

Ultrasonic flow meter

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Preface

Thank you for purchasing ultrasonic flowmeter. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

J-DCS2000H-MYEN1

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Chapter 1 Introduction

1.1. Preface

You are welcome to buy a portable/handheld ultrasonic flow meter.

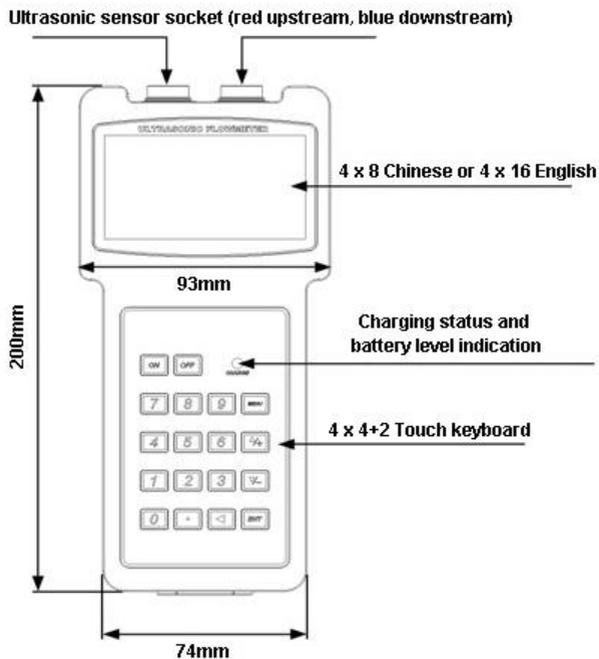
This manual explains the characteristics, configuration, measurement methods, how to use, failure causes, and maintenance of portable/handheld ultrasonic flow meters.

To ensure correct use, please read this manual carefully before use.

In addition, please keep this manual in a place where the user can refer to it at any time.

1.2. Goods confirmation

1.2.1. monitor



1.2.2. Sensor

Name	Model	Range	Temp.	Picture
Small size	TS-2	DN32~100	-30~90	
Medium size	TM-1	DN50~700	-30~90	
Large size	TL-1	DN300~6000	-30~90	
High temp. small size	TS-2-HT	DN32~100	-30~160	
High temp. medium size	TM-1-HT	DN50~700	-30~160	
High temp. large size	TL-1-HT	DN300~6000	-30~160	
Bracket type small size	HS	DN32~100	-30~90	
Bracket type medium size	HM	DN50~300	-30~90	
High temp. bracket small size	HS-HT	DN32~100	-30~160	
High temp. bracket medium size	HM-HT	DN50~300	-30~160	
Extension bracket	EB-1	DN300~700	—	

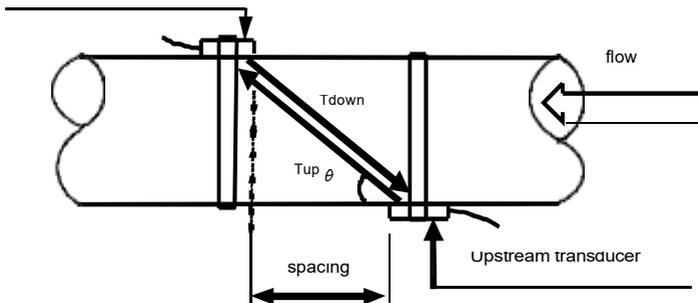
1.3. Specifications

Accuracy	±1%	
Range	32mm~6000mm	
Pipe material	Steel, stainless steel, cast iron, PVC, copper, aluminum, and other dense pipelines. Lining is allowed	
Medium	Water, sea water, industrial sewage, acid and alkali, alcohol, beer, various oils and other single uniform liquids that can conduct ultrasonic waves	
Screen	4*16 dot matrix backlit LCD display	
Communication	RS232	
Protocol	MODBUS, M-BUS, FUJI extended protocol, simple water meter protocol, compatible with other manufacturers' protocols	
Output	1channel OCT output	
Data record	Built-in 32Mbit memory	
Power Supply	Adapter	Power: 6W
		Input: AC90~260V
		Output: DC6V
	Battery	Type: Ni MH Unit: 3 sections 1.2V Capacity: 2000 mAh Charging time: 8h Working time: more than 12h Use power adapter charging, can achieve uninterrupted measurement.
	Feature	Intelligent charging management, charging status indication, anti-overcharge, over-discharge protection, real-time power detection, prompt the remaining work time
Housing Material	ABS	
Case Size	200x93x33mm	
Handset Weight	390g with batteries	

1.4. Principle Of Measurement

Our ultrasonic flow meter is designed to measure the fluid velocity of liquid within a closed conduit. The transducers are a non-contacting, clamp-on type, which will provide benefits of non-fouling operation and easy installation.

The transit time flow meter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe at a specific distance from each other. The transducers can be mounted in V-method where the sound transverses the pipe twice, or W-method where the sound transverses the pipe four times, or in Z-method where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. This selection of the mounting method depends on pipe and liquid characteristics. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that it takes for sound to travel between the two transducers. The difference in the transit time measured is directly and exactly related to the velocity of the liquid in the pipe.



$$V = \frac{MD}{\sin 2\theta} \times \frac{\Delta T}{T_{up} + T_{down}}$$

θ is the include angle to the flow direction

M is the travel times of the ultrasonic beam

D is the pipe diameter

T up is the time for the beam from upstream transducer to the downstream one

T down is the time for the beam from downstream transducer to the upstream one

$$\Delta T = T_{up} - T_{down}$$

1.5. Typical Application

Portable/handheld ultrasonic flowmeter is used to measure the flow and heat of various single uniform liquids that can conduct ultrasonic waves.

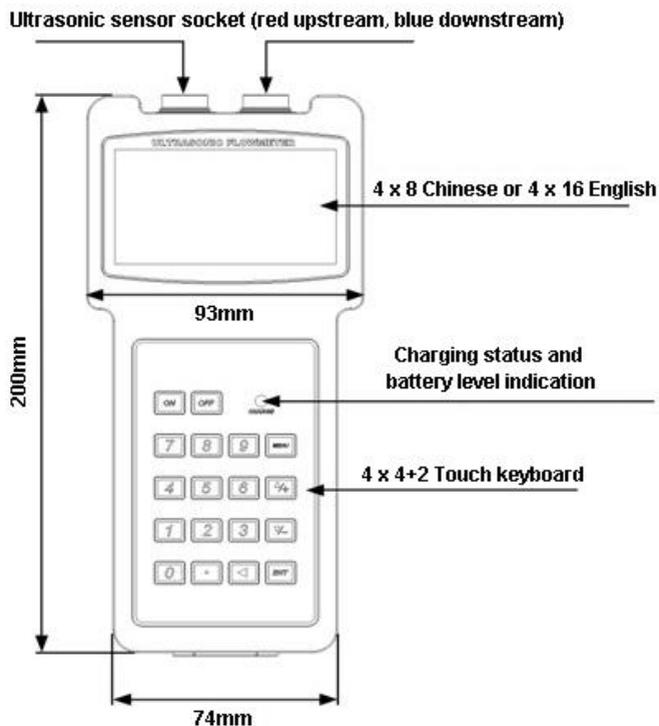
Portable/handheld ultrasonic flowmeter adopts non-contact measurement method, with large measurement range, no moving mechanical parts, and is not affected by system pressure and harsh environment. It has been widely applied to water, pure water, sea water, sewage, chemical liquids, rivers In the measurement of water, fuel oil and other fluids. The upper limit temperature of the standard sensor is 110°C. Please contact the manufacturer or supplier if the temperature exceeds this temperature.

Portable/handheld ultrasonic energy meters are widely used in the measurement of system energy consumption in refrigeration, heating, heat exchangers, freezers, boilers and other industries.

