



# EPF Doppler Ultrasonic Flowmeter Operations Manual



## **FineTek Co.,Ltd.**

No.16, Tzuchiang St., Tucheng Industrial Park, New Taipei City 23678

Tel : 886-2-22696789

Fax : 886-2-22686682

Website : <http://www.fine-tek.com>

E-mail: [info@fine-tek.com](mailto:info@fine-tek.com)

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# 1. Operation manual use

Thank you for purchasing this FineTek product. This operation manual describes the product features, operating principle, operation and maintenance methods, as well as precautionary measures that should be taken during the installation, operation or maintenance of this product. This manual is designed to prevent dangerous situations that can result in damage to the product or injury to an installer or operator.

- Please read this operation manual completely and carefully before installing the product.
- Please contact FineTek if this operation manual does not answer your questions.
- The content of this operation manual may be updated from time to time. Updates are Maintained on the FineTek website [www.fine-tek.com](http://www.fine-tek.com) for your easy access.
- Do not disassemble or attempt to repair the product as this will void the product warranty. Please return the product to FineTek for repair and calibration if required.
- This manual may utilize warning symbols. An explanation of these symbols is as follows:



Danger→this symbol indicates an incorrect operation will result in major accidents and death.



Note→this symbol an incorrect operation will result in injury to personnel and some damage to the product.



Electric shock→this symbol warns of a possible electric shock hazard.



Fire→this symbol warns of a possible fire hazard.



Prohibited→this symbol indicates the action is prohibited.

## 2. Product warranty

### 2.1 New product warranty

- Each FineTek EPF series paddlewheel flowmeter is backed by 1-year limited warranty. Should you experience a problem with one of our products deemed by our factory to be a product failure covered by our warranty, for a period of 1-year from the delivery date we will repair the unit at our factory or provide you with a replacement unit or sub-assembly at our discretion. A return authorization number must be obtained from FineTek before returning any unit.
- If the EPF product failed to operate out-of-the-box, and this failure was not due to transportation, handling or incorrect Installation, then you can request a replacement unit within 7 days from the delivery date.
- When returning a product to the factory, return the entire device and do not disassemble the unit as previously mentioned. In addition, wherever possible please returning the device please ensure it is packed to avoid damage during transportation.
- The EPF product is designed for general use. Special applications, extraordinary use and overloading or operating beyond published specifications may void the warranty.
- The product is not warranted in the following situations or conditions, therefore charges will result for repair of product:
  - The product is beyond its warranty term.
  - The defect or damage to the product is caused by the incorrect operation or by not following the installation and operation instructions contained within the operation manual.
  - The product damage is a result of force majeure factors, including but not limited to natural disasters, floods, fires, earthquakes, lightning, severe weather conditions such as hurricanes, typhoons, tornadoes etc., human error such as use of improper voltage, high-humidity, water leakage, stains, corrosion, loss, improper storage etc. and other abnormal factors.
  - The damage is caused by installation, addition, expansion, modification and repair of parts not authorized specifically or certified by FineTek.
  - If the data label information on the product is incorrect or unclear so as to not be able to read or confirm the product serial number.

### 2.2 Repair warranty

Repaired product is warranted for 6 months from the delivery date. The warranty is limited to the part(s) replaced or repaired during the repair. If the repaired or replaced part is defective within this term the same part(s) will be repaired or replaced free of charge.

## 2.3 Service Network

<b>Company</b>	<b>Address</b>	<b>Telephon</b>	<b>Fax</b>
<b>Taipei Headquarters (Taiwan)</b>	No.16, Tzuchiang St., Tucheng Industrial Park, New Taipei City 23678	+886 2 2269 6789	+886 2 2268 6682
<b>Taichung Sales office (Taiwan)</b>		+886 4 2465 2820	+886 4 2463 9926
<b>Kaohsiung Sales office (Taiwan)</b>		+886 7 333 6968	+886 7 536 8758
<b>Fine automation Co., Ltd. (China)</b>	No. 451, Duhui Road, Zhuangqiao Township, Minhang District, Shanghai City 201109	+86 021 64907260	+86 021 6490 7276
<b>Aplus FineTek (Sensor Inc.)</b>	355 S. Lemon Ave, Suite D, Walnut, CA 91789	1 909 598 2488	1 909 598 3188
<b>FineTek Pte Ltd. (Singapore Branch)</b>	37 Kaki Bukit Place, Level 4 Singapore 416215	+65 6452 6340	+65 6734 1878
<b>FineTek GmbH (Germany Branch)</b>	Bei den Kämpen 26 21220 Seevetal-Ramelsloh, Germany	+49 (0) 4185 8083 12	+49 (0) 4185 8083 80
<b>FineTek Co., Ltd. (Indonesia Branch)</b>	PERGUDANGAN TUNAS BITUNG JL. Raya Serang KM. 13,8, Blok C3 No. 12&15, Bitung Cikupa, Tangerang 15710	+62 (21) 2923 1688	+62 (21) 2923 1988

## **3. Product Inspection**

### **3.1 Product Check**

- Doppler ultrasonic flowmeter transmitter: 1 set.
- Doppler ultrasonic sensor (including cable): 1 set.
- Sensor bracket: 1 group.
- Couplant for ultrasonic testing: 1.
- Operating instructions: 1 set.
- Imported product inspection form: 1 copy.

### **3.2 Safety Inspection**

- Before unpacking, please check that the outer packaging is not deformed or damaged. Take pictures as proof for compensation.
- After unpacking, please check the contents for deformation, damage, or other quality problems. Take pictures as proof for compensation.
- After opening the box, immediately check that the contents and quantity match your order.
- If the above abnormal conditions occur, contact the company (include photos) within 7 days from receiving the goods. Failure to do so will result in the customer bearing the replacement/repair costs.

### **3.3 Handling and Carrying**

- Avoid dropping, collision, or other excessive impact on the product. Electric shocks or damage may result.
- Do not pull hard on the cable probe to avoid the cable falling out or becoming misaligned.

## **4. Storage and Transportation Requirements**

### **4.1 Environmental Requirements**

- Rainproof and moisture-proof.
- During transportation, minimize vibrations and impact as much as possible.
- Applicable temperature range: 20~60 °C.
- Room humidity: less than 80%.
- If stored in the open, the flowmeter may not operate properly.

### **4.2 Handling Requirements**

To prevent the product from being damaged during delivery, please keep it in its original packaging state as packed by the manufacturer.



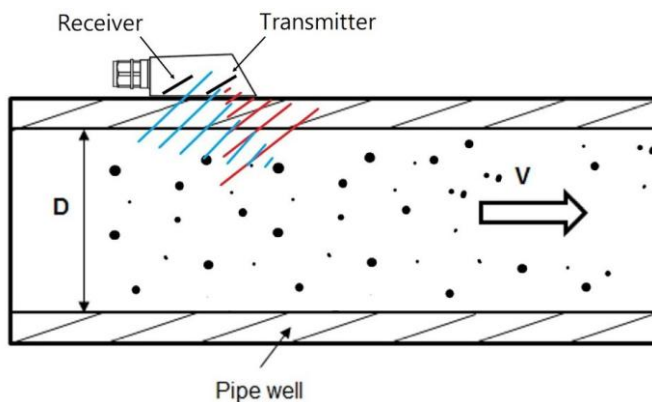
## 5. Product Introduction

### 5.1 Features of the product

- When measuring the flow rate, you may start the measuring without the need of dismantling the pipeline and it will not adversely affect the original pipeline and the process fluid.
- The LCM display module can display the instantaneous flow rate and total flow rate.
- 4-20mA output, pulse output, RS485 Modbus communication.
- Durable industrial design. Highly reliable process.
- Suitable for measuring sewage and wastewater containing higher volumes of air bubbles and the liquid containing particular impurities.

