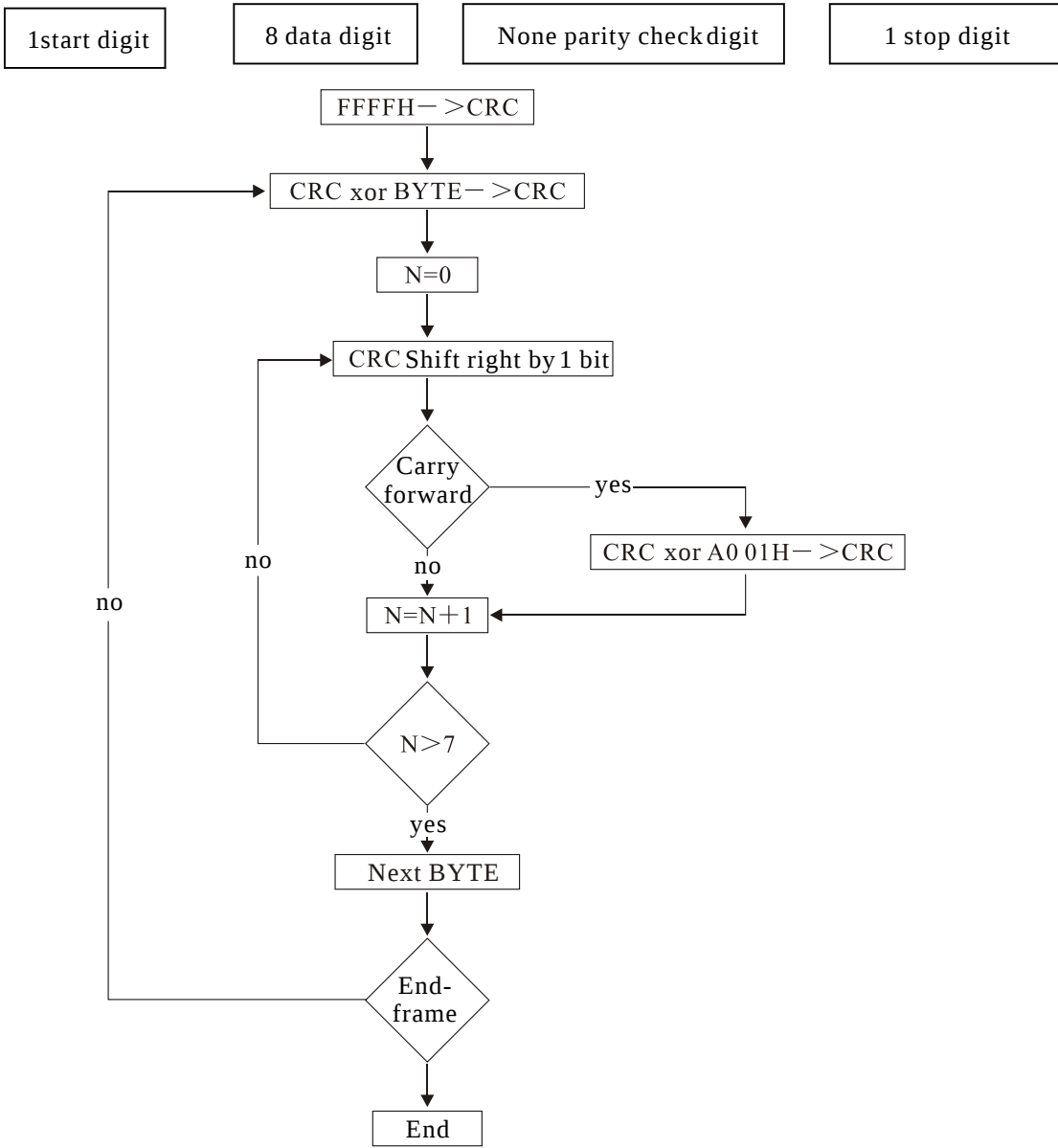
Byte address	+0	+1	+2	+3
Floating - point	S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

In above list, S is symbol for which "0" means positive and "1" means negative. E is order code which is 8 bits and stored by 2 bytes.
Notes: order code E equals to index based 2 plus 127 offset so that it can be avoided that the order code become negative value. The normal value of order code E is 1~254, and the index is -126~+127 actually. M is the decimal fraction of mantissa. M is 23 bits and stored by 3 bytes.
And the integer of mantissa is always 1 which is hidden existing and isn't stored. The radix point exists after the hidden integer of mantissa "1". The value of a floating point number is $(-1)^S \times 2^{E-127} \times (1.M)$.
Example: when master read flow velocity data, the flow address is 0 (0000H) and length is 2 (0002H) in the Address List.
Master request: 01H 03H 00 00H 00 02H C4 0BH
Slave response: 01H 03H 04H 00 00 C1 48H ABH 95H
00 00 C1 48 is communication format of current flow velocity, value is -12.5 (viz. C1 48 00 00H in IEEE-754 format). ABH is CRC16 low and 95H is CRC16 high.

(7). Check code calculation

The Cyclic Redundancy Check code 16 (CRC 16) can be calculated according to the following procedures. BYTE is data code of each information frame, from start to finish (Remark: CRC 16 low in front, and high in post).
Example:
Master request: 01H 03H 00 00H 00 02H C4 0BH
Slave response: 01H 03H 04H 00 00 C1 48H ABH 95H
Explain: In order to reading the next 4 bytes data of the flow address is from 0 (viz. flow velocity) on instrument No. 1, the check code of information frame is C4H 0BH which is sent from master, and address, command, data length and information code reposed by slave is 00 00 C1 48H. Exchanging the position of high and low registers, the flow velocity will be -12.5 by calculated according to data criterion of IEE-754.

(8). Character transfers



Appendix Address list

Flow Meter (MODBUS) ©					
SIC Protocol Address		Name of variable	Operation	Character	Function explain
40001	0x0000	Read Vel	c, r	Floating-point	Flow velocity
40003	0x0004	Read Flow	c, r	Floating-point	Flowrate
40005	0x0008	Read Fwd_F	c, r, w	Floating-point	Decimal fraction of Forward Accumulated Total
40007	0x000C	Read Fwd_L	c, r, w	Long	Long integer of Forward Accumulated Total
40009	0x0010	Read Rev_F	c, r, w	Floating-point	Decimal fraction of Reverse Accumulated Total
40011	0x0014	Read Rev_L	c, r, w	Long	Long integer of Reverse Accumulated Total
40013	0x0018	Read Net_F	c, r	Floating-point	Decimal fraction of Net Total
40015	0x001C	Read Net_L	c, r	Long	Long integer of Net Total
40017	0x0020	Read Per	c, r	Floating-point	Flowrate as the percentage of range
40019	0x0024	Read Cur	c, r	Floating-point	Current
40021	0x0028	Read Pul	c, r	Floating-point	Frequency
40023	0x002C	Read MtEm	c, r	Floating-point	Resistance
40025	0x0030	Read Rspn	c, r	Floating-point	Changing rate
40027	0x0034	Start address of changed parameter	c, r	Integer	Start address of changed parameter
40028	0x0036	Length of changed parameter	c, r	Integer	Length of changed parameter
40029	0x0038	Read Alm	c, r	Integer	Alarm
40030	0x003A	Snsr Status	c, r, w	Integer	Flowmeter status
40031	0x003C	Flow Rng	r / w	Floating-point	Flow range
40033	0x0040	Anlg No2	r / w	Floating-point	Second flow range
40035	0x0044	Test Flow	r / w	Floating-point	Test flow value
40037	0x0048	Anlg Fsd	r / w	Floating-point	Electric current output at full scale

40039	0x004C	Anlg Zero	r / w	Floating-point	Electric current output at zero
40041	0x0050	Pls Fact	r / w	Floating-point	Frequency factor
40043	0x0054	Pls Max	r / w	Floating-point	Max. output of frequency
40045	0x0058	Snsr Fact Lout	r / w	Floating-point	Factor 1
40047	0x005C	Snsr Fact offset	r / w	Floating-point	Factor 2
40049	0x0060	Flow Probe Ins	r / w	Floating-point	Insert factor
40051	0x0064	Flow Probe Prof	r / w	Floating-point	
40053	0x0068	Trm Vf	r / w	Floating-point	Magnify multiple
40055	0x006C	Trm Vz	r / w	Floating-point	Zero excursion
40057	0x0070	Flow Rspns Thr	r / w	Integer	Damp threshold of flowrate
40058	0x0072	Flow Vary Limit	r / w	Integer	Vary threshold of flowrate
40059	0x0074	Flow Step Value	r / w	Integer	Flow step value
40060	0x0076	Snsr Size	r / w	Integer	Nominal size of sensor
40061	0x0078	Pls Size	r / w	Integer	Frequency width
40062	0x007A	Alm TripHi	r / w	Integer	High flow alarm trip point
40063	0x007C	Alm TripLo	r / w	Integer	Low flow alarm trip point
40064	0x007E	Alm Hyst	r / w	Integer	Return receipt space
40065	0x0080	Mtsnsr Empty	r / w	Integer	Setting value of empty pipe
40066	0x0082	Coil Save	r / w	Integer	Excitation protection (coil save)
40067	0x0084	PassWord	w	Integer	Password
40068	0x0086	Anlg mANo1 Fsd	r / w	Integer	Revised value of No. 1 electric current output at full scale
40069	0x0088	Anlg mANo1 Zero	r / w	Integer	Revised value of No. 1 electric current output at zero
40070	0x008A	Anlg mANo2 Fsd	r / w	Integer	Revised value of No. 2 electric current output at full scale
40071	0x008C	Anlg mANo2 Zero	r / w	Integer	Revised value of No. 2 electric current output at zero
40072	0x008E	Snsr No	r / w	Character string	Serial number of flowmeter