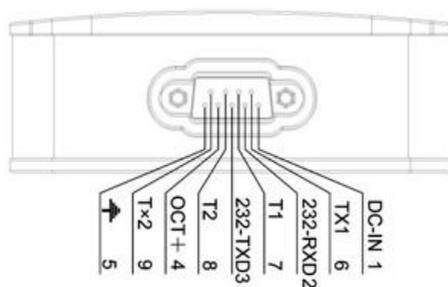
1.6. Parts Identification

1.6.1. Converter:

➤ Front view



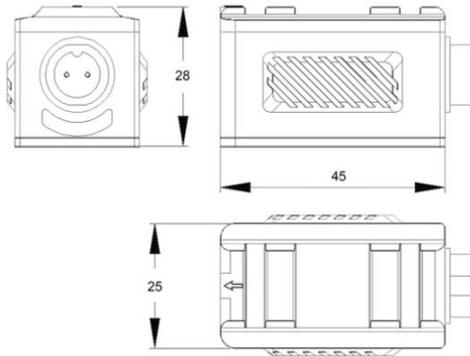
➤ Side view:



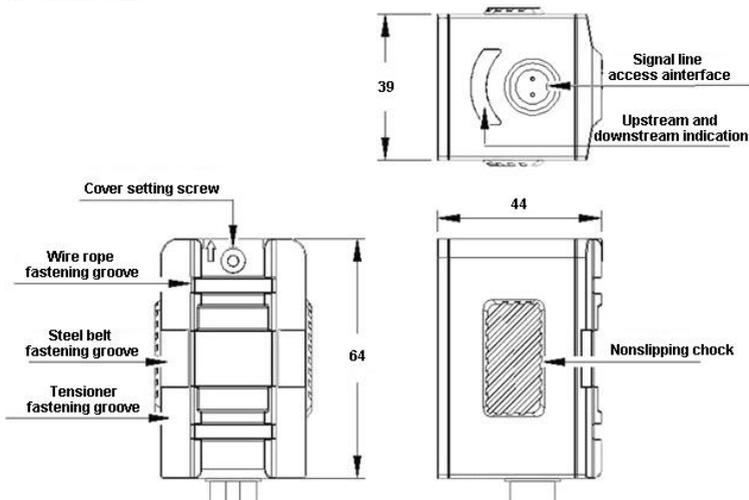
- **Output signal:**
 - 1–5: Power terminal
 - 2–3: **RS232** communication interface
 - 4 - 5: OCT pulse signal output interface
 - 6 - 7: Inlet pipe temperature resistance interface
 - 8–9: Outlet pipe temperature resistance interface

1.6.2 Sensor

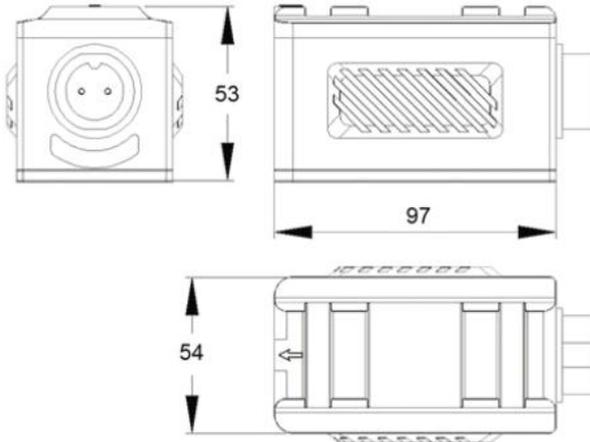
- **Small size**



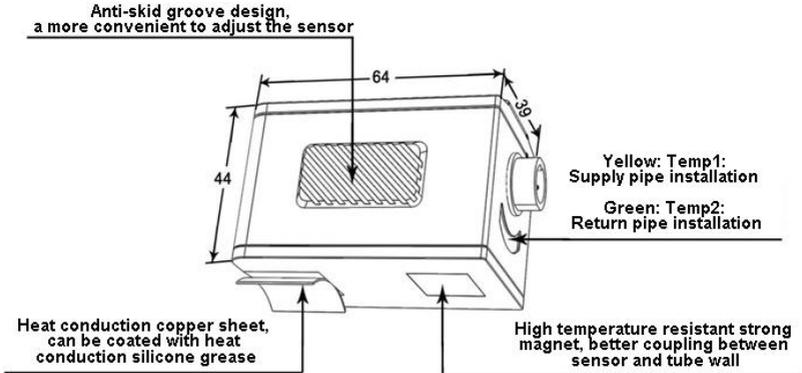
- **Medium size**



➤ **Large size**



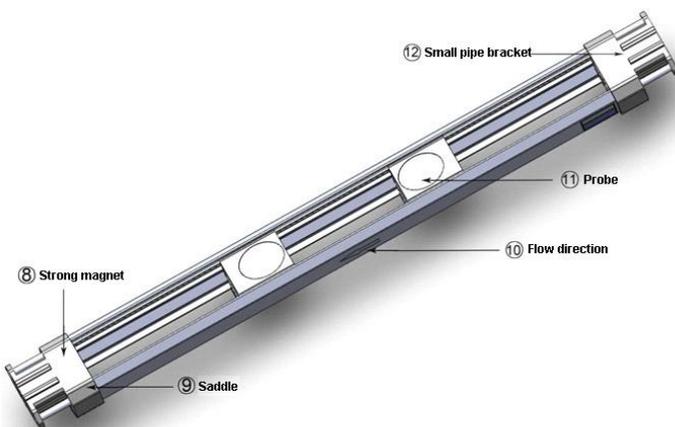
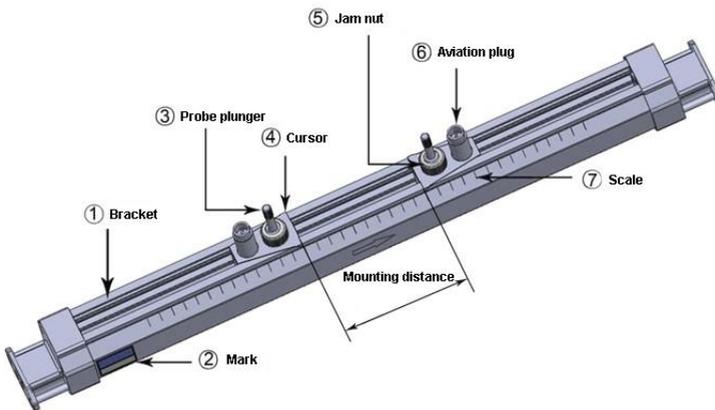
1.6.2. High temperature compact on sensor



The high temperature clamped sensor is made of special custom-made high temperature resistant materials. The fluid temperature range can be measured from -30°C to 160°C . Different types of sensors can be selected according to different pipe diameters. See page 7 for sensor options in the host menu.

- High temperature outside the clip-on small sensors (TS - 2 - HT)
Same size as standard small sensor (TS-2)
- High temperature outside the clip-on medium-sized sensors-1-HT(TM)
The same size as standard medium sensor(TM-1)
- Outside clip-on large high temperature sensor (TL - 1 - HT)
The same size as standard medium sensor (TM-1)

1.6.3. Bracket transducers



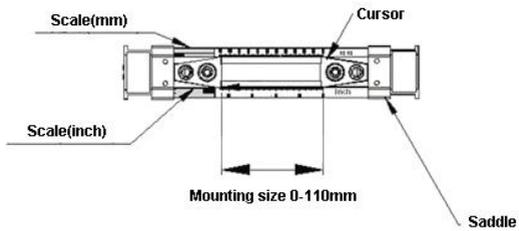
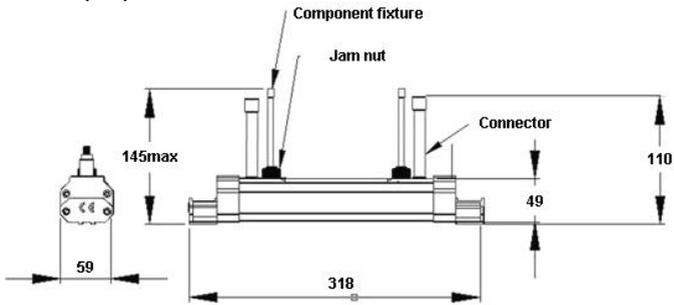
Description of each part:

1. Support frame: made of aluminum alloy, used to support and slide the probe.
2. Label: used to indicate the type of bracket probe.
3. Probe jacking rod: the probe can be moved up and down to press the probe against the wall or remove the probe.
4. Marker: Used to determine probe position.
5. Lock nut: Used to loosen or lock the probe.
6. Aviation plug: used to connect ultrasonic flowmeter and bracket probe.
7. Incense: Available in metric and imperial systems, used to indicate probe mounting distance.
8. Strong Magnet: Used to fix the bracket probe to steel or cast iron pipe.
9. Saddle: made of aluminum, used for fixing bracket probe, suitable for magic belt fixing, steel belt fixing, tension belt fixing.
10. Fluid flow direction indicator: used to indicate the mounting direction of the bracket probe, consistent with the direction of fluid flow.
11. Probe head: Used to transmit and receive ultrasonic signal.