### 5.2 Working theory

The primary measuring theory of the Doppler Ultrasonic Flow Meter is to measure the flowing speed according to the Doppler Effect. When executing the measuring, the liquid medium should contain tiny particles (impurities or air bubbles) that are moving at the same speed as the liquid. During the measuring process, the transducer mounted on the Doppler Flow Meter will transmit the ultrasonic pulse signal to the liquid. When hitting the tiny particles in the liquid, the pulse signal will be reflected by the ultrasonic signal. In this way, the frequency will change when the reflective wave is received by the transducer. Based on the variation value of the frequency and the Doppler Effect, the Doppler Flow Meter will then calculate the moving speed of the particulars when flowing through the measuring point. Through the programmed flow field, the Flow Meter calculates the average flowing velocity along the entire sectional profile.



Described below

$$v = \frac{\Delta f \times c}{2f_0 \cos\theta - \Delta f \cos\theta}$$

V = Velocity

C = Acoustic speed of fluid

$\Delta f$  = Calculated by demodulating the hardware circuit.

$f_0$ : Signal transmission frequency: 640KHz

$\theta$ : Angle of incidence

※The resonance point is intended for transmitting the frequency and the reverse resonance point is designed for receiving the returned frequency. During the entire process, the Doppler transducer is used for transmitting and receiving the signals. Therefore, the frequency of the transmitted signal is set as 640KHz.

### 5.3 Product applications

The Doppler Ultrasonic Flow Meter is mainly designed for measuring liquid that contains excessive impurities such as solid particles or bubbles and that is deeply contaminated. It is mainly applied in the following fields:

- Sewage, oily sewage, wastewater, and dirty circulation water; for example, the wastewater and sewage treatment plant.
- The liquid medium used by the industrial production process contains particles and bubbles; for example, the pulps in the factory and the toxic wastewater.
- The liquid contains the sands and particles; for example, the liquid in the mining mucks, the grouting liquid used in the oilfield well drilling, and the harbor dredging, etc.
- Other types of turbid pulps; for example, paper pulps, mining pulps and crude oil, etc.

## 6. Specifications of the product

### 6.1 Specifications

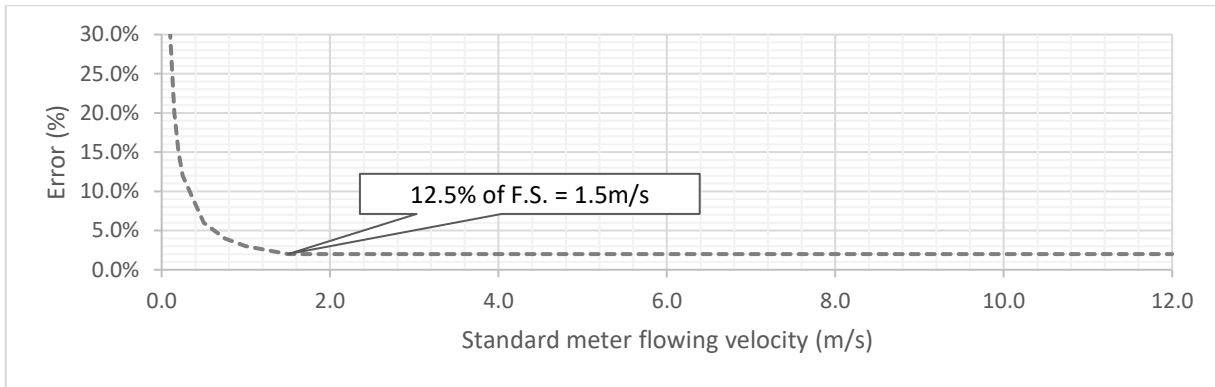
<b>Specifications of the transmitter</b>	
Dimensions of the screen	LCM 128*64-pixel, backlight type
Push key	3-key operation type
Communication interface	RS-485(Modbus)
Measuring techniques	Doppler Method
Liquid to be measured	The medium that is used for stuffing the pipeline and that contains solids or bubbles such as sewage, wastewater, mud, grinding medium and sticky liquid (Note 1)
Analog output	4~20mA
Pulse width	Automatic (pulse width: 50%)
Pulse Mode	NPN crystal output: 32 vdc/200mA
Pipe dimensions	DN15 to DN500
Scope of flow rate	0.03 to 12 m/s
Measuring accuracy (Note 3)	0.12~1.5 m/s, $\pm 0.25$ % F.S. (Note2) 1.5~12 m/s, $\pm 2$ % O.R. (Note2)
Pipe materials	The materials that can transmit ultrasonic waves such as PVC, carbon steel, stainless steel, cast iron, ductile iron, etc.
Power input	18~32 VDC/100~240VAC
Meter working temperature	-20° to 70°C
Meter protection rating	Waterproof/dustproof: IP67
<b>Specifications of the transducer</b>	
Resonance frequency	600 $\pm$ 30 KHz
Resonance impedance	$\leq 55\Omega$
Reverse resonance frequency	680 $\pm$ 30 KHz
Reverse resonance impedance	$\leq 200\Omega$
Working temperature	-25°C ~ 55°C
Working humidity	$\leq 95$ %RH
Waterproof class	IP66
Cable length	Cable length: 6.8m

Note 1: The minimum size required for the solids or bubbles is 100 $\mu$ m and the minimum concentration is 75 ppm.

Note 2:

- ◆ Physical water flow testing device manufactured by Finetek. Fluid temperature: 20 $\pm$ 10°C; environment temperature: 20 $\pm$ 5°C
- ◆ Length of straight piping section: Upstream – 15 D or over; downstream section: Over 5 D
- ◆ When operating in the regular environment, the value after the following calculation process will be considered: linearity +measuring error+ repetitive accuracy.
- ◆ Additional errors to the measured value due to the type and status of the pipeline used in the site, as well as the fluid type and fluid temperature, may occur.

Note 3: The recommended economic flowing velocity should be over 1.5m/s.

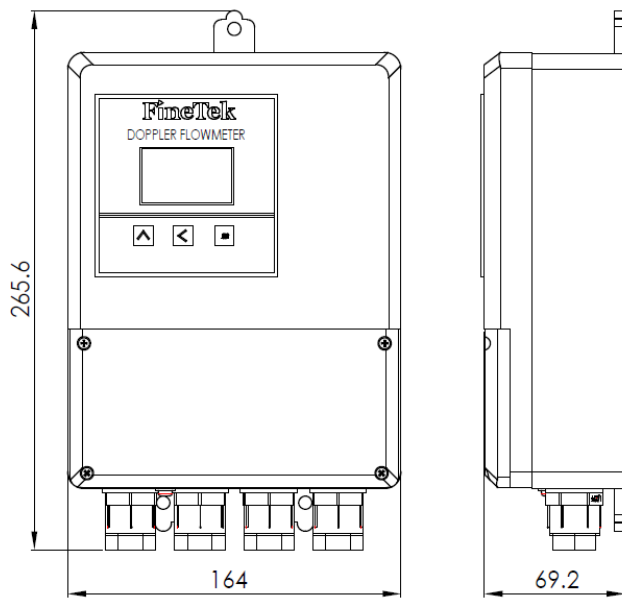


Pipe Diameter Flow Rang

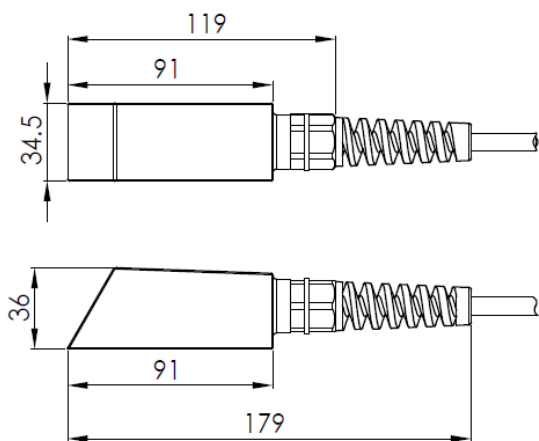
Diameter (mm)	Flow Rang(M <sup>3</sup> /h)				
	Flow rate 0.12m/s	Flow rate 1m/s	Flow rate 1.5m/s	Flow rate 6m/s	Flow rate 12m/s
15	0.07	0.63	0.95	3.81	7.63
20	0.13	1.13	1.69	6.78	13.57
25	0.21	1.76	2.65	10.6	21.2
32	0.34	2.89	4.34	17.37	34.74
40	0.54	4.52	6.78	27.14	54.28
50	0.84	7.06	10.6	42.41	84.82
65	1.43	11.94	17.91	71.67	143.35
80	2.17	18.09	27.14	108.57	217.14
100	3.39	28.27	42.41	169.64	339.29
125	5.29	44.17	66.26	265.06	530.14
150	7.63	63.61	95.42	381.7	763.4
200	13.56	113.09	169.64	678.57	1357.17
250	21.19	176.7	265.06	1060.27	2120.49
300	30.52	254.45	381.69	1526.8	3053.64
350	41.54	346.34	519.52	2078.14	4156.34
400	54.27	452.36	678.6	2714.29	5428.69
450	68.7	572.52	858.79	3435.3	6870.69
500	84.85	706.82	1060.29	4241.11	8482.29