40077	0x0098	Disp Res	r / w	Byte	Digit of radix point
	0x0099	FlowRspnsRspns 1	r / w	Byte	Damp coefficient 1
40078	0x009A	FlowRspnsRspns 2	r / w	Byte	Damp coefficient 2
	0x009B	Flow Cutoff	r / w	Byte	Flow velocity in mm/s below which all outputs are set to zero
40079	0x009C	Mtsnsr Intvl	r / w	Byte	Interval inspected time of empty pipe
	0x009D	Snsr Tag	r / w	Byte	Tag number
40080	0x009E	Snsr Fact Wave	r / w	Byte	Wave selection
	0x009F	Flow Slow Time	r / w	Byte	Flow velocity response time
40081	0x00A0	Net Meter No	r / w	Byte	Network number
	0x00A1	Baud Rate	r / w	Byte	Baud rate
40082	0x00A2	Current Alm	r / w	Byte	4-20mA alarm ouptut
	0x00A3	Time Set H	r / w	Byte	(Disavailable)
40083	0x00A4	Time Set M	r / w	Byte	(Disavailable)
	0x00A5	BitBlock1	r / w	Byte	Bit-block 1
40084	0x00A6	BitBlock2	r / w	Byte	Bit-block 2
	0x00A7	BitBlock3	r / w	Byte	Bit-block 3
40085	0x00A8	BitBlock4	r / w	Byte	Bit-block 4
	0x00A9	BitBlock5	r / w	Byte	Bit-block 5
40086	0x00AA	BitBlock6	r / w	Byte	Bit-block 6
	0x00AB	BitBlock7	r / w	Byte	Bit-block 7
40087	0x00AC	BitBlock8	r / w	Byte	Bit-block 8

Snsr Status (sensor status)

LSB.0	Port Flag	c, r	Bit	Port status
LSB.1	RESET Flag	c, r	Bit	Program reset flag
LSB.2	Ram Flag	c, r	Bit	Memory status flag
LSB.3	EEPROM Flag	c, r	Bit	EEPROM status flag
LSB.4	AD7715_SigErrFlag	c, r	Bit	AD7715 status flag
LSB.5	Mtsnsr Cr1 Flag	c, r	Bit	Empty pipe control flag
LSB.6	Debug Reset	r / w	Bit	Parameter reset
LSB.7	Test Data Out	r / w	Bit	Data output test
MSB.0	Tot Clr	r / w	Bit	Reset totallser
MSB.1	LOCAL OPENA	r / w	Bit	Local operation enable

Read Alm(Alarm status)

LSB.0	Mtsnsr Alm	c, r	Bit	Alarm occurs for empty pipe
LSB.1	Fwd Alm	c, r	Bit	Alarm occurs for forward flowrate
LSB.2	Rev Alm	c, r	Bit	Alarm occurs forreverse flowrate
LSB.3	Cut Alm	c, r	Bit	Alarm occurs for Cutoff
LSB.4	Hi Alm	c, r	Bit	Alam occurs for Flow $\geq$ "Hi Alm"
LSB.5	Lo Alm	c, r	Bit	Alarm occurs for Flow $\leq$ "Lo Alm"
LSB.6	Anlg Alm	c, r	Bit	Alarm occurs for electric current slop over
LSB.7	Pls Alm	c, r	Bit	Alarm occurs for frequency slop over
MSB.0	Coil Alm	c, r	Bit	Alarm occurs for excitation coil

BitBlock1				
0 bit	Flow Unit Ltr	r / w	Bit	Liters
1 bit	Flow Unit M3	r / w	Bit	Cubic metres
2 bit	Flow Unit Igal	r / w	Bit	Disavailable
3 bit	Flow Unit Ugal	r / w	Bit	Disavailable
4 bit	Flow Unit ft3	r / w	Bit	Disavailable
5 bit	Flow Mult m	r / w	Bit	x0.001
6 bit	Flow Mult c	r / w	Bit	x0.01
7 bit	Flow Mult	r / w	Bit	x1
BitBlock2				
0 bit	Flow Mult h	r / w	Bit	x100
1 bit	Flow Mult k	r / w	Bit	x1000
2 bit	Flow Mult M1	r / w	Bit	x1000000
3 bit	Flow Time S	r / w	Bit	Seconds
4 bit	Flow Time Min	r / w	Bit	Minutes
5 bit	Flow Time Hr	r / w	Bit	Hours
6 bit	Flow Time Dy	r / w	Bit	Days
7 bit	Flow Time Wk	r / w	Bit	Weeks
BitBlock3				

0 bit	Anlg Dir Fwd	r / w	Bit	Calculate electric current direction is the same with reference direction
1 bit	Anlg Dir Rev	r / w	Bit	Calculate electric current direction is the reverse with reference direction
2 bit	Anlg mANo1 Dir	r / w	Bit	Disavailable
3 bit	Anlg mANo2 Dir	r / w	Bit	Disavailable
4 bit	Pls Idle	r / w	Bit	Idle status of frequency output
5 bit	Tot Unit Ltr	r / w	Bit	Liters
6 bit	Tot Unit M3	r / w	Bit	Cubic metres
7 bit	Tot Unit Igal	r / w	Bit	Disavailable
BitBlock4				
0 bit	Tot Unit Ugal	r / w	Bit	Disavailable
1 bit	Tot Unit ft3	r / w	Bit	Disavailable
2 bit	Tot Mult m	r / w	Bit	x0.001
3 bit	Tot Mult c	r / w	Bit	x0.01
4 bit	Tot Mult	r / w	Bit	x1
5 bit	Tot Mult h	r / w	Bit	x100
6 bit	Tot Mult k	r / w	Bit	x1000
7 bit	Tot Mult M1	r / w	Bit	x1000000
BitBlock5				
0 bit	Tot Clr En	r / w	Bit	Totallser reset enable
1 bit	Alm No1 Idle	r / w	Bit	Idle status for No 1 alarm output
2 bit	Alm No1 En	r / w	Bit	0= No 1 Alarm output disabled; 1= No 1 Alarm output enabled
3 bit	Alm No1 Coil	r / w	Bit	No 1 Alarm occurs for excitation coil
4 bit	Alm No1 Fwd	r / w	Bit	No 1 Alarm occurs for forward flow
5 bit	Alm No1 Rev	r / w	Bit	No 1 Alarm occurs for reverse flow
6 bit	Alm No1 Cutoff	r / w	Bit	No 1 Alarm occurs for Cutoff
7 bit	Alm No1 Mtsnsr	r / w	Bit	No 1 Alarm occurs for empty pipe

BitBlock6				
0 bit	Alm No1 Hi	r / w	Bit	Alarm occurs for Flow $\geq$ "Alm No 1 Hi"
1 bit	Alm No1 Lo	r / w	Bit	Alarm occurs for Flow $\leq$ "Alm No 1 Lo"
2 bit	Alm No1 Anlg	r / w	Bit	No 1 Alarm occurs for current slop over
3 bit	Alm No1 Pls	r / w	Bit	No 1 Alarm occurs for pulse slop over
4 bit	Alm No2 Idle	r / w	Bit	Idle status for No 2 alarm output
5 bit	Alm No2 En	r / w	Bit	0= No 2 Alarm output disabled; 1= No 2 Alarm output enabled
6 bit	Alm No2 Coil	r / w	Bit	No 2 Alarm occurs for excitation coil
7 bit	Alm No2 Fwd	r / w	Bit	No 2 Alarm occurs for forward flow
BitBlock7				
0 bit	Alm No2 Rev	r / w	Bit	No 2 Alarm occurs for reverse flow
1 bit	Alm No2 Cutoff	r / w	Bit	No 2 Alarm occurs for Cutoff
2 bit	Alm No2 Mtsnsr	r / w	Bit	No 2 Alarm occurs for empty pipe
3 bit	Alm No2 Hi	r / w	Bit	Alarm occurs for Flow $\geq$ "Alm No 2 Hi"
4 bit	Alm No2 Lo	r / w	Bit	Alarm occurs for Flow $\leq$ "Alm No 2 Lo"
5 bit	Alm No2 Anlg	r / w	Bit	No 1 Alarm occurs for current slop over
6 bit	Alm No2 Pls	r / w	Bit	No 1 Alarm occurs for pulse slop over
7 bit	Alm Scr	r / w	Bit	Alarm display
BitBlock8				
0 bit	Inpt Anlg	r / w	Bit	Switch Flow range
1 bit	Inpt Clr	r / w	Bit	Reset totallser
2 bit	Inpt Hld	r / w	Bit	Flowrate holding
3 bit	Inpt Zero	r / w	Bit	Flowrate is zero
4 bit	Inpt Idle	r / w	Bit	Disavailable
5 bit	Test Mode	r / w	Bit	Test mode
6 bit	Current Alm	r / w	Bit	Alarm output

Notes:

1) In Address list, the information are two types. One is readable and writable (t/w) which can be programmed; The other one is read-only (c,r) which can be only collected.
2) The data length which is visited at one time should be within 122. (That means byte length is within 244 Bytes.
In order to visit a great lot of data, the address of save register is assigned according to data type.
Note: When revising a parameter, it's necessary to revise corresponding address, length and data value.

3) Parameter setting of communication control (address: 40081 MSB)

Communication control	Communication parameter setting
1 7« 4	Baud rate selection
	4800
	9600
	19200
	38400

Note: Default baud rate is 38400bps.