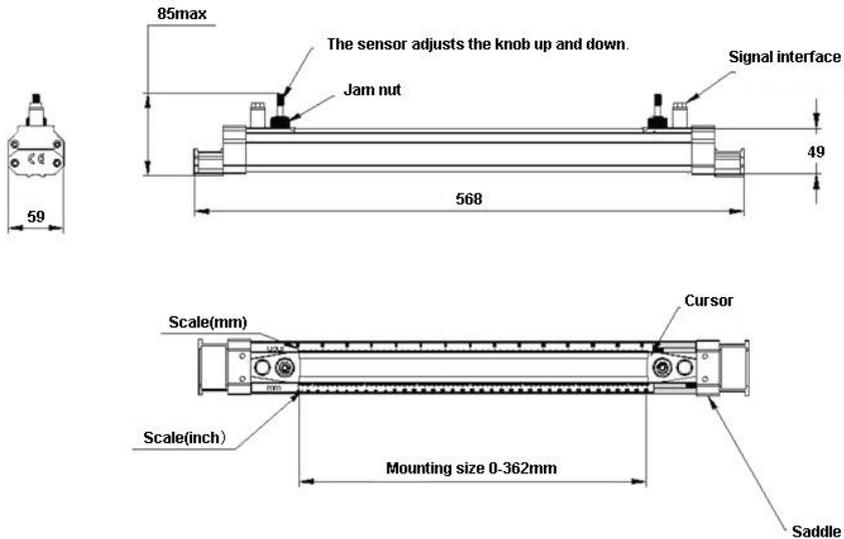
Small caliber bracket: used to fix the bracket probe, installed in pipes smaller than DN50mm.

View and size

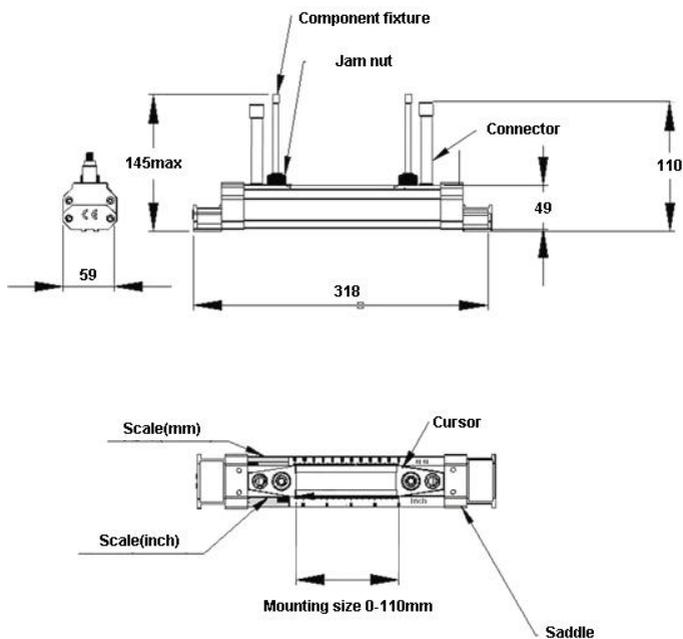
➤ **Small size (HS)**



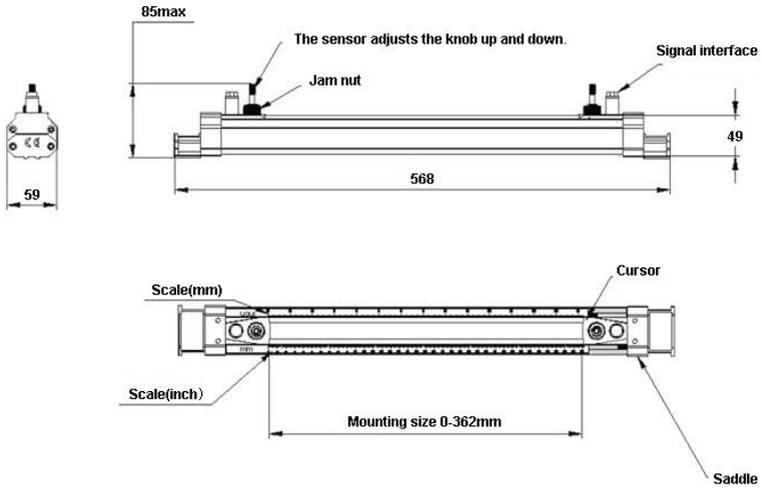
➤ **Medium size (HM)**



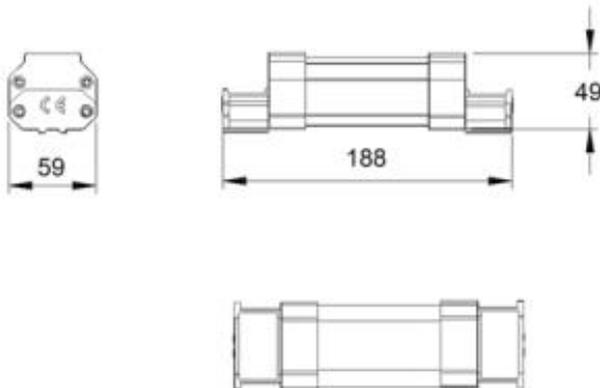
➤ High temp. Small size (HS-HT)



➤ High temp. Medium size (HM-HT)



➤ Extension bracket



Chapter 2 Operation

2.1. Power On

Press the **ON** to switch on the instrument and press the **OFF** to turn off the power.

2.2. Charging and capacity

(1) Charge indicator light status description

The power supply of the ultrasonic flowmeter is the built-in rechargeable Ni-HM battery, and the use of external charger can achieve uninterrupted measurement. The main machine is equipped with Charge indicator and Battery indicator, which is convenient for users to use.

Indicator light status	Status description
Red indicator light always on	Be charging
Green indicator light always on	Battery fully charged

(2) Battery indicator light status description

Indicator light status	Status description	Estimated remaining working hours (hours)
		Handheld type
Green indicator light on	Battery capacity \geq 30%	\geq 4
Yellow indicator light on	$10 \leq$ Battery capacity \leq 30%	1~4
Red indicator light on	Battery capacity \leq 10%	\leq 1
Red indicator light on	The battery status is abnormal during charging, please send it to repair.	
Remarks	When the battery runs out, the mainframe shuts down automatically	

2.3. Display

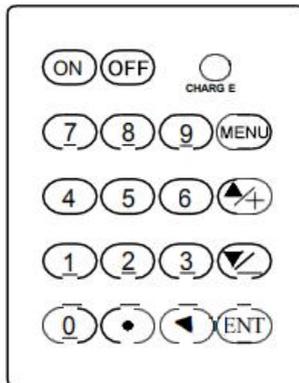
Positive cumulative	0 m ³
Flow	0.0000 m ³ /h
Flowrate	0.0000 m/s
S= 000,000 Q=00 l	

All measurement results and the menu for setting up the meter are arranged into over 100 different Windows. These Windows are referred to as M00, M01.....M99, M + 0...M+9 and other Windows.

You can use the MEMU key and enter two numeric keys to enter a window quickly, or you can use the up or down keys to enter the window above or below the adjacent.

2.4. Keypad

The keypad for the operation of the flow meter has 16+2 keys, as shown by the right picture.



The 0~9 and \odot Keys are used to enter numbers or menu numbers;

The \leftarrow key is used to backspace or delete the left character.

\uparrow and \downarrow are used to enter the previous menu or the next menu. When

entering the number, they are equivalent to the plus and minus sign keys.

 key (referred to as M key) for access to the MENU, first type this key and then type two numeric keys, you can enter the corresponding number MENU window; The  key is the enter key, also known as the OK key, which is used to "confirm" the number entered or the selection. Another function is to press this key before entering a parameter to enter the "Modify" state.

The ultrasonic flowmeter/heat meter uses windowed software design. A quick way to access the window is to type  key in any state, followed by a two-digit window address code. For example, to enter or view pipe diameter parameters, the window address is 11, and type   .

Another way to access the window is to move it. Use the keys  and  and . For example, the current window is 66, and type  to enter the window 65 and then type  enter window 64; When I type this, I go back to window 65. Then I type this again, again to window 66.

Under normal circumstances, if you want to "modify" the operation, you must first type  key (you can omit the number type window), if you can't enter the modified state after typing  key, the instrument has been added with password protection. The user must select the "unlock" item in the No. 47 window and enter the original password before modifying the operation.

Chapter 3 Menu Windows Arrangement

The window is arranged according to the following rules. Keep in mind these window arrangements, which can effectively improve the operation speed and also facilitate the use of shortcut keys.

M00~M09 windows for showing measurement results.

M10~M29 windows for setting initial parameters.

M30~M38 windows for setting flow unit.

M40~M49 windows for selecting settings.

M50~M83 windows for setting data signal input and output.

M84~M89 windows for setting heat measurement.

M90~M94 windows for diagnosing flow measurement correct or not.

M96~M99 windows for print setting.

M+0~+9 windows for additional features that are less commonly used.