## 6.2 Outline dimensions

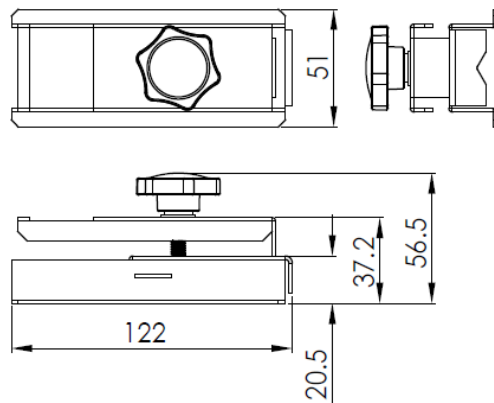
### Transmitter



### Transducer (DN15~DN500)



### Transducer support unit



# 7. Wiring instructions

## 7.1 Electrical specifications – DC

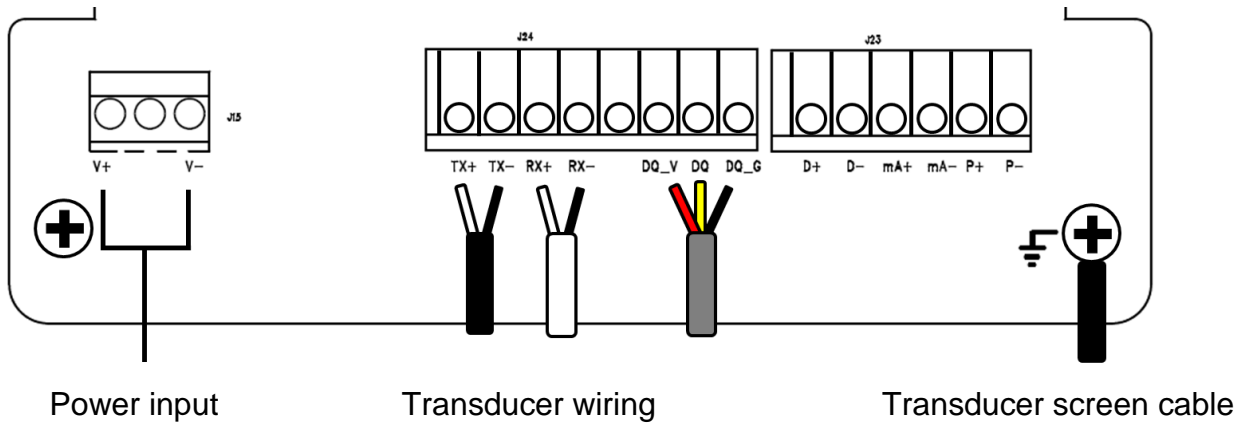
Input voltage: DC24V

Input current: 200mA±20%

### 7.1.1 Instructions for wiring terminal

Before each use, please follow the safety hint provided below:

The wiring shall be allowed for the transducer under the power outage status.



Wiring function	Insulation layer color of the wires	Description	Insulation layer color of the core
V+		24V	
V-		0V	
TX+	Dual-core black wire	Transducer transmitting end	White
TX-			Black
RX+	Dual-core white wires	Transducer receiving end	White
RX-			Black
DQ_V	Trip-core, 3-color wire	Temperature transducer	Red wire
DQ			Yellow wire
DQ_G			Black wire
GND	Transducer screen cable	Electromagnetic screening	Black
D+		RS485 wiring	
D-			
MA+		4-20mA output wire	
MA-			
P+		Pulse output wire	
P-			

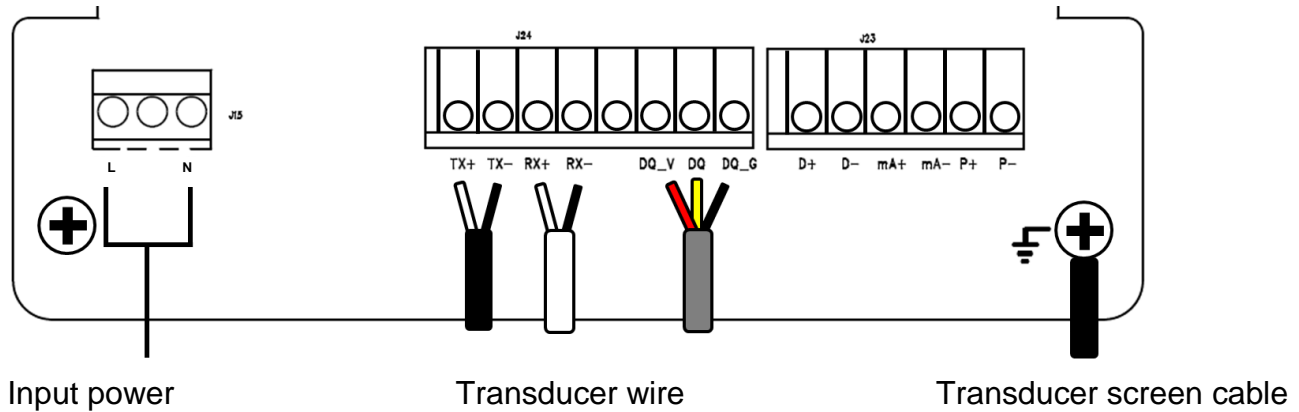
## 7.2 Electrical specifications – AC

Input voltage: AC100~240V

### 7.2.1 Instructions for wiring terminal

Before each use, please follow the safety hint provided below:

The wiring shall be allowed for the transducer under the power outage status.



Input power

Transducer wire

Transducer screen cable

Wiring function	Insulation layer color of the wires	Description	Insulation layer color of the core
L		AC input power	
N		AC input power	
TX+	Dual-core black wire	Transducer transmitting end	White
TX-			Black
RX+	Dual-core white wires	Transducer receiving end	White
RX-			Black
DQ_V	Trip-core, 3-color wire	Temperature transducer	Red wire
DQ			Yellow wire
DQ_G			Black wire
GND	Transducer screen cable	Electromagnetic screening	Black
D+		RS485 wiring	
D-			
MA+		4-20mA output wire	
MA-			
P+		Pulse output wire	
P-			

## 8. Installation instructions

For detailed operating instructions and operating methods, please refer to the instructions provided below:

- Applicable regulations have been established for the design, testing and power supply of the flow meter. The users are required to comply with the provided instructions in order to maintain the safe operation and normal function of the flow meter.

### 8.1 Environmental safety

To protect the bodily and equipment safety, the user must comply with the following requirements:

- Before selecting the position and installing the flow meter, the user must peruse the applicable instructions provided in this Manual. In the meantime, the user is also required to consider the safety requirements being established for the environment where the flow meter, the equipment and the machine are installed.
- The flow meter shall be installed and serviced by persons possessing a certain level of knowledge required for the flow meter.
- The transducer and the transmitter must be correctly installed on the flow meter to ensure that they are tightly sealed, safe and reliable.
- Take appropriate precautions to prevent the electrocution accident from occurring.