Appendix:

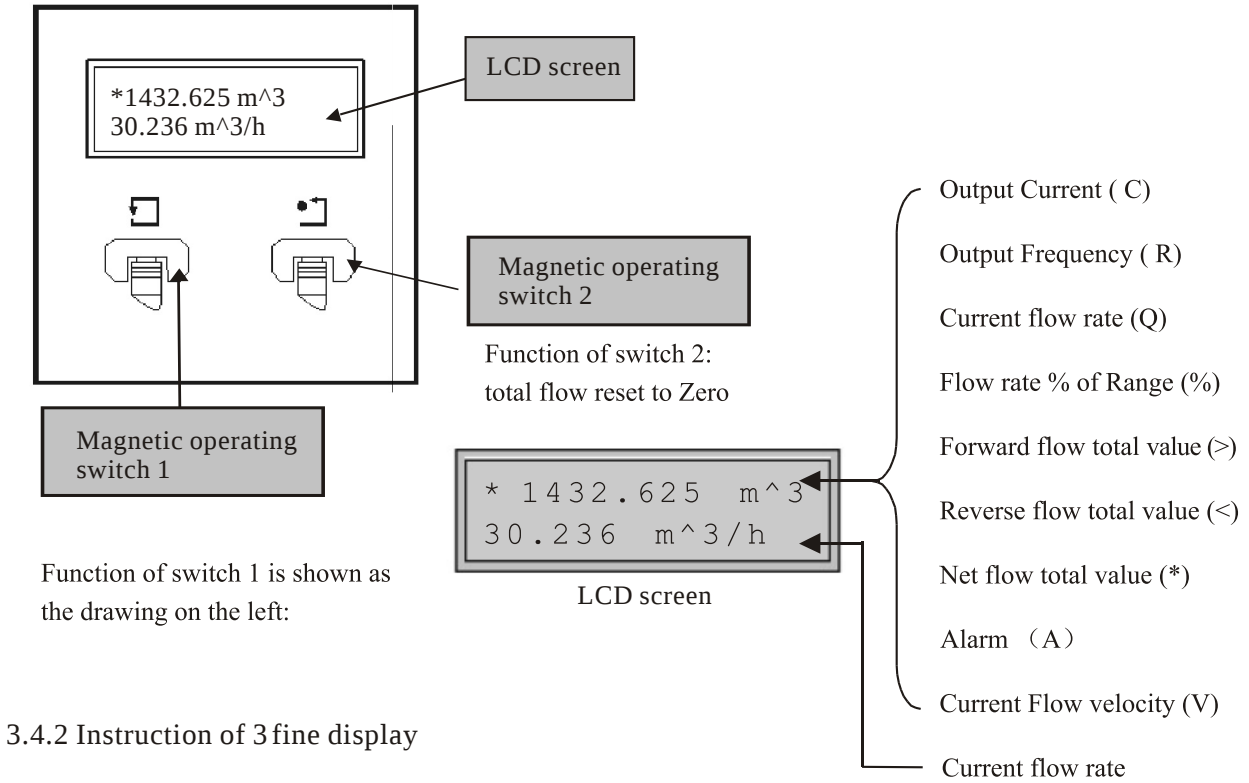
The operation of "Three line display with Modbus(485)" and "Three line display with RS232" is almost the same. Please refer to the Operation Manual of "Three line display with RS232 communication" for relative operation can refer to. The difference of them is as shown blow.

Three line display with Modbus(485) communication	Three line display with RS232 communication
Set network address by menu "Meter No" (default value is 1)	None
Set baud rate by menu "Baud Rate"	None
Press both lower left keypad and higher right keypad to quit paramant setting interface and into main interface.	Press lower left keypad and hold on 5 seconds to quit paramant setting interface and into main interface.
Reset paramant of circuit baord by menu "Debug Reset ":"When set "Debug Reset " to "1", all the parameter will be reset.	None
"LOCAL OPENA " is local operation enable bit. The value "1" of such bit means "operation is not valide" and value "0" means "operation is valide ". In order to keep the consistency of parameters, we commend to set "LOCAL OPENA" to "1" for Modbus (485) communication.	None

Passwords are "02041" and "04121" as two levels. (Customer only).
Enter menu "Baud Rate" by inputing password "02041" or "04121".
Enter menu "Reset" and "Meter No" by inputing password "04121"

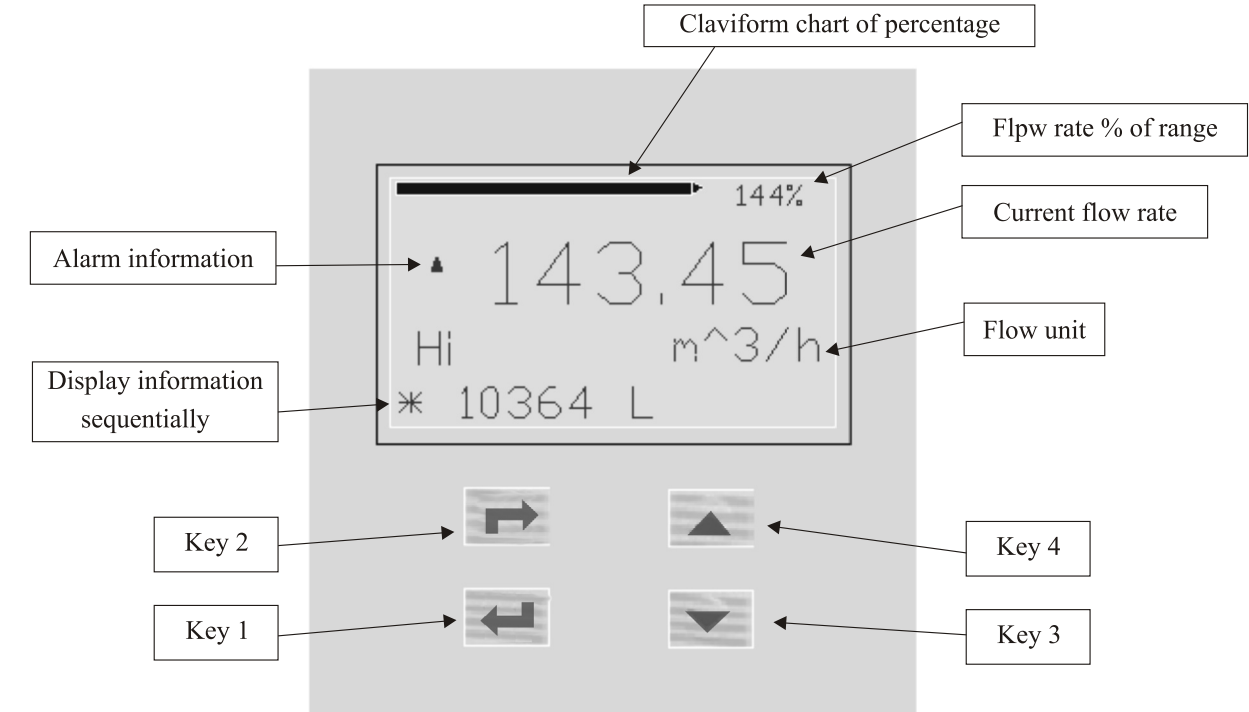
3.4 Magnetic operating switch on LCD screen

3.4.1 Two line LCD display operating



3.4.2 Instruction of 3 fine display

A. Reading interface



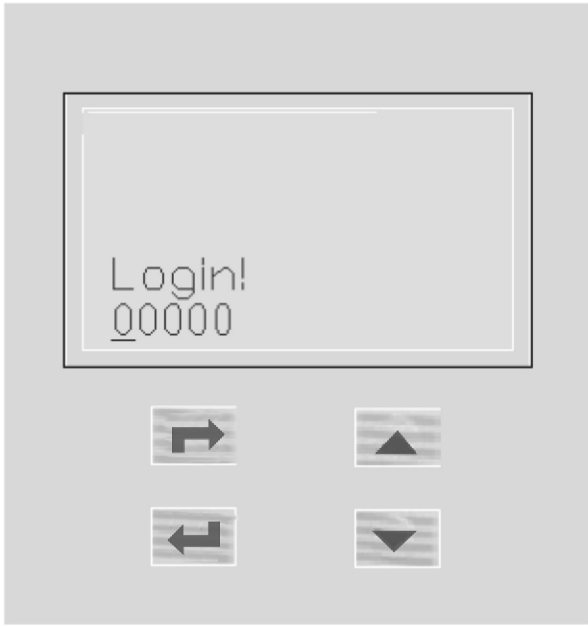
Press  switch, following items are displayed sequentially:

- > Forward flow total value
- < Reverse flow total value
- * Net flow total value
- A Active alarms (f more than one alarm is present, all alarms are displayed sequentially.
Display ‘None’ when there is not any alarm.)
- V Current flow velocity
- % Flow rate % of range

Press  switch to reset the Flow total value.

Note: Only parameter of “Tot Clr En” be set to “1” , can the Flow total value be reset.
(The next introduction will explain the parameter revising.)