3.1. Menu window general

Flow accumulati on display	0	Display instantaneous flow/net accumulation	Default setting	13	Input pipe inner diameter
	1	Display instantaneous flow rate / instantaneous flow rate		14	Select pipe material type
	2	Display instantaneous flow/positive totalizer		15	Input pipe sound velocity
	3	Display instantaneous flow / negative totalizer		16	Select the type of lining material
	4	Display date and time / instantaneous flow		17	Enter the sound velocity of the lining material
	5	Display heat flow/total heat		18	Enter the lining thickness
	6	Display temperature input T1, T2		19	Enter the absolute roughness of the inner wall
	7	Display analog input AI3, AI4		20	Select fluid type
	8	Display system error code		21	Enter fluid sound velocity
	9	Display today's net cumulative flow		22	Enter fluid viscosity
	10	Input pipe outer circumference		23	Select sensor type
	11	Input pipe outer diameter		24	Select the sensor installation method (handheld: select the sensor frequency)
	12	Enter pipe wall thickness		25	Display sensor installation distance (handheld: select sensor installation method)
	26	Parameter curing and setting (handheld: sensor installation distance)	Input and output settings	55	Current loop output mode selection
Default setting	27	Installation point installation parameter access		56	Corresponding value when current loop 4mA or 0mA output
	28	Set to keep the last data when the signal becomes worse		57	Corresponding value when current loop 20mA output
	29	Signal strength when setting empty pipe		58	Current loop output inspection

	30	Select the metric system			59	Current output value of current loop
Flow unit setting	31	Select instantaneous flow unit			60	Date time and settings
	32	Select cumulative flow unit			61	Software version number and electronic serial number
	33	Select the accumulator multiplication factor			62	Set serial port parameters
	34	Net accumulator switch			63	Communication protocol selection (including compatible protocol selection)
	35	Positive accumulator switch			64	Analog input AI3 corresponding value range
	36	Negative accumulator switch			65	Analog input AI4 corresponding value range
	37	Select the totalizer to clear			66	Analog input AI5 corresponding value range
	38	Manual accumulator			67	Set frequency output signal frequency range
	39	Operation interface language selection			68	Set frequency signal output lower limit flow
	3.	Set local LCD display mode			69	Set frequency signal output upper limit flow
Choose settings	40	Enter the damping coefficient			70	Display backlight control
	41	Enter low flow cutoff value			71	Display contrast control
	42	Set static zero point			72	Working timer (can be cleared)
	43	Clear the zero setting and restore the original value			73	Set #1 alarm lower limit flow
	44	Manual zero setting			74	Set #1 alarm upper limit flow
	45	Meter factor			75	Set #2 alarm lower limit flow
	46	Enter the network identification address code			76	Set #2 alarm upper limit flow
	47	Password protected operation			77	Buzzer setting options
	48	Linearity broken line correction data input			78	Set the open collector level (OCT) output option
	49	Network communication tester			79	Set relay (or OCT2) output options
	4A	Handheld recorder memory			80	Select quantitative

		management			(batch) controller control signal
	50	Data timing output option setting		81	Flow rate (batch) controller
	51	Timing output time setting		82	Day month year accumulator
	52	Print data flow control		83	Automatically add and break current switch
	53	Display analog input AI5	Heat	84	Select heat unit
	54	OCT pulse width setting (6-1000)		85	Select temperature signal source
Heat test	86	Heat capacity	Hardware adjustment window	0.2	Store static zero point
	87	Heat accumulator switch		0.5	Q value threshold setting
	88	Heat accumulation product factor		0.8	Maximum instantaneous flow of the day and month
	89	Display current temperature difference and set temperature difference sensitivity		0.9	Serial port test window with CMM command output
	8.	Select the installation location of the heat meter		0	Circuit hardware parameter adjustment entrance
Diagnosis	90	Display signal strength and signal quality		-1	4-20 mA current loop calibration
	91	Display signal transmission time ratio		-2	AI3 analog input 4 mA input calibration
	92	Display calculated fluid sound velocity		-3	AI3 analog input 20 mA input calibration
	93	Display total transmission time/time difference		-4	AI4 analog input 4 mA input calibration
	94	Display Reynolds number and its pipe coefficient		-5	AI4 analog input 20 mA input calibration
	95	Display positive and negative heat accumulation and start cycle display function	-6	AI5 analog input 4 mA input calibration	
Print	96	Printer paper feed	-7	AI5 analog input 20 mA input calibration	
	97	Initial setting content printing	-8	Zero point setting when PT100 is low temperature (<40°C)	
	98	Measurement word diagnosis content printing	-9	Zero point setting when PT100 is high temperature (>55°C)	
	99	Screen copy printing	-A	PT100 standard calibration at 50°C	
Additional	0	Display power-on and	-B	PT100 standard	

window		power-off time and flow		calibration at 84.5°C
	1	Display the total working time of the flowmeter		
	2	Display the time of the last power failure		
	3	Show the flow when the power was last cut off		
	4	Display total power-on times		
	5	Scientific calculator		
	6	Fluid sound velocity threshold setting		
	7	Net cumulative amount this month		
	8	Net cumulative this year		
	9	Fault operation time (including power outage time)		

Menu window No.	Function
M00	Display three positive negative net totalizers, signal strength, signal quality and working status
M01	Display POS totalizer, flow rate, velocity, signal strength, signal quality and working status
M02	Display NEG totalizer, flow rate, velocity, signal strength, signal quality and working status
M03	Display NET totalizer, flow rate, velocity, signal strength, signal quality and working status
M04	Display date and time, flow rate, signal strength, signal quality and working status
M05	Display date and time, velocity, signal strength, signal quality and working status
M06	Display temperature input T1,T2
M07	Display analog input AI3,AI4
M08	Display system error code
M09	Display today's total flow, velocity, signal strength, signal quality and working status
M10	Window for entering the outer perimeter of the pipe
M11	Window for entering the outer diameter of the pipe 0 to 6000mm is the allowed range of the value.

M12	Window for entering pipe wall thickness
M13	Window for entering the inner diameter of the pipe
M14	Window for selecting pipe material Standard pipe materials (that the user need not know the speed) include: (0) carbon steel (1) stainless steel (2) cast iron (3) ductile iron (4) copper (5) PVC (6) aluminum (7) asbestos (8) fiberglass
M15	Window for entering the pipe material speed only for non-standard pipe materials
M16	Window for selecting the liner material, select none for pipes without any liner Standard liner materials that the user need not know the speed include: (1) Tar Epoxy (2) Rubber (3) Mortar (4) Polypropylene (5) Polystyrol (6)Polystyrene (7) Polyester (8) Polyethylene (9) Ebonite (10) Teflon
M17	Window for entering the liner material speed only for non-standard liner materials
M18	Window for entering the liner thickness, if there is a liner
M19	Window for entering the ABS thickness of the inside wall of the pipe
M20	Window for selecting fluid type For standard liquids that the user need not know the liquid speed include: (0) Water (1) Sea Water (2) Kerosene (3) Gasoline (4) Fuel oil (5) Crude Oil (6) Propane at -45C (7) Butane at 0C (8)Other liquids (9) Diesel Oil (10)Caster Oil (11)Peanut Oil (12) #90 Gasoline (13) #93 Gasoline (14) Alcohol (15) Hot water at 125C
M21	Window for entering the fluid sonic velocity only for non-standard liquids
M22	Window for entering the viscosity of the non-standard liquids
M23	Window for selecting the proper transducers There are 22 different types of transducers for selection. If the user-type-transducers are used, 4 user type wedge parameters, which will be prompted by the software, should be entered following. If the π type transducers are used, 3 π type transducers and pipe parameters should be entered following.
M24	Window for selecting the transducer mounting methods Four methods can be selected: (0) V-method (1) Z-method(2) N-method (3) W-method
M25	Display the transducer mounting spacing
M26	Entry to store the parameter configuration into the internal NVRAM
M27	Entry to load one set of saved parameters

M28	Select YES or NO for the instrument to determine whether or not to hold (or to keep) the last correct value when poor signal condition occurs. YES is the default setup
M29	Enter a value ranging from 000 to 999. 0 is the default value
M30	Window for selecting unit system. Default value is 'Metric'. The change from English to Metric or vice versa will not affect the unit for totalizers.
M31	Window for selecting flow rate that will be used by the instrument afterward. Flow rate can be in Cubic meter short for (m ³) Liter (l) USA gallon (gal) Imperial Gallon (igl) Million USA gallon (mgl) Cubic feet (cf) US barrels of oil (OB) British barrels of oil (IB) The flow unit in terms of time can be per day, per hour, per minute or per second. So there are 36 different flow rate units in total for selection.
M32	Window for selecting the totalizers' working unit
M33	Select totalizer multiplier The multiplier ranges from 0.001 to 10000
M34	Turn on or turn off the NET totalizer
M35	Turn on or turn off the POS totalizer
M36	Turn on or turn off the NEG totalizer
M37	Totalizer reset Restore the instrument to the default parameters as the manufacturer did by pressing the dot key followed by the backspace key. Take care or make note on the parameters before doing the restoration
M38	Press-a-key-to-run or to stop totalizer for easier calibration
M39	Select three languages for display: Chinese, English, Italian, French, Portuguese, Turkish, and Spanish
M40	Flow rate damper for a stable value. The input range is 0 to 999 seconds. 0 means there is no damping. Default value is 10 seconds
M41	Lower flow rate cut-off to avoid invalid accumulation.
M42	Zero point setup under the condition when there is no liquid running inside the pipe.
M43	Clear the zero point set by the user, and restore the zero point set by the manufacturer
M44	Set up a manual flow bias. Generally this value should be 0.
M45	Scale factor for the instrument. The default value is "1". Keep this value as "1", when no user calibration has been made.