### 8.2 Circuit installation

Wiring cautions

- The 2-core insulating rubber sheath cable shall be used as the power cord, and the outer diameter of the wire shall be ranged between 5~7mm.
- When operating under normal 24VDC power supply status, the resistance of the cable shall not be higher than 10Ω.
- The total impedance of the cable drawn from the current output terminal shall not be higher than the specified nominal value.
- Normally, the NPN crystal output is used as the pulse wave or the frequency output. Therefore, it should be connected with the external power.
- 

### 8.3 Cautions

- Before starting the installation, the pipe area provided for installing the ultrasonic transducer must be thoroughly cleaned until the original metallic luster is exposed.
- The transducer and the pipe engaging section must be thoroughly cleaned and shall be fully coated with the ultrasonic-dedicated coupling agent in the meantime. Its purpose is to ensure that air or sand layer will not remain on the transducer and pipe contracting interface to affect the ultrasonic signal transmission effect.

### 8.4 Cautions for power supply

Inspection before power supply

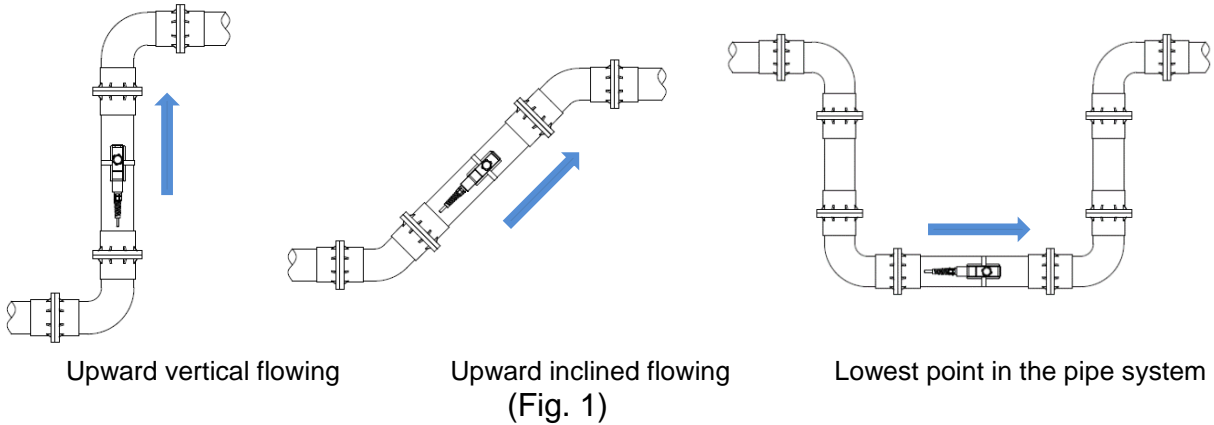
- If damage occurs to the transmitter and the transducer in the flow meter during the installation process.
- If the voltage of the operating power meets the indicated specifications.
- The installation distance of the transducer shall depend on the distance required for the transmitter.
- Ensure that the pipe is fully filled with the liquid. In the meantime, it is also required to remove the gas remaining in the pipe.



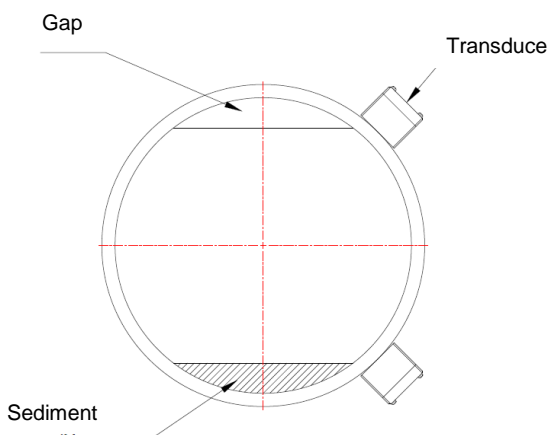
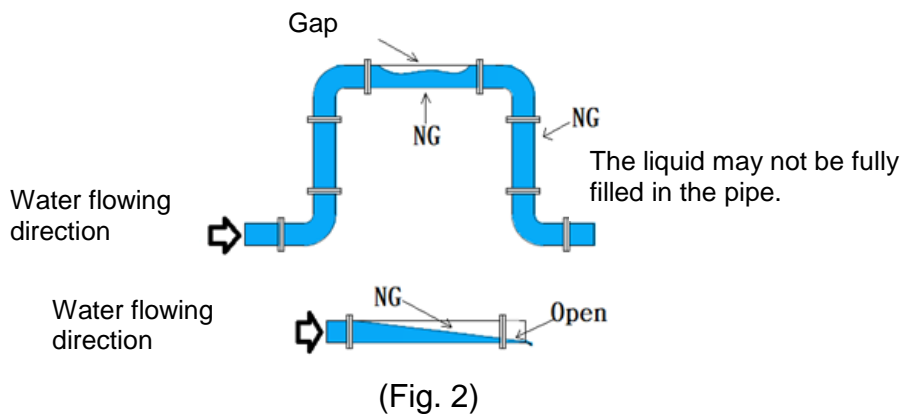
# 9. Transducer installation

## 9.1 Select the installation position

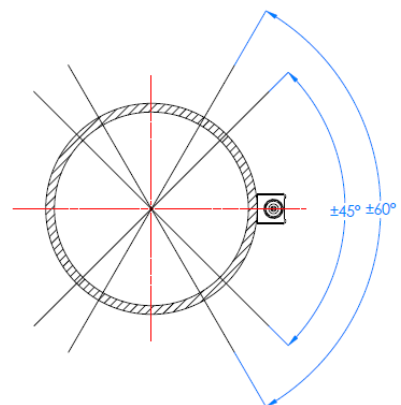
To avoid the measuring pipe not under low liquid level conditions, please install the transducer until reaching the constant full-load position being marked in the pipe (Fig. 1).



- During the using process, care should be used to prevent the gas from entering. If bubbles exist in the fluid, it will affect the measuring stability (Fig. 2).

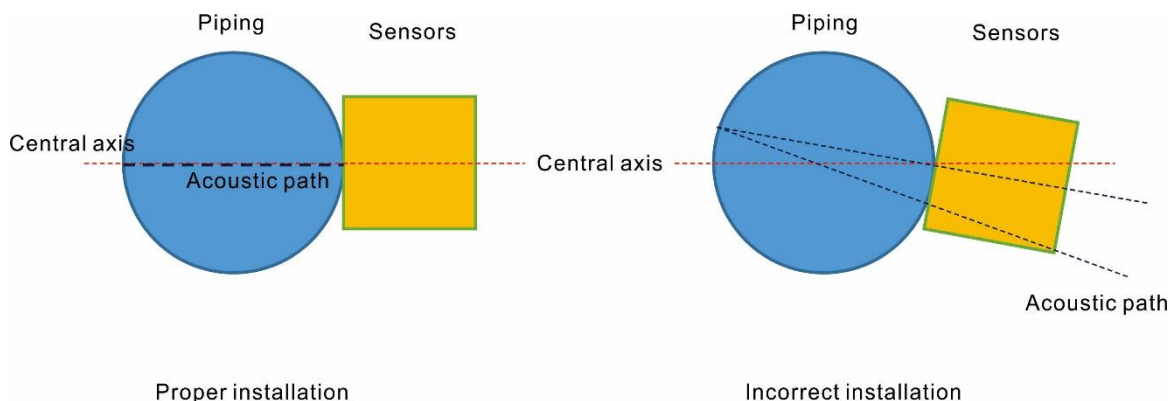


(Fig. 3)