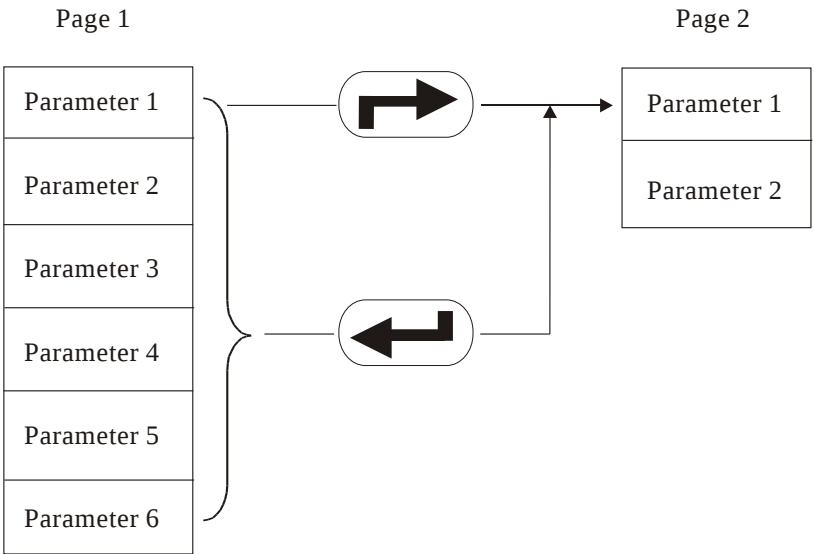
Press  switch to enter login interface as shown on the rightside:



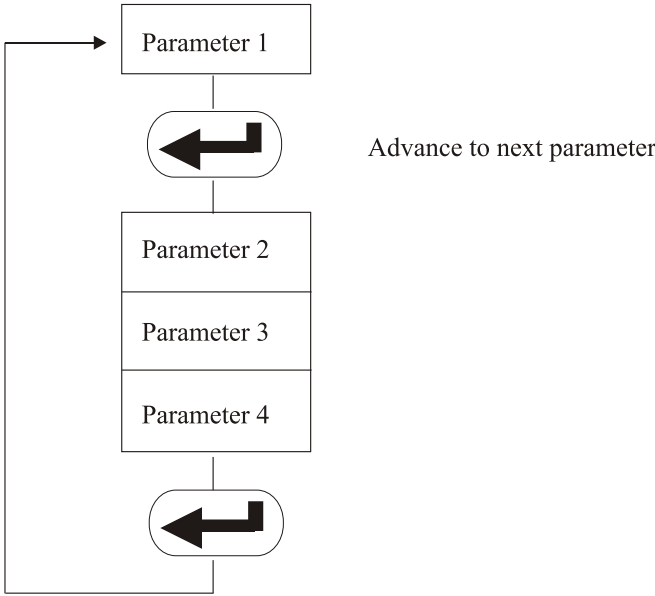
Only input correct password, can the parameter be changed in the 'Parameter interface'. If the password is wrong, the displayed interface will return to started status. (The next introduction will explain the parameter revising.)

3.5 The using method of switch on transmitter

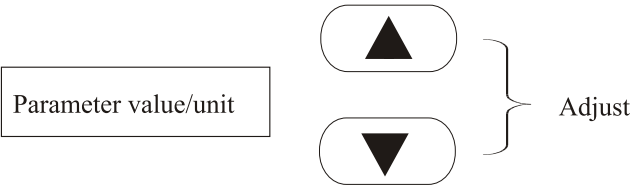
3.5.1 Advancing to next page:



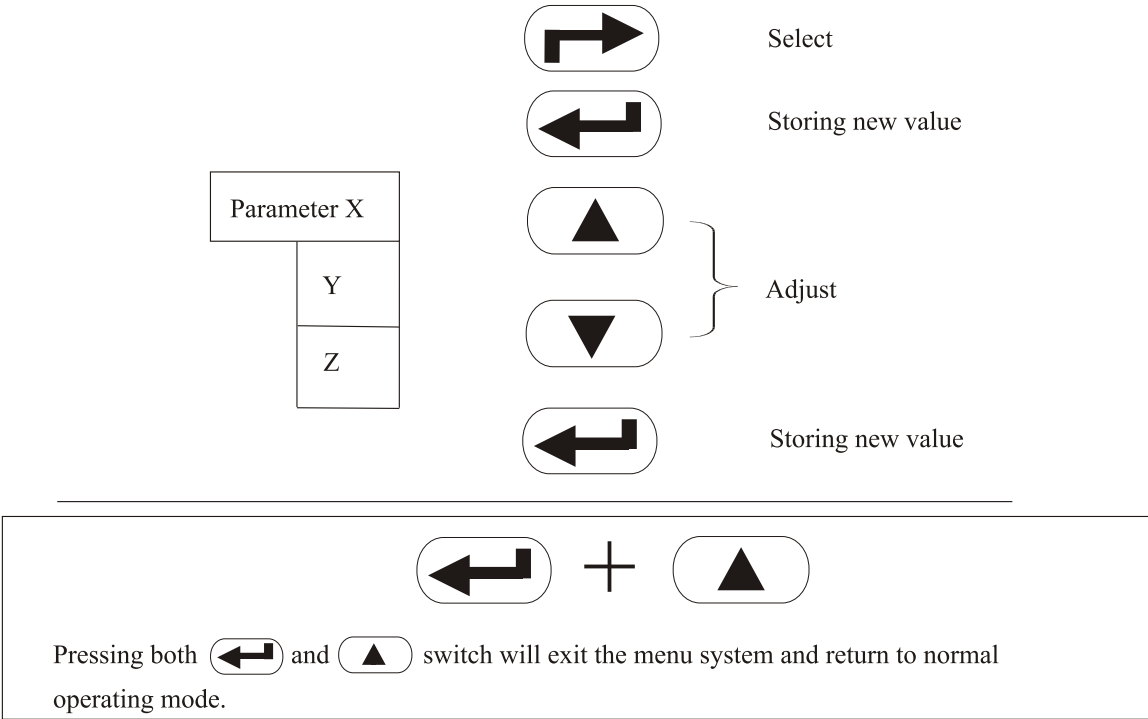
3.5.2 Moving between parameters in the same page



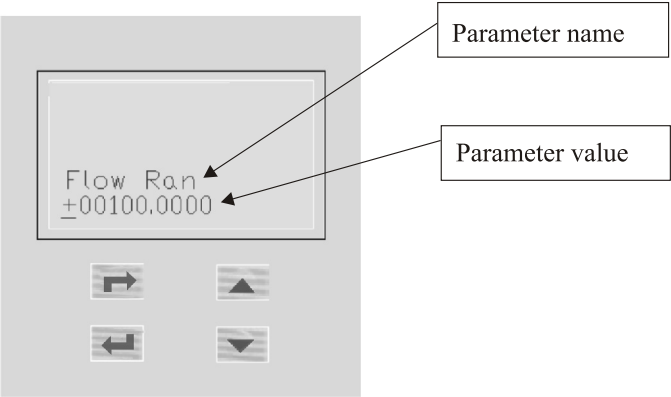
3.5.3 Adjusting and Storing a parameter value



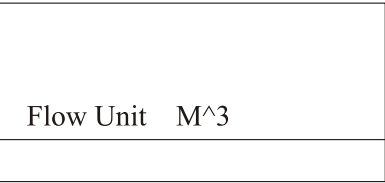
3.5.4 Selecting and accepting the selected parameter



Parameter configuration



(1). When a parameter is selected, which holds one or more optional items, e.g. ‘Flow Unit’ parameterb which can be litres, cubic metres etc., Proceed as follows to change the units:



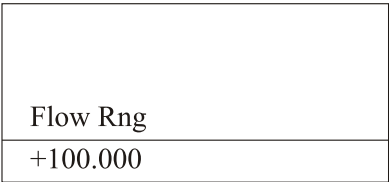
'Flow Unit' M^3 parameter selected

Press or switches to select the units.

Note: the existing units will flash when pressing or switches.

Pressing switch will enter the newly selected units.
This type of action is similar for parameter units..

(2). Changing parameter values e.g. The value of ‘Flow Rng’ parameter.



Firstly, move prompt to the behind of ‘Flow Rng’ . The cursor under the first digit or letter will flash, that means this digit/letter can be changed when pressing or switches at the first time. And then change the value with the or switches. Press switch to move cursor to the next digit/letter and change it. Lastly, pressing switch will enter the final selection.

3.5.5 Three line display with infrared ray keypad operating
The operation is almost the same between three line display with infrared ray keypad and with normal keypad. Please refer to the manual for the details of operation.

The function of infrared ray keypad is the same with normal keypad

The function of infrared ray keypad is the same with normal keypad

The function of infrared ray keypad is the same with

The function of infrared ray keypad is the same with

The difference between them is that a new function (Lock keypad) is added for the transmitter with infrared ray keypad in order to avoiding the impact interference from strong light source. Lock keypad / Unlock keypad: press and once within 5 seconds, display “Lock” means the keypad is locked successfully and display “Unlock” means the keypad is unlocked. When power on, the flowmeter is locked as default setting. User must unlock the flowmeter before change the parameters or status of flowmeter. After finishing the change of parameters, press and simultaneously to turn back to main interface. The keypad is locked when turning back to main interface. If user doesn't make any operation when the display is the interface of changing parameters for more than 30 seconds, the flowmeter will turn back to main interface automatically and then the keypad is locked.

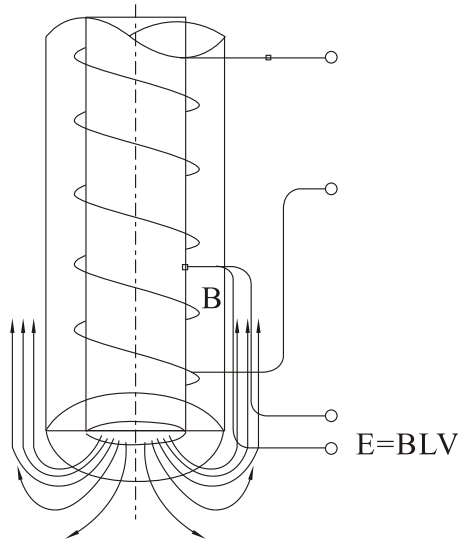
Part 2 Insertion-type Electromagnetic Flowmeter

Product summarize

1. Product introduction

MFP insertion-type electromagnetic flowmeter is a newkind of flow meter developing from pipe-type electromagnetic flowmeter.It not only remains the advantages of pipe-type electromagnetic flowmeter, but also avoids the defect of pipe-type electromagnetic flowmeter which is hard to be installed in big size pipe and costs highexpenses. Basing on NIKURADS principle, it could get the volume flow of liquid by measuring average flow velocity. Specially,adopting the technology of drilling hole and installing flow meter on pipe under pressure, insertion-type electromagnetic flowmeter can be installed on cast iron pipe or cement pipe in the condition of not cutting off the flow.The successful development of insertion-type flowmeter provides a new way to measure flow. Different from the normal electromagnetic flowmeter, sensor of insertion-type electromagnetic flowmeter has external magnetic field and the electrode is installed at the top or both sides of sensor as shown in the following electromagnetic flowmeterprinciple picture. Be attention that liquid and thickness of magnetic field boundary layer can affect the inductive signal and reduce the linear of measured value.