M46	Network environment Identification Number. Any integer can be entered except 13(ODH, carriage return), 10 (0AH, line feeding), 42 (2AH), 38, 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer to the chapter for communication.
M47	System locker to avoid modification of the parameters
M48	Linear polyline correction data input
M49	Communication tester
M50	“Option” selection for the built-in logger. It also functions as the switch of logger
M51	Time setup for the data logger
M52	Data output flow control, such as select "0. Input to the internal serial bus", data is sent to the printer; If select "1. Output to serial port", the data will be sent to RS485/RS232 interface;2. Output to internal 32Mbit memory
M53	Display analog input AI5
M54	Display pulse output pulse width setting (6-1000)
M55	Current loop output mode selection
M56	The corresponding value for 4mA or 0mA output of the current loop
M57	Current loop 20mA output corresponding value
M58	Current loop output check
M59	Current output value of current loop
M60	Set date and time
M61	Display Version information and Electronic Serial Number (ESN) that are unique for each Ultrasonic flow meter. The users can employ the ESN for instrumentation management
M62	RS-232 setup. Baud rate can be 75 to 115200 bps
M63	Communication protocol selection (including compatible protocol selection)
M64	Simulate input AI3 corresponding value range
M65	Simulate input AI4 corresponding value range
M66	Simulate input AI5 corresponding value range
M67	Input the frequency range for the frequency output. The biggest range is 0Hz-9999Hz. Default value is 1-1001 Hz
M68	Enter a flow rate value that corresponds to lower frequency
M69	Enter a flow Rate value that corresponds to higher frequency
M70	LCD display backlight control. The entered value indicates how many

	seconds the backlight will be on with every key pressing.
M71	LCD contrast control. The LCD will become darker when a small value is entered.
M72	Working timer. It can be cleared by pressing ENT key, and then select YES.
M73	Enter Lower Flow Rate value that will trigger the #1 Alarm. There are two virtual alarms in the system. By "virtual" we mean that the user must redirect the output of the alarms by setuping the output hardware in M78 and M77
M74	Enter the higher flow rate value that will trigger the #1 Alarm.
M75	Enter the lower flow rate value that will trigger the #2 Alarm.
M76	Enter the higher flow rate value that will trigger the #2 Alarm.
M77	Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs
M78	OCT (Open Collect Transistor Output) setup By selecting a proper input source, the OCT hardware will close when the trigger event occurs
M79	Set relay output options
M80	Select the quantitative (batch) controller to control the signal
M81	Select a quantitative (batch) controller
M82	Date totalizer
M83	Automatic supplementary power off flow switch
M84	Not used
M85	Not used
M86	Not used
M87	Not used
M88	Not used
M89	Not used
M90	Display signal strength, signal quality, time ratio on the upper right corner.
M91	Displays the Time Ratio between the Measured Total Transit Time and the Calculated time. If the pipe parameters are entered correctly and the transducers are properly installed, the ratio value should be in the range of 100±3%. Otherwise the entered parameters and the transducer installation should be checked.
	Displays the estimated fluid sound velocity. If this value has an obvious

M92	difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again.
M93	Displays total transit time and delta time(transit time difference)
M94	Displays the Reynolds number and the pipe factor used by the flow rate program.
M95	Not used
M96	Not used
M97	Command to record the pipe parameters entered by the user either to the built- in data logger or to RS-232C serial interface
M98	Command to record the diagnostic information either to the built-in data logger or to RS-232C serial interface
M99	Command to copy the current display either to the built-in data logger or to RS-232C serial interface
M+0	Display the last power outage time and flow rate
M+1	Displays the total working time of the instrument
M+2	Displays the last power-off date and time
M+3	Displays the last power-off flow rate
M+4	Displays the times of instrument powered on(the instrument has been powered on)
M+5	A scientific calculator for the convenience of field working. All the values are in single accuracy. The drawback is that the user can't operate it by direct key-pressing
M+6	Automatic supplement-off flow switch fluid sound velocity threshold setting
M+7	Net cumulative flow this year
M+8	Net cumulative flow this year
M+9	Total time of failure operation (including power outage time)
M.2	Store static zero
M.5	The threshold value of Q is set
M.8	Maximum instantaneous flow for the day and month
M.9	Serial test window with CMM instruction indicating output
M-0	Circuit hardware parameter adjustment inlet
M-1	4-20mA current loop calibration
M-2	AI3 analog input 4 mA input calibration
M-3	AI3 analog input 20 mA input calibration

M-4	AI4 analog input 4 mA input calibration
M-5	AI4 analog input 20 mA input calibration
M-6	AI5 analog input 4 mA input calibration
M-7	AI5 analog input 20 mA input calibration
M-8	PT100 zero setting at low temperature (< 40°C)
M-9	PT100 at high temperature (> 55°C) zero setting
M-A	PT100 standard calibration at 50°C
M-B	PT100 standard calibration at 84.5°C

Note: 1. Detailed explanation is provided for each menu;

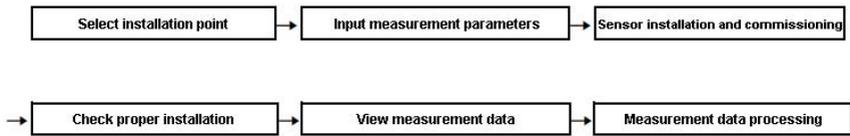
2. Menu may be added, deleted or modified.

Menu details and the latest update software, please obtain from the supplier or download from the manufacturer's website.

Chapter 4 Flow measurement

Portable/handheld ultrasonic flowmeter of simple and convenient flow measurement, only selecting a proper installation, pipeline parameters of input on a host computer installation points, and then according to the host for installation of sensors, the sensor installed on the pipe surface, and ultrasonic special cable to connect to the host, can complete the flow measurement. As shown in the figure:

It can be operated according to the following steps:



4.1. Select installation point

The selection of installation points is the key to the correct measurement. The following factors must be considered in the selection of installation points:

Full pipe, steady flow, scaling, temperature, and interference are described below.

4.1.1. Full pipe

To ensure measurement accuracy and stability, the fluid at the measurement point must be filled with the pipe (otherwise the measurement value will be too large or Can't be measured). Therefore, the following conditions should be met during installation:

The two sensors shall be mounted horizontally on the axial plane of the pipe within a range of 45° as shown in Fig. 2.

In order to prevent the upper dissatisfaction tube, bubble or lower precipitation and other phenomena affect the normal sensor measurement.

The following methods can be used to determine whether the tube is full:

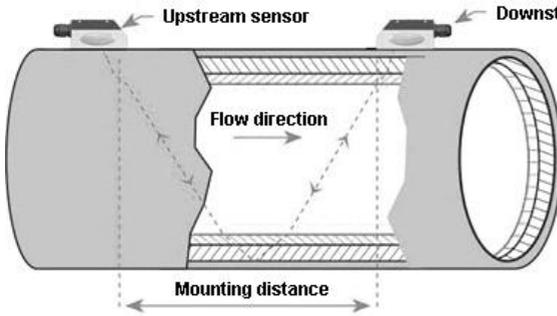


Figure 1 - Top view

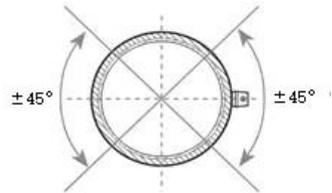


Figure 2- Side view

Full pipe	Possible dissatisfaction with management
A vertical upward flow pipe	A vertical downward flow pipe
An upward sloping pipe	An downward sloping pipe
The lowest point in a piping system	The highest point in a piping system
	Natural flow
	No pressure in the pipe

4.1.2. Steady Flow

The steady flow of the fluid contributes to the stability of the measurement, thus ensuring the accuracy of the measurement. And the flow state is chaotic flow. To make the measured data unstable or unmeasurable.

To meet the standard requirements of steady flow conditions:

1. When the pipeline is far away from the pump outlet and the valve is partially opened, the straight pipe section shall be 10D upstream and 5D downstream (D is the outer pipe diameter).
2. 30D from the pump outlet and the straight pipe section of the semi-open valve.

If it fails to meet the standard requirements of steady flow conditions, the following conditions can also be measured:

1, there is an elbow or buffer device between the pump outlet, the half-open valve and the installation point.

2, the inlet of the pump, upstream of the valve.