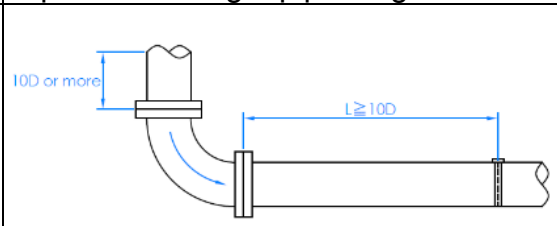
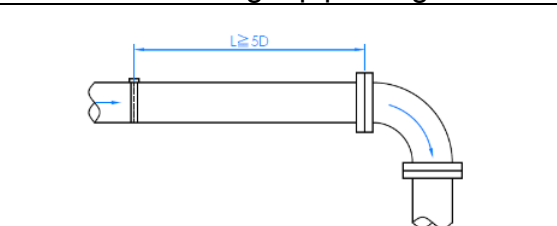
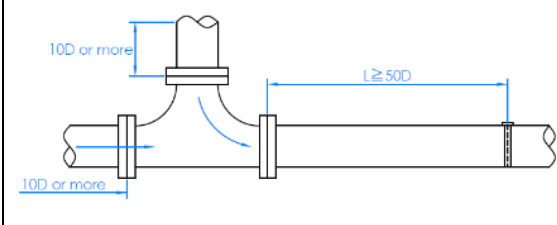
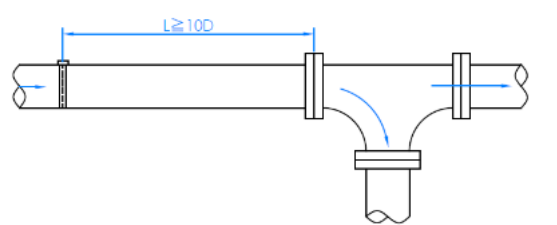
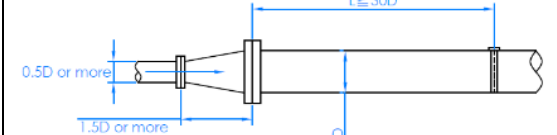
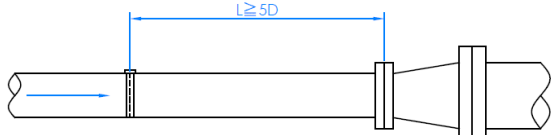

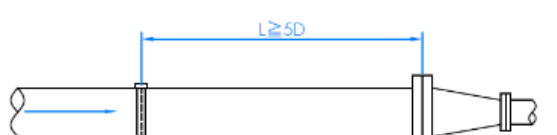
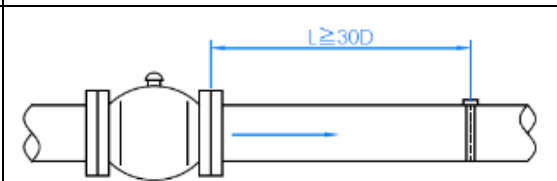
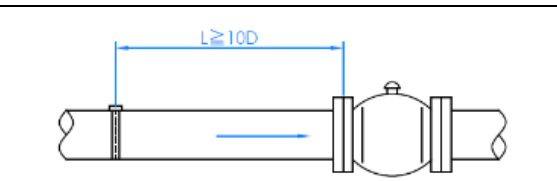
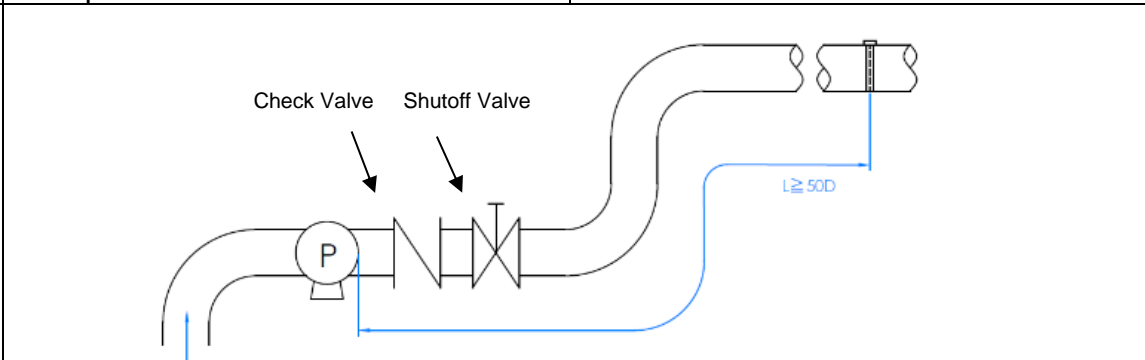
(Fig. 4) Transducer installation scope

- The transducer should be installed in a position that is fully filled with the liquid in the pipe and it should not be installed in a position that is filled with the air or the sediment in the pipe (Fig. 3). The optimal installation scope of the transducer should be within  $\pm 45^\circ$  and the maximum installation angle should be within  $\pm 60^\circ$ . If the maximum installation angle is not availed due to the working conditions, then the optimal installation scope should be selected (Fig. 4)
- Do not install the transducer in the pipeline connection area and it should not be installed in the area presenting a welded gap in the pipe. In this case, the smooth area of the pipe surface should be selected.
- To prevent interfering with the testing signal, do not install multiple devices in the adjacent area.
- The measuring stability will be affected if installing the Ultrasonic Flow Meter in the position containing the fluid mixed by different water sources.
- Transducer installation environment temperature  $-25^\circ\text{C} \sim 55^\circ\text{C}$ . Do not install the transducer near the heating component.
- When exposing the transducer to rain and sunshine for a longer time, it may accelerate the degrading of the transducer's performance. Therefore, avoid installing the transducer in these environments.
- The transmitter, the transducer and the signal lead wire used by the Ultrasonic Flow Meter are vulnerable to the interference of the inverter, radio station, TV station, microwave communication station, GSM base station and HV lines, etc. Therefore, the transmitter and the transducer should be installed at positions that are far away from the aforesaid interfering sources. The cutoff isolating wire connected with the transmitter housing and the signal lead wire should be grounded.
- It shall not use the power drawn from the circuit used by the inverter. Instead, isolated power sources should be selected to supply the power to the transmitter.
- Must pay more attention on mounting method for small-diameter pipelines. The emitting surface of the sensor must be perpendicular to the central axis. It will lead the sound wave signal dispersed and even no signal being received or the signal got weaken if not complying with such requirement. (Figure 5).



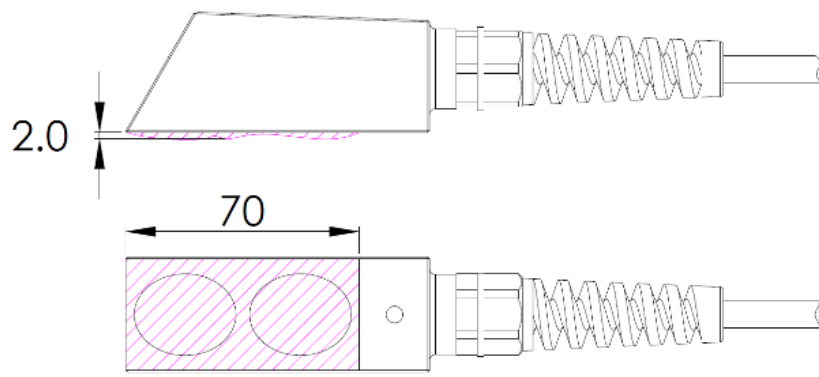
(Fig. 5)

- To enhance the measuring accuracy, it should be installed in the straight pipe section at the upstream and downstream of the transducer; as indicated in the table below. (Fig. 6)  
(D = Outer diameter of the pipeline)

Type	Upstream straight pipe length	Downstream straight pipe length
90° Elbow		
T-shape connector		
Expansion pipe		
Converging pipe		
Control valve	 Upstream flow rate control	 Downstream flow rate control
Pump		

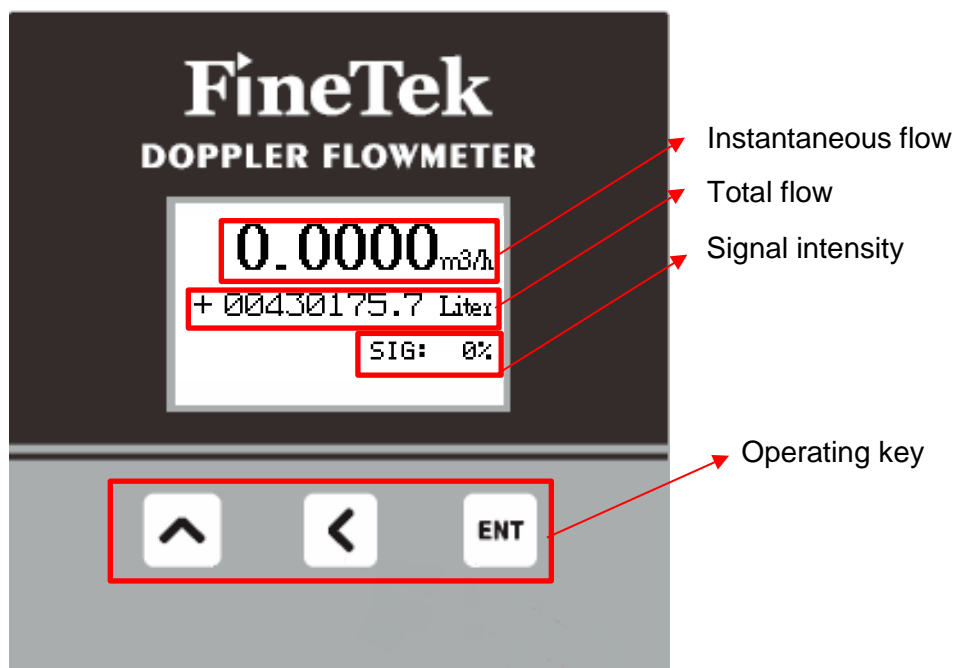
(Fig. 6)