For MFP insertion-type electromagnetic flowmeter, the conductive liquid inside pipeline is the conductor moving in magnetic field. The distance between two electrodes is conductor'slength (L).



The inductive voltage is directly proportional to the average flow velocity.The liquid flow inside pipeline can be calculated through formula (1).

$$Q=\pi D^2U/4KBL$$

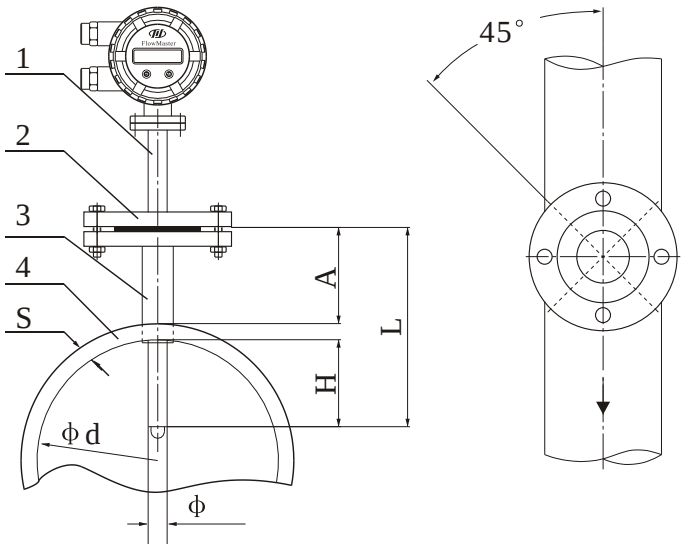
D: Inner diameter of the measuring pipe U: Inductive voltage B: Magnetic induction intensity

K: Instrument invariable factor concerned with magnetic field distribution

Dimensions

1.1 Sensor dimensions

The mounting of sensor is flange connection. Firstly, calculate the length of mounting port connection pipe according to pipe diameter. Secondly, drill hole on pipe and weld mounting port to the hole. Be sure the position of mounting port screw hole and inserting deepness is correct, and the direction of sensor detector is the same with flow direction when welding. The connection pipe of mounting port couldn't exceed the internal wall of measured pipe. Be sure this internal wall is smooth. The detailed dimension and material specification refers the following diagram.

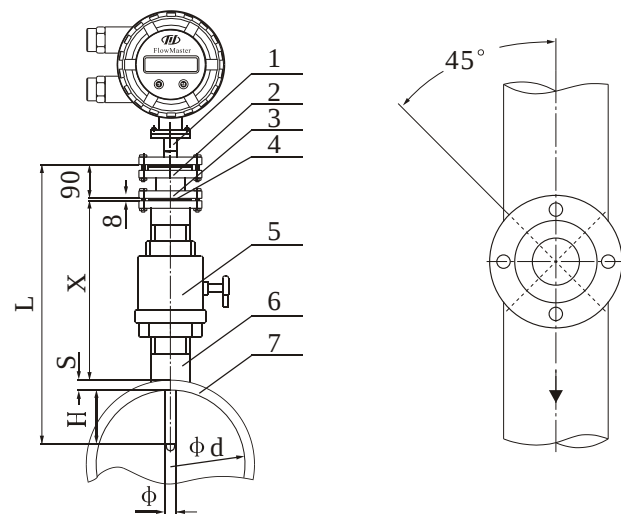


(1) DN200mm、DN300 mm、DN400mm (Install instrument not under pressure)

Item	Name/normal size (mm)	DN200	DN300	DN400
1	Sensor(L×Φ)	182×Φ38		
2	Flange	DN40 1.6MPa		
3	Connection pipe	Φ45		
4	Measured pipe	Φd×s		

Installing principle: be sure inserting depth is H= (d-2s) 10%, viz. A=182-(h+S)

Remark: in the condition that it isn't allowed to cut off flow for manufacture device, it's available to install instrument while pressure exist in pipe. Weld mounting port to the installing position of measured pipe firstly. Then install primary ball valve and drill hole on pipe. (Our company could provide especial pipe drilling device which is optional to purchase. The hole could be drilled in other ways.) Close the ball valve to stop liquid flowing out after drilling the hole. At last, install the provided sealing parts and sensor. (The operation of manufacture device is not affected in this installing method under pressure.) The detailed dimension and material specification refers the following diagram.



Installing principle under pressure: be sure inserting depth is $H=(D-2S)\times 10\%$, $A=182-(H+S)$

(2)DN200mm、DN300mm、DN400mm (Installing under pressure)

Item	Name/normal size (mm)	DN200	DN300	DN400
1	Sensor(L×Φ)	400×Φ38		
2	Transition flange	DN40 1.6MPa		
3	Connection flange	DN40 -Φ50		
4	Sealing parts (provided by factory)	Φ45×3		
5	Ball valve	DN50		
6	Connection pipe	Φ50		
7	Measured pipe	ΦD×s		

(3)DN500mm~DN1200mm (Installing under pressure)

Name/normal size (mm)	DN500	DN600	DN700	DN800	DN900	DN1000	DN1200
Sensor(L×Φ)	450×Φ38						
Sealing parts (provided by factory)	Φ45×3						
Transition flange	DN40 1.6MPa						
Ball valve	DN50						
Connection pipe	Φ50						
Measured pipe	ΦD×s						

(4)DN1400mm、DN1600mm、DN1800mm (Installing under pressure)

Name/normal size (mm)	DN1400	DN1600	DN1800
Sensor(L×Φ)	600×Φ38		
Sealing parts (provided by factory)	Φ45×3		
Transition flange	DN40 1.6MPa		
Ball valve	DN50		
Connection pipe	Φ50		
Measured pipe	ΦD×s		

(5)DN2000mm~DN3000mm (Installing under pressure)

Name/normal size (mm)	DN2000	DN2200	DN2400	DN2600	DN2800	DN3000
Sensor(L×Φ)	800×Φ38					
Sealing parts (provided by factory)	Φ45×3					
Transition flange	DN40 1.6MPa					
Ball valve	DN50					
Connection pipe	Φ50					
Measured pipe	ΦD×s					

Remark: the specification above is all applied for the installation on steel pipe. It's necessary to specially indicate the parts and specification for the installation on cast iron pipe and cement pipe.

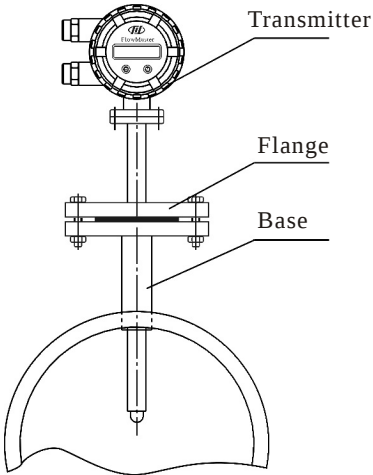
1.2 Transmitter dimensions

MFP insertion-type electromagnetic flowmeter transmitter is the universal transmitter with our pipe-type electromagnetic flowmeter. Please refer to the details mentioned before.

2. Structure and installation

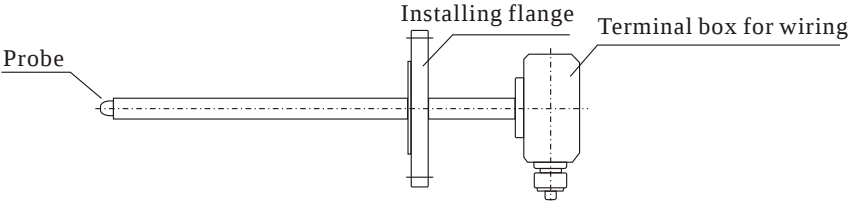
2.1 Transmitter structure

Transmitter can display flow, accumulative total and output pulse, analog current by which liquid can be measured or controlled. Transmitter adopt the design of smart and combined structure, and installed in Aluminum house.



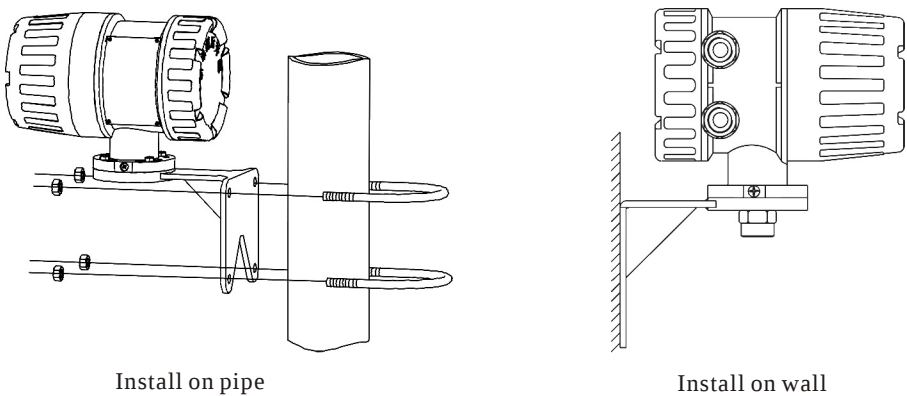
2.2 Sensor Structure

Sensor is composed of probe, installation flange and terminal box (for separate-type installation). The figure of sensor is a cylinder with installation flange. And excitation coil magnetic core and two wetted electrodes are installed in/on the cylinder.