3. The flow rate of the fluid is medium and low.

(Low flow rate: flow rate $< 1\text{m/s}$; Medium flow rate: flow rate $1\sim 2\text{m/s}$; High flow rate: flow rate $> 2\text{m/s}$).

Unsteady flow may occur under the following conditions, so it is necessary to be careful when selecting measurement points.

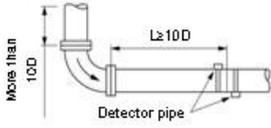
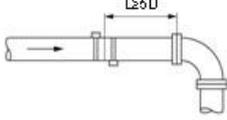
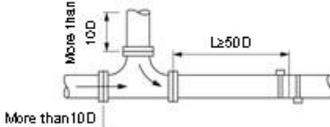
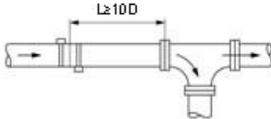
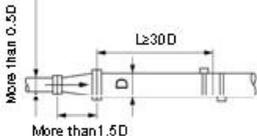
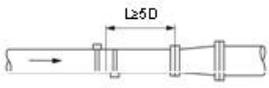
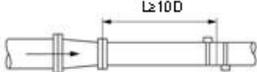
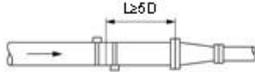
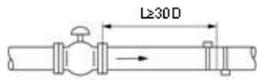
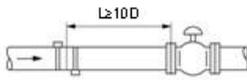
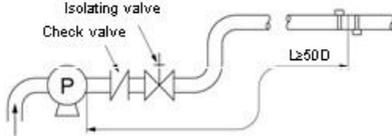
1. The distance from the measuring point to the outlet of the pump and the straight pipe section of the half-open valve cannot be guaranteed to be $10D$, and there is no elbow and other buffer device.

2. The distance between the measuring point and the outlet of the pump and the straight pipe section of the semi-open valve cannot be guaranteed for $10D$, and the flow rate is high.

3. Vertical downward flow, oblique downward flow.

4. The downstream pipe of the measuring point is open, and the straight pipe segment is less than $10D$.

Examples of sensor mounting points under ideal conditions:

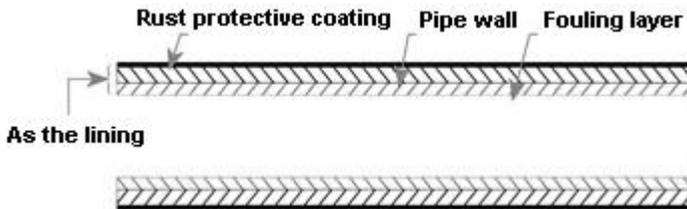
Sort	Upstream side straight pipe length	Downstream side straight pipe length
90 ° Bend		
T Pipe		
Expanded Pipe		
Collapsible Pipe		
Various Valves	 <p>The upstream side valve is used for flow regulation.</p>	 <p>The downstream side valve is used for flow regulation.</p>
Pump		

4.1.3. Scaling

Scaling on the inner wall of the pipe will attenuate the transmission of ultrasonic signal and reduce the pipe inner diameter. Therefore, the scaling of the inner wall of the pipe will make the flow meter can not be measured normally or affect the measurement accuracy. Therefore, it is necessary to avoid choosing the place of scaling on the inner wall of the pipeline as the installation point. If the scaling installation point cannot be avoided, the following measures can be taken to

eliminate or reduce the shadow noise of the measurement of scaling on the inner wall of the pipe

- 1.Hit the pipe at the measuring point with a hammer until the signal strength at the measuring point increases significantly.
- 2.Z method was selected for measurement, and scaling was set as lining to obtain better measurement accuracy.
- 3.Replace the pipe at the measuring point.



4.1.4. Temperature

Extrapolating the temperature range of the sensor can easily cause damage to the sensor or significantly shorten the life of the sensor. Therefore, the temperature of the fluid at the installation point must be within the range of the installation and use of the sensor, and try to choose the installation point with lower temperature. Therefore, the same pipeline as far as possible to avoid the boiler water outlet, heat exchanger outlet place, as far as possible installed on the backwater pipeline (conditions allow, it is best to measure the temperature of the installation point before measurement).

4.1.5. Interfere

The host, sensor and cable of portable/handheld ultrasonic flowmeter (energy meter) are vulnerable to interference sources such as frequency converter, radio, television, microwave communication station, mobile phone base station, high voltage line and so on. So select sensors and host installation points, as far away as possible from these sources of interference

4.2. Steps to Configure the Parameters

Before the measurement, the settings of 10~29 need to be completed. In order to obtain the installation distance of the sensor.

- (1) Pipe outer diameter
- (2) Pipe wall thickness
- (3) Pipe materials
- (4) Liner material
- (5) Liquid type (for non-standard liquids, the sound speed of the liquid is also needed)
- (6) Transducer type
- (7) Transducer mounting methods (the V-method or Z-method is the common option)

- (1) Press key     nter M11 window to input the digits for the pipe outer diameter, and then press  key.
- (2) Press key  to enter M12 window to input the digits for the pipe outer diameter and then press  key.
- (3) Press key  to enter M14 window. and press  key to enter the option selection mode. Use keys  and  to scroll up and down to the intended pipematerial , and then press  key.
- (4) Press key  to enter M16 window, press  key to enter the option selection mode, use keys  and  to scroll up and down to the liner material, and then press  key. Select "No Liner", if there is no liner.
- (5) Press key  to enter M20 window, press  key to enter the option selection mode, use keys  and  to scroll up and down to the proper liquid, and then press  key.
- (6) Press key  to enter M23 window, press  key to enter the option selection mode, use keys  and  to scroll up and down to the proper transducer type, and then press  key.
- (7) Press key  to enter M24 window, press  key to enter the option selection mode, use keys  and  to scroll up and down to the proper transducer mounting method, and then press  key.

- (8) Press key  to enter M24 window to install the transducers on the pipe, and then press  key to go to M01 for the results.

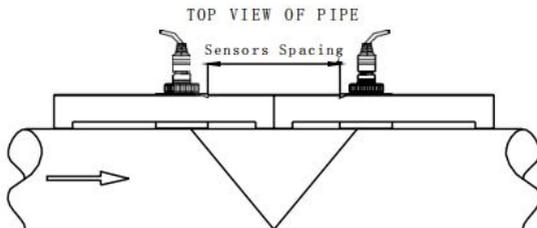
4.3. Transducers Installation

4.3.1. Transducers Spacing

The spacing value shown on menu window M25 refers to the distance of inner spacing between the two transducers. The actual transducers spacing should be as close as possible to the spacing value.

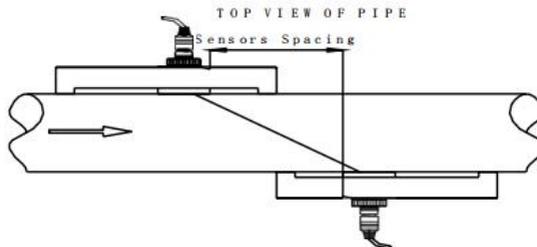
V-method Installation

V-method installation is the most widely used mode for daily measurement with pipe inner diameters ranging from 20 millimeter to 300 millimeter. It is also called reflective mode or method.



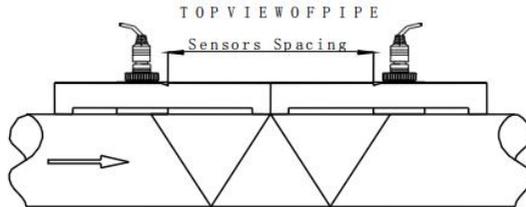
Z-method Installation

Z-method is commonly used when the pipe diameter is between 300 millimeters and 500 millimeters.



W-method Installation

W-method is usually used on plastic pipes with a diameter from 10 millimeters to 100 millimeters



N-method Installation

Rarely used method.

4.3.1.1. Input measurement parameters to get the installation distance

Before starting the measurement, the flowmeter needs to be initially set, usually from the menu 10 to 26 item by item (M39 menu is available in a variety of languages). After setting, the installation distance of the sensor can be obtained in M25, which refers to the distance between the innermost edge of the two sensors (see figure above), and the sensor can be installed according to this data.

4.3.1.2. Handling installation point

There are two installation points of the external clamp sensor, which are the upstream sensor and the downstream sensor. In dealing with these two Ann When decorating, the treatment area of one installation point is about the same size as the sensor, and the treatment area of another installation point is about the same size. It should be about twice the size of the sensor area (centered on the installation point) to facilitate signal debugging. First clean the area outside the tube where the sensor is to be installed to remove rust and paint. If there is an antirust layer should also be removed, it is best to use a grinding machine to polish the metallic luster, and then wipe away oil and dust with a clean cloth.