# Transducer coupling agent coating method



# 10. Description of panel functions

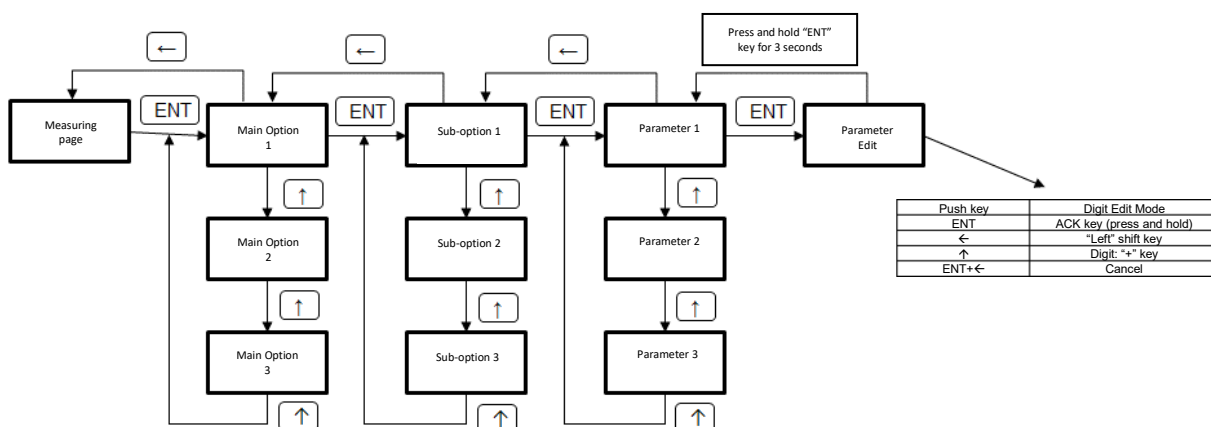
## 10.1 Description of display interface



## 10.2 Description of push key



Push key	Measuring Main Page	Menu Mode	Parameter set interface		
			Read Only	Digit Edit Mode	List Edit Mode
ENT	Access the menu	Access the sub-menu		ACK key (press and hold)	ACK key (press and hold)
←		Return to the previous layer	Return to the previous layer	"Left" shift key	Return to the previous layer
↑		Sub-menu item (lower)		Digit: "+" key	Option: Next page
ENT+←				Cancel	

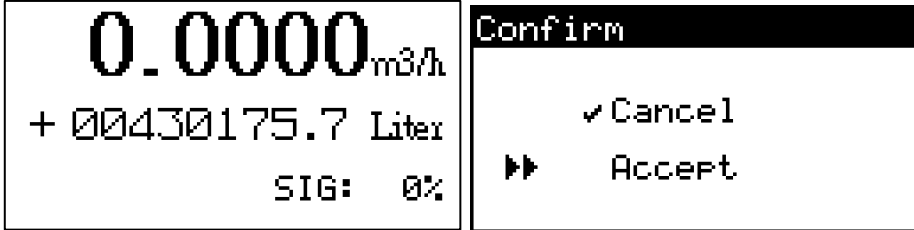
## 10.3 Menu setting process instructions






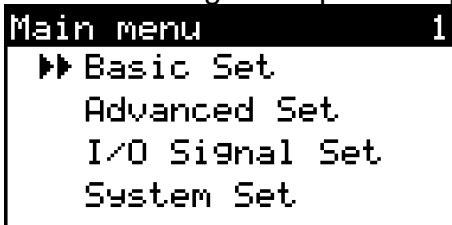
## 10.4 Quick setup process


### Set pipe ID

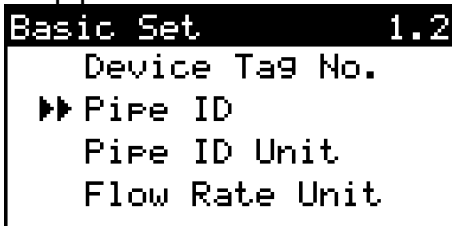
(1) Set pipe ID, Measuring Page. Press and hold  for 3 seconds to access Operation ACK page. Press  to confirm the selection.








(2) Press  to access Main Menu. Select Basic Set. Press  to access Basic Set and press  for returning to the previous page.



(3) Select pipe ID. Press  to access Pipe ID for starting the setting.



(4) Press  to start selection. Press  to change the digit. Press and hold  for 3 seconds to save the value. Press   at the same time and you may return to the previous page.



Set the Instantaneous Flow Unit and Set Total Flow Unit

(1) Set the unit of flow. Select the unit of instantaneous flow and then press **ENT** to access Instantaneous Flow Unit. Select according to the desired setting.

Basic Set	1.4	Flow Rate Unit	1.4.1
Device Tag No.		▶▶ L/m	
Pipe ID		L/h	
Pipe ID Unit		m <sup>3</sup> /m	
▶▶ Flow Rate Unit		✓ m <sup>3</sup> /h	

(2) Set Total Flow Unit. Select cumulative total flow unit and then press **ENT** to access. Select according to the desired setting.

Basic Set	1.6	Total Unit	1.6.1
Pipe ID Unit		▶▶ ✓ Liter	
Flow Rate Unit		gal	
Flow Span		m <sup>3</sup>	
▶▶ Total Unit		kg	

## 10.5 Description of parameter setting function

Menu 1	Menu 2	Menu 3	Unit	Default Value	Set value scope	Description of function
Basic Set (1)	Device Tag Num (1.1)	N/A	-	00001	1~65535	Tag number for customer-end factory management
	Pipe ID (1.2)	N/A	Pipe ID Unit	80	xxx.xx	Set pipe ID to calculate volumetric flow.
	Pipe ID Unit (1.3)	N/A		mm	0.mm 1.inch 2.m	Set pipe ID unit
	Flow Unit (1.4)	N/A		m <sup>3</sup> /h	"L/m" "L/h" "m <sup>3</sup> /m" "m <sup>3</sup> /h" "gal/m" "gal/h"	The system will display the corresponding setting unit for the instantaneous flow automatically.
	Flow Span (1.5)	N/A	= Flow Rate Unit		(0.03 ~ 12.0m/s) * (Pipe ID: mm/2) <sup>2</sup> * pi * Flow rate unit (000.00)	The system will correspond such span value set directly to 4-20mA output and frequency output value.
	Total Unit (1.6)	N/A	-	0.Liter	0.Liter 1.gal 2.m <sup>3</sup> 3.kg 4.Ton	The system will display such a setting unit for the Total Flow automatically.
	Total Reset (1.7)	N/A	-	0. No (Cancel)	0. No (Cancel) 1. Yes (Accept)	Delete the total flow currently displayed.
Advanced Set (2)	Zero Adj. (2.1) (Zero Adj.)	AUTO MANUAL	m/s	0.0000	-0.5000~+0.5000	Zero flow offset when no flow under a fully loaded condition
	K-Factor (2.2) (K-Factor)	N/A	Factory calibration value		0.0000~3.0000	Feature parameter of flow-detecting Transducer. True value = Measured value *k
	Low Cutoff (2.3) (Low cutoff)	N/A	%	0.5	0.00~100.00	If a slight flow or vibration occurs in the pipeline, seek for the low flow display shielding (the system will display and accumulate the value if the flow rate is higher than such value).
	Single Cutoff (2.4) (single cutoff)	N/A	%	10	0.00~100.00	If the return wave signal is too weak, jumping and lower than the set shielding, the system will cover up the instantaneous flow.
	Fwd Init. (2.5) (Fwd. Init.)	N/A	= Total Unit	0	0~99999	Initialize the current CW total
I/O Signal Set (3)	Damping Time (3.1) (Damping Time)	N/A	second(s)	6	0~100	Output the mean value of the actual flow rate.