2.3 Transmitter installation

MFP electromagnetic flowmeter have two kinds of installation types,one is integral type and the another is separate type.
Integral type flowmeter is directly installed on the pipeline.
The transmitter of separate type flowmeter Can be installed on pipe or wall.

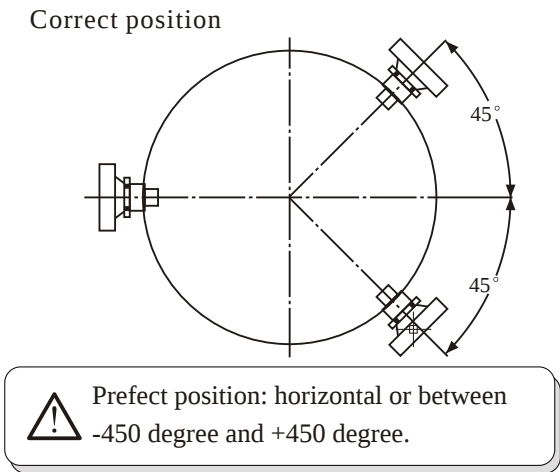


2.4 Installion of sensor

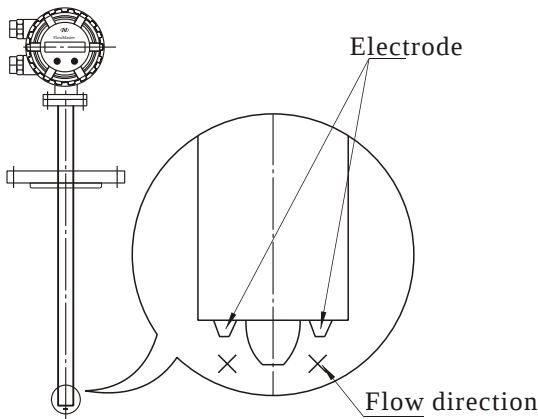
- Senser have following foor types;
- ① integral type between sensor and transmitter
 - ② Separat type between sensor and transmitter
 - ③ Submersible type
 - ④ Install or remove with pressure existed in pipeline

2.5 Selecting sensor installing position

Sensor can be installed in any position of process pipe in which liquid fully filled. It is available to install it horizontally, slantwise or vertically. For horizontal process pipe, please install sensor according to the following diagram according to which electrodes can fully immerse into the liquid and won't be isolation due to all the bubble rise to the top of pipe. For the liquid in which sediment easily forms, sensor couldn't be installed in the bottom of horizontal pipe in order to avoid sediment covering electrodes.



Keep correct flow direction which should be vertical with inserted flowmeter when installing flowmeter.



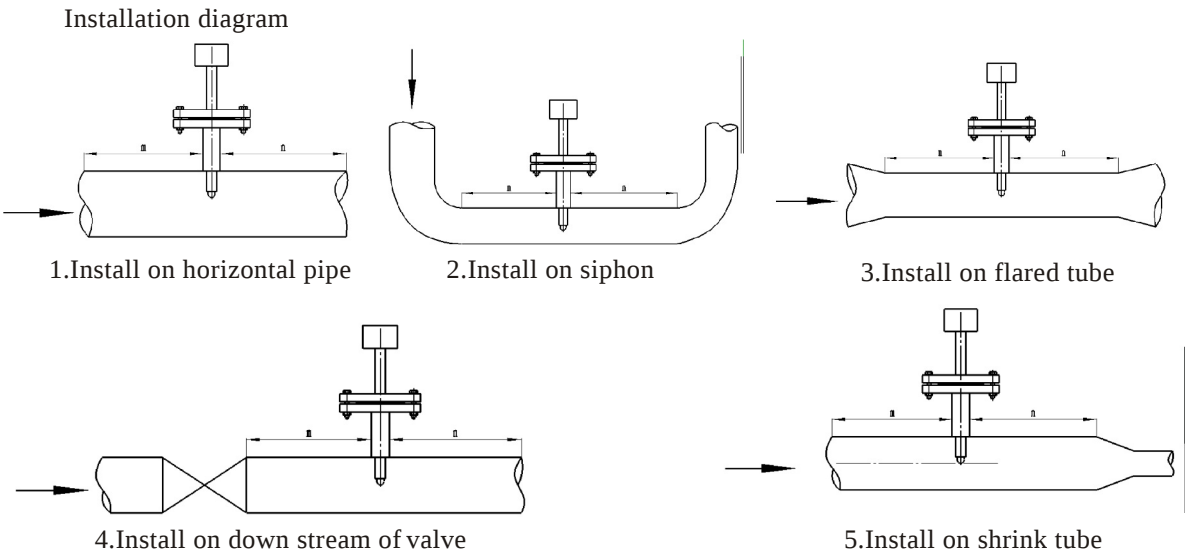
Be sure the process pipe is filled full of liquid when install sensor. It's most probable that vortex generates if liquid filled a half of pipe or sensor is installed after valve, angle fitting and Y-shaped connector. Therefore, the straight pipe of the sensor must assure 10D of the upstream section and 5D of the downstream section to avoid vortex and ensure measurement accuracy. If requiring the accuracy of +/-0.5%, the straight pipe of the sensor must assure 30D of the upstream section and 10D of the downstream section.

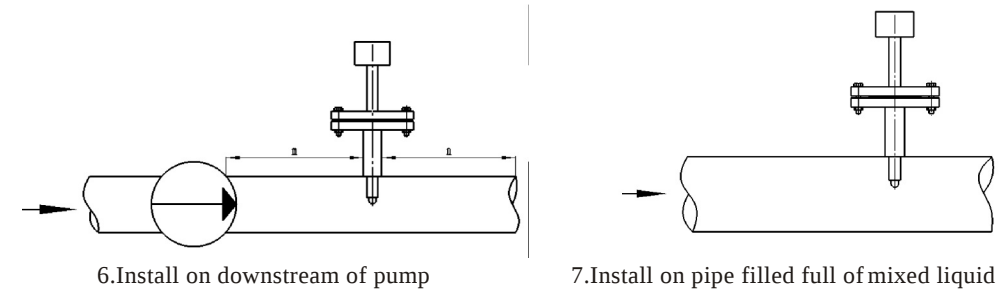
3.Installation requirement

3.1 Straight pipe requirement

Straight pipe requirement refer to following

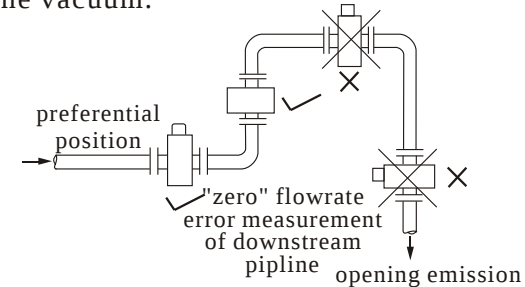
Pipe installation type	Installation diagram	Upstream part	Downstream pant
Horizontal pipe	1	10D	5D
Syphon	2	20D	5D
Flared tabe	3	20D	10D
Downstream of valve	4	20D	5D
Shrinktube	5	10D	10D
Downstream of pump	6	30D	10D
Mixed liquid	7	30D	5D



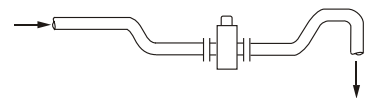


3.2 Pipeline design requirement

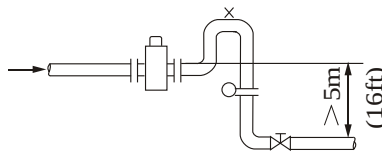
a. Avoiding measure deviation resulted from the additional gases and the damages against the lining resulted from the vacuum.



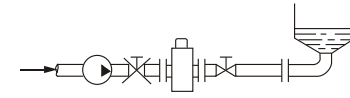
b. For the opening emission pipe, the flwometer should be installed at the low pipe-line part.



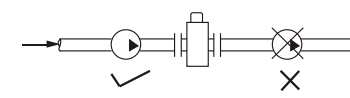
c. For pipe fall exceeding 5m, air valve (vacuum) should be installed at downstream flowmeter.



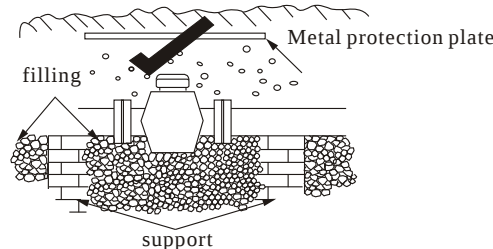
d. For the long pipeline, control valve is usually installed at downstream flowmeter.



e. The flowmeter could not be installed at the pumping side.



f. Install sensor under the ground.



g. Do not install on the pipeline with free vibration.

3.3 Workingenvironment

The requirement of external environment is as shown below:

- a. Avoid large change of temperature and high temperature emanated from neigh boring device. Heat in sulationand ventilation must be carried out if flowmeter is installed there.
- b. It's best to install flowmeter in house, If it has to be installled in the open air, moisture-proof and sun protection must be carried out to avoid rainwater, water log and sunshine.
- c. Avoid corrosive atmospheric environment. Well ventilation is required if flowmeter is installed there.
- d. There should be enough space around flowmeter for installing and maintaining it.
- e. Avoid strongelectromagnetic field and vibration. If it vibrated largely, the process pipe should be fixed with installation foundations at both sides of flowmeter.

4. Distance between densor and transmitter

The distance between sensor and transmitter should be as short as possible in principle in order to make sure transmitter stands near the sensor. The distance between sensor and transmitter is confirmed by signal distribution capacitance and measured electric-liquid for which the condu ctance is not lower than $5 \mu \text{ S/cm}$. It equals to the conductance of deionized water. The condu ctance of general tap water and natural water is about $15 \sim 500 \mu \text{ S/cm}$. The conductance of same liquids under 20°C is listed below.