4.3.1.3. Sensor fixation

Apply 2~3mm thick random coupled agent on the signal generator of the sensor,

and then stick the sensor closely to the wall of the tube. Pay attention to the direction of the sensor to be correct, and there can be no air and gravel between the sensor and the wall of the tube. Tighten the sensor with cloth tape or tensioner after positioning.

Attached: the use method of the tensioner



Pass the tape through the transverse groove in the middle of the tensioner's rotating shaft and tighten it by hand.



Pull the tensioner spanner continuously to tighten the cloth tape.



Press the buckle and turn the wrench of the tensioner outwards until the middle buckle falls into the slot. At this time, the lifter can be removed.

4.3.1.4. Commissioning of sensors

In dealing with larger area of the center of the installation points with 4 ~ 5 mm thick accompanied with the coupling agent (with coupling agent is to isolate the sensor surface and the air, on the surface of the pipe decreases when the ultrasonic wave propagation in different medium loss), and then put the sensor to stick on the wall, pay attention to the shooting direction to correct sensors, sensor and tube wall between air and sand. Based on the center point, the maximum value of signal strength and Q is found by moving the sensor slightly horizontally, and then the maximum value of signal strength and Q is found by moving the sensor slightly vertically. Then slightly adjust the transmitter Angle of the sensor to find the maximum signal strength and Q value. The sensor can then be positioned.

Note:

1. Cleaner surface treatment may result in higher signal strength and Q values.
2. During installation, the duct area where the sensor is installed must be cleaned to expose the original luster of the metal. Coupling agent should be coated around the contact part between the sensor and the pipeline to prevent air, dust or rust from

entering and affecting the transmission of ultrasonic signals.

4.3.2. The installation and use of the bracket probe

4.3.2.1. Use method of bracket probe

1. Options of bracket probe in M23 menu:

Medium Stent Probes (HM), High Temperature Medium Stent Probes (HM-HT) :
standard HM stent sensors

Small bracket probe (HS), high temperature small bracket probe (HS-HT) :
standard HS small bracket sensor

2. According to the installation distance of ultrasonic sensor indicated in the menu
of ultrasonic flowmeter M25, the required measurement shall be made

The pipeline is clean and the area is larger than the sensor. Metal pipes should be
treated with a grinder, file, or sandpaper until

All see the metallic sheen.

3. According to the ultrasonic sensor installation distance indicated in the menu
M25 of the ultrasonic flowmeter, according to the bracket probe

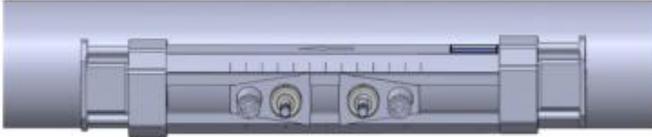
Adjust the position of the sensor on the scale and fix it with the lock nut.

4. Rotate the top rod of the probe, screw the upper and lower sensors of the probe
of the bracket to the top, and apply a 2~3cm pole

Special coupling agent for acoustic wave (or special coupling agent for high
temperature ultrasonic wave).



5. According to the fluid flow direction indicated by the bracket probe, fix the bracket probe on the pipe to be measured and twist the sensor downward until it is close to the pipe wall. (See § 4.3.2.3 for fixing method of stent probe).

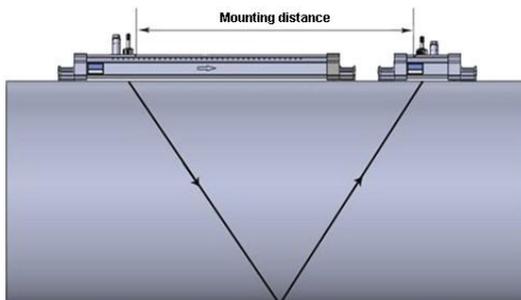


6. Connect the bracket probe and the host machine of the ultrasonic flowmeter with the ultrasonic special cable to start the measurement

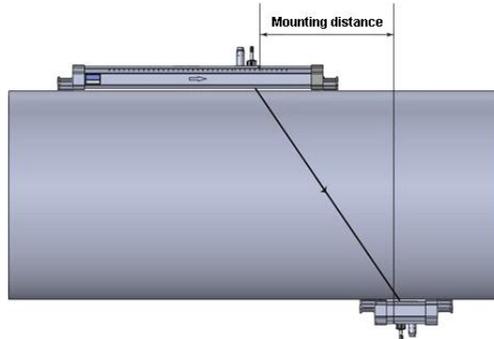
4.3.2.2. Method of bracket probe extension

When measuring the diameter of the pipeline greater than DN300, the extension bracket should be used. The diameter of the pipe measured with the extension bracket shall not be less than DN700. The extension bracket can be installed by the V method and the Z method, and the Z method is generally recommended for installation, so that the signal strength will be greater.

The installation distance can be measured using a random attached tape measure. The installation distance is the vertical distance between the two cursors. According to the installation distance, adjust the sensor on the bracket probe to the appropriate position, and fix it with the lock nut. Rotate the top rod of the probe to make the sensor close to the pipe wall.



Top view of extension bracket installation by V method



Extend bracket Z method to install top view

The use of the extension bracket is as follows:

Turn the probe ejector downward to remove one of the probes of the bracket, and then put the probe and accessories into the extension bracket. In the same way, twist the probe ejector upward to mount the probe into the extension bracket.

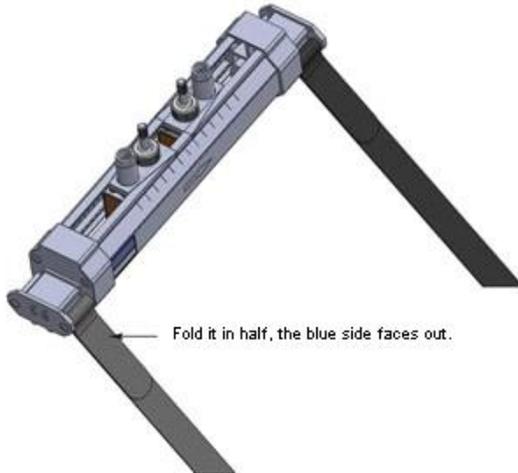
4.3.2.3. Method for fixing bracket probe

There are many ways to fix the bracket probe, including: with a strong magnet fixed, magic belt fixed, tension belt fixed, steel belt fixed.

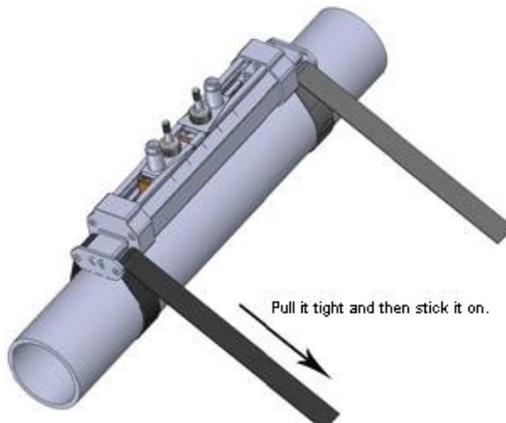
- **Bracket probe with strong magnet fixed:** for carbon steel pipe, cast iron pipe, can be fixed by the bracket probe with force magnet, only need to adsorb the bracket probe on the outer wall of the pipe, as shown in the figure below. (Note: it is possible to reduce the magnetic force of a strong magnet if you measure a fluid at high temperature.)
- **Magic belt fixation:** the method is very simple, for the temperature below 100°C fluid can be fixed by this method.

Here's how:

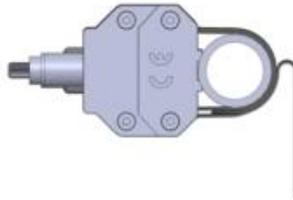
Tighten the bracket of the magic belt through the bracket probe with the black side up, fold it in half and stick it firmly.



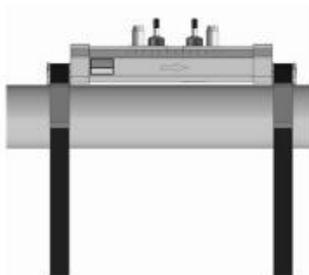
The magic belt through the pipeline, the black side up through the bracket probe magic belt fastening bracket, fold in half after the force to tighten, adjust the direction of the bracket probe, and then paste firmly.



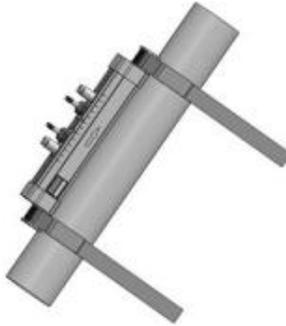
For small diameter pipeline, the method is the same as above, as shown in the figure below:



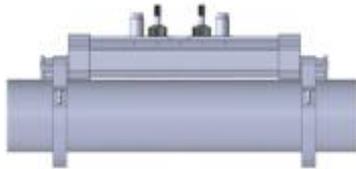
- **Tensioning belt fixation:** for fluid temperature $\leq 100^{\circ}\text{C}$ fluid can be fixed by this method, the method is as follows:
Move the tensioner around the pipe and through the tensioner, making sure it is not too tight. Do the same with the other tensioner.