Menu 1	Menu 2	Menu 3	Unit	Default Value	Set value scope	Description of function
	Pulse Out Mode (3.2) (Pulse Out Mode)	N/A	-	0.Pulse NO	0.Pulse NO 1.Pulse NC 2.Frequency	The initial status of the Pulse output contact or the flow rate is displayed with the frequency (if selecting the frequency, it will be displayed according to the flow rate). Pulse No and Nc refer to the high/low potential status during the total output process.
	Pulse Out Unit (3.3) (Pulse Out Unit)	N/A	Unit/pulse	0.1 L	0.001~100(L,gal, m <sup>3</sup> ,g,kg,Ton) L/pulse,gal/pulse,m <sup>3</sup> /pulse,g/pulse,kg/pulse,Ton/pulse	Set the flow rate represented by each pulse.
	Max. Freq. (3.4) (Max. Freq.)	N/A	Hz,kHz	2K	1~8K (00.000)	The maximum output frequency value under the set flow span.
	Curr. Mode (3.5) (Curr. Mode)	N/A	-	4-20	4-20,0-20	Select the current output mode.
	4mA Fine-Tune (3.6) (4mA Fine-Tune)	N/A	count	0	-5000~5000	Adjust the baseline of 4mA output.
	20mA Fine-Tune (3.7) (20mA Fine-Tune)	N/A	count	0	-5000~5000	Adjust the baseline of 20mA output.
System Set (4)	Language (4.1) (Language)	N/A	-	English	English, Standard Chinese, Simplified Chinese	The system will display the desired language.
	System Info. (4.2) (System Info.)	Current flowing speed	m/s			Display current speed
		Current flow rate	= Flow rate unit (Flow Rate Unit)			Display the current flow rate
		Current signal intensity	%			Display current signal intensity
		Temperature				Display current temperature
	Modbus Comm. (4.3) (ModBus Comm.)	Modbus ID	N/A	1	1~255	Basic communication setting
		BaudRate	BPS	9600	1200,2400,4800,9600,19200,38400,57600	
		Data bit	N/A	8	8,9	
		Parity	N/A	none	none,odd, even	
		Stop bit	N/A	1	1,2	

Menu 1	Menu 2	Menu 3	Unit	Default Value	Set value scope	Description of function
	Recover Default (4.4) (Recovery Default)	N/A	N/A	Cancel	Cancel, Accept	
	LCM Brightness (4.5)	N/A	N/A	50%		
Simulation (5) (Resume normal mode after quitting this menu.)	Flow Speed (5.1) (Flow Speed)	N/A	m/s	0	-15 ~ 15	Simulate the flowing speed for the system to make a corresponding reaction. (The menu does not include the return timing function)
	Flow Rate (5.2) (Flow Rate)	N/A	Flow rate unit	0	0~max. value of such diameter.	Simulate the flow rate for the system to make a corresponding reaction. (The menu does not include the return timing function)
	Output Curr. (5.3) (Output Curr.)	N/A	mA	4mA	3.6~22	The system will make the reaction after outputting the current. (The menu does not include the return timing function)
	Output Freq. (5.4) (Output Freq.)	N/A	for the system to make a corresponding reaction.	2	2~8000	The pulse port will output the corresponding frequency. (The menu does not include the return timing function)
Product Info. (6)	F.W. Version (6.1) (F.W. Version)					

## 11. Error message and troubleshooting

Failure Status	Cause of failure	Solution
The water flow rate is abnormally displayed. The signal is violently changed.	The transducer is installed at the position subjecting to stronger pipeline vibration or causing the change of flowing direction. In other words, the position presents an unstable flow field.	Install the transducer at the location without a vibration source or the straight pipeline section where the liquid is flowing steadily.
The value is incorrect ①	If installing the transducer at the top or the bottom of the horizontal pipeline, then the bubbles of the top of the sediment at the bottom will affect the value of the ultrasonic wave.	By installing the transducer at $\pm 45^\circ$ within the optimal installation scope, the lower liquid level of the pipeline can be avoided effectively.
	It is caused by installing the transducer on the pipeline section subjecting to downward flowing and lower liquid level status.	Change the installation position and install it at the upward-flowing pipeline section.
The value is incorrect②	The position subjecting to visible flowing fluctuation such as the Venturi nozzle, pipeline connection area and the position adjacent to the front and rear ends of the equipment cause incorrect values.	Such an issue can be avoided by installing the transducer on the position along the straight pipeline section.
	The pipeline diameter parameters received from the flow meter are inconsistent.	Change the incorrect parameters until the values are consistent.
The transducer is under normal conditions, but the flow rate is low or the water is not flowing.	The paint or the rust remained on the transducer and the pipeline is not removed.	Execute the grinding and cleaning again and then change the coupling agent.
	The concentricity of the pipe is incomplete, and the pipeline surface is uneven or is being installed at the welding area.	Execute the grinding again until smooth and avoid the welding area.
	Serious scum has accumulated on the pipeline lining (such defect is easily caused to the cast iron pipeline).	Select the seamless steel pipeline presenting a smoother internal and external surface or the lower side without being provided with the lining.

	The measured material is excessively clean, or the content of the solid suspension is too low.	Replace it with a suitable transducer.
	Install the transducer on the FRP fabricated pipeline.	Change the installation position.
	When installing the transducer on the waterproof jacket or the pipeline wrapped with insulation cotton, it may degrade the intensity of the return wave signal.	Change the installation position.
	The transducer is incompletely coupled with the pipeline where gaps or bubbles are formed on the coupling face.	Apply the coupling agent again.
	The signal intensity is lower than the set shielding value.	Adjust the signal intensity shielding level.
The value is rising instead of dropping when reducing the flow rate by operating the valve.	The transducer installation position is too close to the valve. When the valve openness is reduced, it will increase the flow speed and result in a higher value.	Sufficient length of a straight pipeline section should be maintained between the transducer and the valve. It should be located at 30D from the upstream and 10D from the downstream.
The value is fluctuating and incorrect when the transducer is operating normally.	The measured material may have changed.	If the material change situation occurs frequently, maybe it should be replaced with a transducer that can adapt to such kind of situation.
	The coupling agent between the transducer and the pipe is embrittled.	Reapply the coupling agent.
	The value has exceeded that of the filter due to the appearance of high frequency.	Reconfirm the filter value.
	The value has exceeded that of the filter due to the appearance of high frequency.	Reconfirm the filter value.

	The transducer is abnormal.	①Restart the transducer. ②Please contact this company to solve the problem.
	The transducer is not tightly fixed to the pipeline.	Check if it has been coated with the coupling agent.
	Check if the liquid inside the pipeline is presenting any bubbles or particles.	Check if the liquid is presenting any bubbles or particles.
The LCM fails to display and is not showing the backlight.	The power is not connected.	Check if the wire is incorrectly connected or broken.