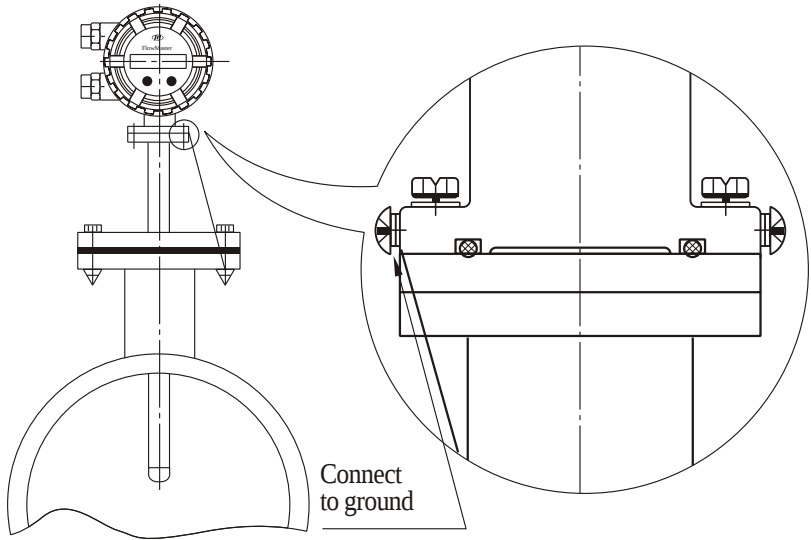
Remark: the length of cable doesn't exceed 30m.

The conductance of some liquid is listed below:

Liquid name	Conductance(s/cm)	Liquid name	Conductance(s/cm)
Petroleum	3×10^{-13}	Sulphuric acid(5%)	20.85×10^{-2}
Kerosene	$< 1.7 \times 10^{-8}$	Hydrochloric acid(40%)	5×10^{-1}
Acetone	6×10^{-8}	Hydrochloric acid(10%)	4×10^{-2}
Distillated water	4×10^{-8}	Nitric acid(31%)	78.19×10^{-2}
Tap water	0.05	Nitric acid(6.2%)	31.23×10^{-2}
Seawater	53	Ammonia(30%)	1.93×10^{-4}
Glycerin	6.4×10^{-8}	Ammonia(0.1%)	2.51×10^{-4}
Acetic acid	5.0×10^{-9}	Sodium hydroxide(50%)	82×10^{-3}
Ethanol	1.35×10^{-9}	Sodium hydroxide(2%)	46.5×10^{-2}
Acetaldehyde	1.7×10^{-6}	Saline solution(saturated)	2×10^{-1}
Sulphuric acid(99.4%)	8.5×10^{-3}	Benzene	7.6×10^{-8}
Sulphuric acid(97%)	98.5×10^{-3}	Methylbenzene	$< 1.0 \times 10^{-14}$

5. System grounding connection

As the inductive signal is at the level of mV in the electromagnetic flowmeter, avoiding disturbing signal outside is of great importance. To have a good grounding connection is the most important to ensure the measuring accuracy and stability of flowmeter. The measured liquid acts as conductor. Other irrelevant electromagnetic disturbing signal must be excluded. Flowmeter is generally installed on metal pipe which must connect to flowmeter and the ground.



Remark:
be sure to single-point grounding. Other electric device couldn't be connected to one grounding line. Grounding resistance is less than 10 ohm.

6. Electric connection

MFP insertion-type electromagnetic flowmeter transmitter is the universal transmitter with our Flow Master pipe-type electromagnetic flowmeter. Please refer to the details mentioned before.

Working Parameter

MFP insertion-type electromagnetic flowmeter transmitter is the same with our Flowmaster flange-type electromagnetic flowmeter please refer to working parameter of flange-type.

Inspection and Maintenance

Electromagnetic flowmeter is the high accuracy flow meter. So we suggest user termly make maintenance for same simply parts of flowmeter. For example: visually check the reliability of the electrical connections, check whether tube and electrode contaminated, and so on. Read this instruction manual and understand the technical requirements of flowmeter performance. Then make normal maintenance. If it is necessary to maintain flowmeter deeply or exchange parts, please consult with customer service center of our company. We will provide comprehensive technical support. For errors appear in the normal applications, the FlowMaster can give adequate alarm information through its self-diagnostics function. See table below.

Normal error diagnostics table

Errors	Checking Items
No display	① Check whether the cables are switched on ② Check whether the cable fuses work well ③ Check whether the cable connections are correct
Flow measurement incorrect	① Check whether the pipeline is full of mediums ② Check whether signal wire is correctly connected and reliable ③ Check whether following parameters accord with those on the sensor nameplate [B3]=Sensor Diameter [B51]=Instrument quotient 1 [B52]=Instrument quotient 2 ④ Readings vibrating, check whether signal wire and ground connection is OK
Electromagnetism-driven malfunction	① Check whether electromagnetism-driven connections (CD1 and CD2) are switched off, or are switched on with the earth. ② Check whether resistance of sensor magnetic wire less than 20 Ω .
Empty pipe error	① Check whether the measuring pipeline is full of mediums ② Connect SIG1 and SIG2 to SIG GND to see if errors can be excluded ③ Check whether signal wires are correctly connected ④ Check whether electrodes contaminated ⑤ When the flow volume is zero, check whether the value of parameter MtSnsr EmVal is more than 300. ⑥ When water is the medium and the flow exists, check whether the resistance between SIG1 and earth, or between SIG2 and earth is less than 50k Ω
Analog output error	① If analog outputs above range, please regulate the value of parameter Flow Rng ② Switch off current output cable, check the value of parameter Anlg mA and test current value between output terminals IC+ and IC- to see whether they are equal ③ If the flow is full of range and the current output come up to full scale, check whether the current output circuit resistance is less than 750 Ω
PLS frequency error	① If frequency output is out of range, regulate the value of parameter Pls Fact ② If PLS frequency output incorrect, use the test function to test output frequency to exclude output connection errors
Other error	Reset the parameters before leaving the factory. (e.g. Cut off the power supply)

Self-diagnostics alarm information table

Mtsnsr	Empty sensor	Cutoff	Flow velocity in mm/s below which all outputs are set to zero.
Coil	Sensor magnet-driven error		
Fault	Self-inspection fault	Anlg	Analog outputs higher than limits
Hi	Flow higher than upper limits of setting	Pls	Pulse output frequency higher than limits of setting
Lo	Flow below lower limits of setting		
Fwd	Forward flow exist	Rev	Reverse flow exist

When the above alarm signals should be opened, the corresponded alarm function could be active. Normally, we only open the empty sensor alarm function when the flowmeter leave factory. You could set the required alarm functions by yourselves, or tell us your required alarm functions when ordering the flowmeter. And then we set the alarm functions specially for you before flowmeter leaving factory.

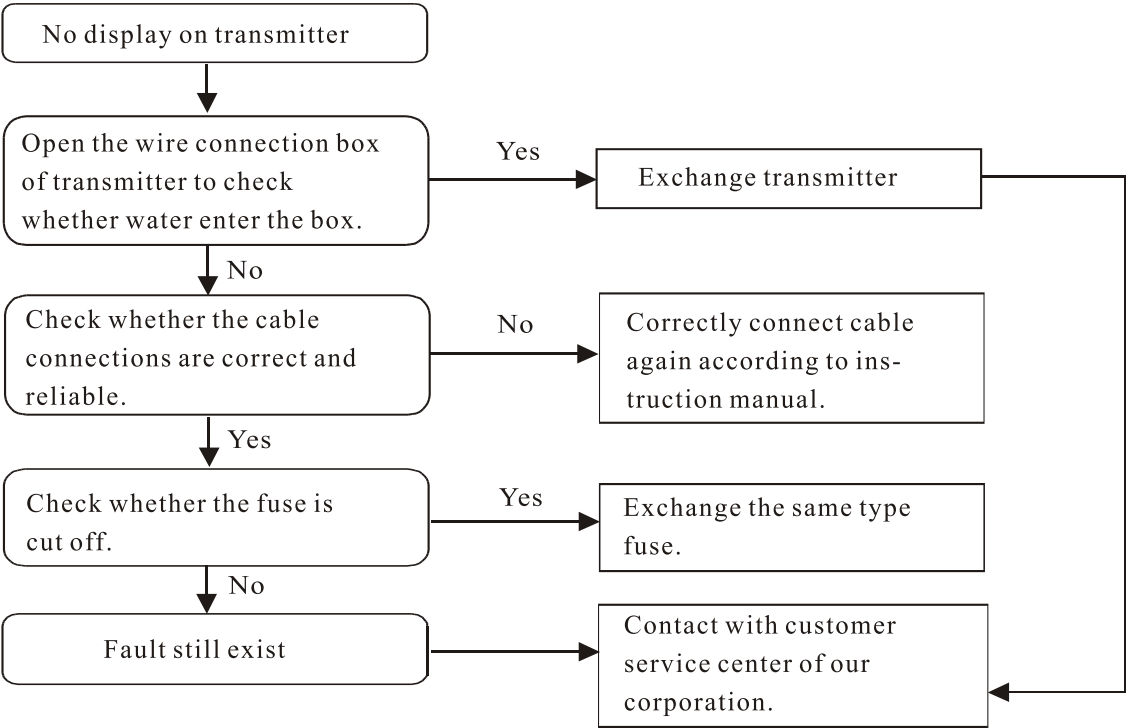
Electromagnetic flowmeter needs very few maintenance tasks. However, the fault will occur if using it incorrect. The information displayed in the transmitter will help you to analyse the fault of flowmeter. Now, introduce some usual faults below.