# 12. MODBUS Communication Protocol

## EPF Measuring System ModBus Communication Address (Auto ID)List

Address (Hex)	Address (Dec)	Variable Name	Data Type	Unit	Range	Definition	Authority
0x1000	4096	gt_modbus_slave_fine_tek_id[0]	UINT8	N/A		"IF"	Read only (Header)
0x1001	4097	gt_modbus_slave_fine_tek_id[2]	UINT8	N/A		"EN"	Read only (Header)
0x1002	4098	gt_modbus_slave_fine_tek_id[4]	UINT8	N/A		"T-"	Read only (Header)
0x1003	4099	gt_modbus_slave_fine_tek_id[6]	UINT8	N/A		"KE"	Read only (Header)
0x1004	4100	PFC_PRODUCT_TYPE	UINT16	N/A		"FM"	Read only (Header)
0x1005	4101	PFC_PRODUCT_NUMBER	UINT16	N/A		0x0001	Read only (Header)
0x1006	4102	PFC_PRODUCT_VERSION	UINT16	N/A		0x0001	Read only (Header)
0x1007	4103	PFC_PRODUCT_DATE	UINT32	N/A			Read only (Header)
0x1008	4104						
0x1009	4105	PFC_PRODUCT_TIME	UINT32	N/A			Read only (Header)
0x100A	4106						
0x1010	Measuring status						
0x1010	4112	flow_velocity	FLOAT32	m/s		Current instantaneous flowing speed	Read only
0x1011	4113						
0x1012	4114	gf_pfc_flow_rate	FLOAT32	N/A		Current instantaneous flow rate	Read only
0x1013	4115						
0x1014	4116	gf_fft_signal_strength	FLOAT32	N/A		Current signal intensity	Read only
0x1015	4117						
0x101E	4126	gf_temperature	FLOAT32	°C		Current probe temperature	Read only
0x101F	4127						
0x1030	Parameter set – The field allowed for reading and writing.						
0x1039	4153	PFC_FlowTotal_FRAM_FWD_VA L	FLOAT64			Current total	Read /Write
0x103A	4154						
0x103B	4155						
0x103C	4156						

Address(Hex)	Address(Dec)	Variable Name	Data Type	Unit	Range	Definition	Authority
0x1080	4224	PFC_BASIC_SET_PIPE_ID	FLOAT32			Basic set/Pipe ID set	Read /Write
0x1081	4225						
0x1082	4226	PFC_BASIC_SET_PIPE_ID_UNIT	UINT16			Basic set/Pipe ID Unit set	Read /Write
0x10B0	4272	PFC_SAVE_SYSTEM_VAR_TO_EEPROM	UINT16		0:Idle1, 1:Save	Write in USER EEPROM	Read /Write
0x10B1	4273	PFC_ENG_MODE_SAVE_SETTING	UINT16		0:Idle1, 1:Save	Write in FACTORY set	Read /Write
0x10B2	4274	PFC_LOAD_FIRMWARE_SETTING	UINT16		0:Idle1, 1:load	Restore default value	Read /Write
0x10B3	4275	PFC_BASIC_SET_DEVICE_TAG_NUM	UINT16			Basic Set/Device Tag Num	Read /Write
0x10B4	4276	PFC_BASIC_SET_PIPE_ID	FLOAT32			Basic Set/Pipe ID	Read /Write
0x10B5	4277						
0x10B6	4278	PFC_BASIC_SET_PIPE_ID_UNIT	UINT16			Basic Set/Pipe ID Unit	Read /Write
0x10B7	4279	PFC_BASIC_SET_FLOW_RATE_UNIT	UINT16		0 : FC_FLOW_UNIT_L_m 1 :PFC_FLOW_UNIT_L_h 2 : PFC_FLOW_UNIT_m3_m 3 : PFC_FLOW_UNIT_m3_h 11 : PFC_FLOW_UNIT_L_s 12 : PFC_FLOW_UNIT_m3_s	Basic Set/Flow Rate Unit	Read /Write
0x10B8	4280	PFC_BASIC_SET_FLOW_SPAN	FLOAT64			Basic Set/Flow Span	Read /Write
0x10B9	4281						
0x10BA	4282						
0x10BB	4283						
0x10BC	4284	PFC_BASIC_SET_FLOW_TOTAL_UNIT	UINT16			Basic Set/Total Unit	Read /Write
0x10BD	4285	PFC_BASIC_SET_TOTAL_RESET	UINT16			Basic Set/Total Reset	Read /Write
0x10BE	4286	PFC_ADVANCED_SET_VELOCITY_ZERO_ADJ	FLOAT64			Advanced Set/Zero Adj.	Read /Write
0x10BF	4287						
0x10C0	4288						
0x10C1	4289						
0x10C2	4290	PFC_ADVANCED_SET_K_FACTOR	FLOAT64			Advanced Set/K-Factor	Read /Write
0x10C3	4291						
0x10C4	4292						
0x10C5	4293						

Address (Hex)	Address (Dec)	Variable Name	Data Type	Unit	Range	Definition	Authority
0x10C6	4294	PFC_ADVANCED_SET_LOW_CUTOFF	FLOAT64			Advanced Set/Low Cutoff	Read /Write
0x10C7	4295						
0x10C8	4296						
0x10C9	4297						
0x10CA	4298	PFC_ADVANCED_SET_SIGNAL_CUTOFF	FLOAT64			Advanced Set/Low Signal Cutoff	Read /Write
0x10CB	4299						
0x10CC	4300						
0x10CD	4301						
0x10CE	4302	PFC_ADVANCED_SET_FWD_TOTAL_INIT	FLOAT64			Advanced Set/Total Init.	Read /Write
0x10CF	4303						
0x10D0	4304						
0x10D1	4305						
0x10D2	4306	PFC_IO_SIGNAL_SET_DAMPING_TIME	UINT16			I/O Signal Set/Damping Time	Read /Write
0x10D3	4307	PFC_IO_SIGNAL_SET_PULSE_OUTPUT_MODE	UINT16			I/O Signal Set/Pulse Output Mode	Read /Write
0x10D4	4308	PFC_IO_SIGNAL_SET_PULSE_OUTPUT_UNIT	FLOAT64			I/O Signal Set/Pulse Unit Set	Read /Write
0x10D5	4309						
0x10D6	4310						
0x10D7	4311						
0x10D8	4312	PFC_IO_SIGNAL_SET_MAX_FREQ	FLOAT64			I/O Signal Set/Freq. Set	Read /Write
0x10D9	4313						
0x10DA	4314						
0x10DB	4315						
0x10DC	4316	PFC_IO_SIGNAL_SET_OUTPUT_CURR_MODE	UINT16			I/O Signal Set/Curr. Output Mode Set	Read /Write
0x10DD	4317	PFC_IO_SIGNAL_SET_4MA_FINE_TUNE	UINT16			I/O Signal Set/4mA Fine-Tune	Read /Write
0x10DE	4318	PFC_IO_SIGNAL_SET_20MA_FINE_TUNE	UINT16			I/O Signal Set/20mA Fine-Tune	Read /Write
0x10DF	4319	PFC_SYSTEM_SET_LANGUAGE	UINT16			System Set/Language	Read /Write



Address(Hex)	Address(Dec)	Variable Name	Data Type	Unit	Range	Definition	Authority
0x10E0	4320	flow_velocity	FLOAT32			System Set/System Info./ Current Flowing Speed	Read /Write
0x10E1	4321						
0x10E2	4322	gf_pfc_flow_rate	FLOAT32			System Set/System Info./ Current Flow Rate	Read /Write
0x10E3	4323						
0x10E4	4324	gf_fft_signal_strength	FLOAT32			System Set/System Info./ Current Signal Intensity	Read /Write
0x10E5	4325						
0x10E6	4326	gf_temperature	FLOAT32			System Set/System Info./ Temperature	Read /Write
0x10E7	4327						
0x10E8	4328	PFC_LCM_BRIGHTNESS_VAL	UINT16		0~100	System Set/LCM Brightness	Read /Write
0x1110	4368	PFC_SYSTEM_SET_MODBUS_ID	UINT16		1~255	System Set/MODBUS Comm./ ID	Read /Write
0x1111	4369	PFC_SYSTEM_SET_MODBUS_BAUDRATE_SEL	UINT16		0:1200 1:2400 2:4800 3:9600 4:19200 5:38400 6:57600 7:115200	System Set/MODBUS Comm./BAUDRATE	Read /Write
0x1112	4370	PFC_SYSTEM_SET_MODBUS_PARITY_SEL	UINT16		0: None 1: Even 2: Odd	System Set/MODBUS Comm./ PARITY	Read /Write
0x1113	4371	PFC_SYSTEM_SET_MODBUS_STOPBITS_SEL	UINT16		0: 1 1: 2	System Set/MODBUS Comm./STOPBITS	Read /Write