(1) Parts exchanging of explosion-proof transmitter

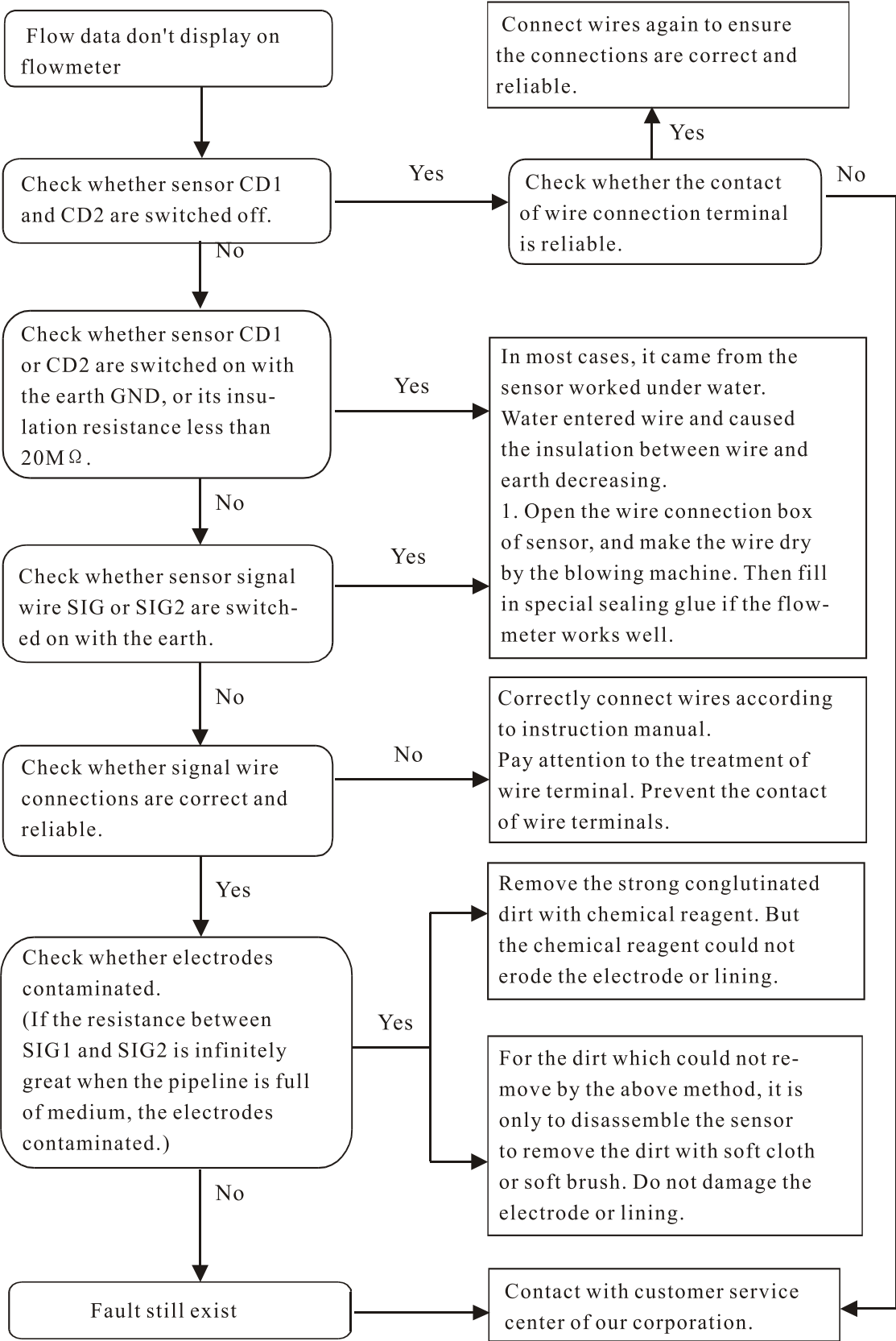
If the glass of explosion-proof transmitter display part is damaged, users must get in touch with our corporation without exchanging it by themselves. If user need O-ring to sealing cable, please contact with us. And ensure to protect the spigot flameproof joint and threaded flame-proof joint of transmitter.

 Only can professional personnel do this operation.

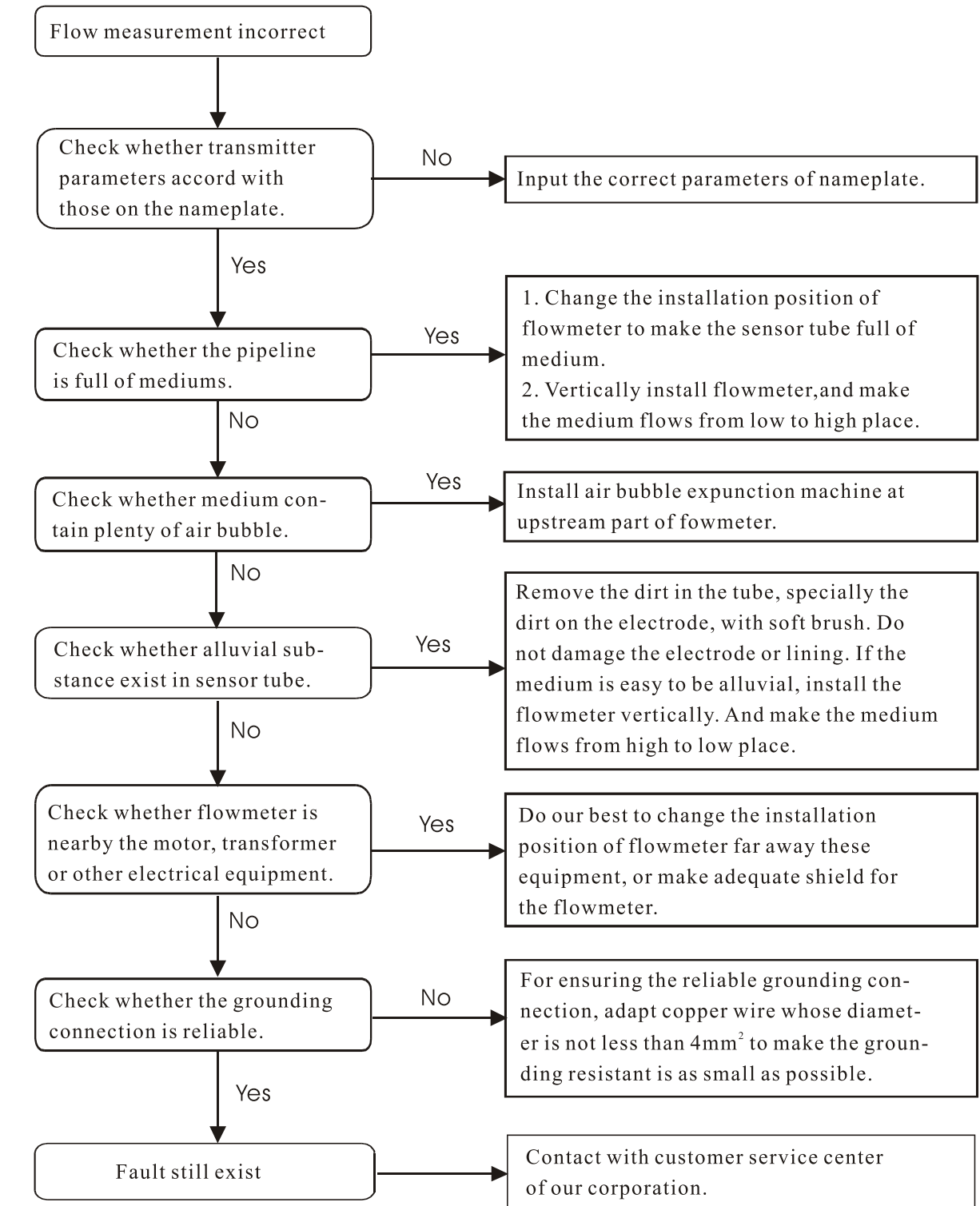
(2) No display on transmitter



(3) Flow data don't display on flowmeter



(4) Flow measurement incorrect



 FlowMaster transmitter applies surface mount technology (SMT), it can't be maintained by the user. Therefore the user is advised not to open the transmitter. If the user is quite sure of the existence of errors, please contact with the customer service center of our corporation.

Appendix 1 FlowMaster Electromagnetic flowmeter
dimension and flow range

Code	Size (mm)	Flow range (m ³ /h)		Code	Size (mm)	Flow range (m ³ /h)	
		Minimum	Maximum			Minimum	Maximum
030	3	0.013	0.509	301	300	127.235	5089.380
050	5	0.035	1.414	351	350	173.180	6927.212
060	6	0.051	2.036	401	400	226.195	9047.787
080	8	0.090	3.619	451	450	286.278	11451.105
090	9	0.115	4.580	501	500	353.429	14137.167
100	10	0.141	5.655	601	600	508.938	20357.520
120	12	0.204	8.143	701	700	692.721	27708.847
150	15	0.318	12.723	751	750	795.216	31808.625
200	20	0.565	22.619	801	800	904.779	36191.147
250	25	0.884	35.343	901	900	1145.111	45804.420
320	32	1.448	57.906	102	1000	1413.717	56548.667
400	40	2.262	90.478	112	1050	1558.623	62344.905
500	50	3.534	141.372	122	1200	2035.752	81430.080
650	65	5.973	238.918	142	1400	2770.885	110835.387
800	80	9.048	361.911	152	1500	3180.863	127234.500
101	100	14.137	565.487	162	1600	3619.115	144764.587
121	125	22.089	883.573	172	1700	4085.641	163425.647
151	150	31.809	1272.345	182	1800	4580.442	183217.680
201	200	56.549	2261.947	192	1900	5103.517	204140.687
251	250	88.357	3534.292	202	2000	5654.867	226194.667