Pipe the fastening grooves on the bracket probe saddle into the two tensioning belts respectively, adjust the direction of the bracket probe and tighten the tensioning belts forcefully.



- **Steel belt fixation:** for fluid temperature $\geq 100^{\circ}\text{C}$ fluid can be fixed by this method, the method is as follows:
Move the strip around the pipe and through the fastening screw, then close it down, not too tight. Do the same for the other strip.



Pipe the fasFlow measurementtening grooves on the saddle of the bracket probe into two steel belts, adjust the direction of the bracket probe, and tighten the steel belt screws forcefully.



4.4. Check proper installation

Signal strength, signal quality and the ratio of measured to theoretical transmission time (referred to as transmission time ratio) are three important parameters used to check whether the sensor is installed correctly. They are described below.

4.4.1. Signal strength and quality

The M90 windoFlow measurementw is used to display the upstream and downstream signal strength and signal quality Q values detected by the flow meter. Signal strength is expressed in numbers from 00.0 to 99.9.00.0 indicates no signal received and 99.9 indicates maximum signal.Under normal working conditions, the signal strength should be ≥ 60.0 .

The signal quality Q value is expressed as a number from 00 to 99, with 00 representing the worst and 99 representing the best.The normal working condition is the signal quality Q value >60 .

When installing, please pay attention to the signal strength and quality, the better, the signal strength and Q value is high, can ensure the flow meter measurement results are more stable and accurate.

Signal strength、Q value	Installation Result Judgment
Below 60	Be unable to work
60~75	Bad
75~80	Good
More than 80	Excellent

If the signal strength and Q value are too low, the following methods can be used to improve the signal strength and Q value:

- (1) If the measured flow value is unstable and the signal strength is lower than 70.0, choose a better installation point again.
- (2) Carefully grind the outer surface of the pipe until there is a metallic sheen, adding a little more coupling agent.
- (3) Slightly adjust the relative position or transmitting Angle of the sensor, observe the received signal strength of the flowmeter at the same time, find the position of

the maximum signal strength, and also check that the ratio of measured and theoretical transmission time is between 97% and 103%.

4.4.2. Transfer time ratio

The M91 window is used to display the transmission time ratio, which is the percentage value of the actual measured time and the transmission time calculated according to the parameters set by the flow meter. If this value exceeds 97%~103%, it indicates that either the parameter setting is wrong or the installation distance is wrong, please check separately.

4.5. Measurement data view

When the signal strength and signal quality, transfer time than meet the requirement of measurement, the measurement data obtained is accurate, can see the measurement in 00 ~ 09 menu data, including the instantaneous flow rate and the instantaneous velocity, the cumulative amount of positive and negative, cumulative amount, date, time, heat flow, total quantity of heat, temperature, current value and the corresponding value of the analog input, net cumulative flow today, and so on.

4.6. Measurement data processing

After the ultrasonic flowmeter (energy meter) is measured normally, the measured data obtained can be printed in real time or timed, and can also be stored in the built-in memory. The data in the memory can be processed by purchasing flow data statistics and analysis software. For data storage methods and usage methods of traffic data statistical analysis software, please refer to Chapter 5 Data Processing.

Chapter 5 Data processing

5.1. Processing of the measured data

Portable/handheld ultrasonic flowmeter (energy meter) measurement data can be processed in a variety of ways, data flow control Settings can be made in the M52 menu.

	Name	Handheld ultrasonic flowmeter (energy meter)
Measurement data flow control	To the built-in recorder	Built-in 32Mbit storage
	To the serial port	RS232 interface upload

5.2. Printing of measurement data

Portable ultrasonic flowmeter (energy meter) is randomly equipped with a 24-column character thermal printer. When the data flow control in the M52 menu chooses to output to the internal serial bus, the printer is ready for printing. There are two kinds of printing, one is screen copy printing, one is timing printing.

1) Screen copy printing

Using the M99 menu, you can copy and print the screen, that is, print what the screen shows.

Several print-related menus:

- M96 Menu: paper, tear off the paper before, please click here; ;
- M97 Menu: print the content of the initial setup, including the M11 ~ M25 content set, used to check whether the initial parameters set correct;
- M98 Menu: print measuring the contents of self-diagnosis, including the content of the set in the M90 ~ M94, used to check installation, measurement is correct

2) Timing printing

The operation of timing printing is divided into two steps. Firstly, the timing printing

output option is opened in the M50 menu, and secondly, the timing printing time is set in the M51 menu.

- Timing print options: in the M50 menu, set the timing print option to open (ON), press ENT can enter the print option is set, in a total of 22 timing print content, choose open (ON) option that is included in the printed content; Select OFF content, will not print.
- Setting: timing print time in M51 menu, press ENT to enter print time Settings, print the unit too, minutes and seconds of time, you need to set up three parameters: the start time, interval time and print. Start time setting: if starting from the current time, press. Set hour, minute, second. If you need to start printing from the set time, enter the start time. (Note that the input start time must be after the current time, so when using this function, you need to check the time in the M60 menu to avoid unsuccessful timing printing.) Interval time setting: unit time, minutes, seconds, the minimum interval is best not less than 5 seconds, so as not to keep up with the printer. Printing times setting: 0~9999 times optional. Printing times reach the set number of times, the printer will stop working.

5.3. Storage of measurement data

Ultrasonic flow meter (energy meter) data storage has two ways, the built-in 32Mbit memory, before the use of data storage to do the following Settings: output data flow control, timing output options, timing printing time Settings.

1. Output data flow control: if you need to output data to the built-in memory, select the built-in recorder in M52, select Internal Bus in M52. (See table § 6.1)
2. Timed printout options: same as § 5.2
3. Timed print time setting: same as § 5.2

5.4. Analysis and statistics of measurement data

Exported stored data

The data recorded in the built-in 32Mbit memory can be exported to the computer through the serial port using the M4A menu.

Chapter 6 How To

6.1. How to judge if the instrument works properly

- Type the M08 window to display "*R" to indicate that it is working properly. In the display of this window, if the word "E" indicates that the current loop output exceeds 100% of the range, it is related to the setting of window No. 57. By increasing the input value of window 57, the "E" word is no longer displayed; if a current loop is not used, it can be ignored.
- If the word "Q" indicates that the frequency output exceeds the range by 120%, it is related to the 69 window setting. By increasing the input value of window 69, the "Q" word is no longer displayed; if the frequency output is not used, it can be ignored.
- If there is "H" the words that receive ultrasonic signal is poor. See the "troubleshooting" chapter for how to handle this.
- This is generally normal if the word "G" indicates that the instrument is performing automatic gain adjustment prior to the measurement. Only when a long time always in this state, the machine is not normal.
- "I" means that the ultrasonic signal cannot be received, so check whether the connection of the sensor is connected correctly and whether the sensor is reliable.
- "J" indicates a hardware failure of the instrument. Some hardware failures may be temporary. Try powering it up again. See "Troubleshooting" for details.
- "F" denotes a hardware-related failure.

6.2. How to judge the liquid flowing direction

- (1) Make sure that the instrument works properly
- (2) Assume that the sensor connected to the upstream wiring of the flowmeter is the A, and the sensor connected to the downstream wiring is the B.
- (3) Check whether the instantaneous flow value is positive or negative; if it is positive, the flow direction of the fluid is A→B; if it is negative, the flow direction of the fluid is B→A.

6.3. How to change between units systems

Use menu window M30 for the selection of unit system in English or Metric system.

6.4. How to select a required flow rate unit

Use menu window M31 to select the flow unit first and then the timing unit.

6.5. How to use the totalizer multiplier

Use window M33 to select a proper totalizer. Make sure that the totalizer pulse is appropriately speeded. It should not be too fast and neither too slow. A speed of producing a pulse in several seconds or minutes is preferable.

If the totalizer multiplier is too small, there can be a loss of accumulation pulse because the output device can output only one pulse in a measurement period (500milliseconds)

If the totalizer multiplier is too large, the output pulse will be too fewer for the devices that are connected with the instrument for a quicker response.

6.6. How to open or shut the totalizers

Use M34, M35 and M36 to turn on or turn off the POS, NEG, or NET totalizer respectively.

6.7. How to reset the totalizers

Use M37 to reset the proper totalizer.

6.8. How to restore the flow meter with default setups

Use M37, when the 'selection' message is displayed. Press the dot key first and the message 'Master Erase' will display, then press the backspace key 

The master erase step will erase all the parameters entered by the user and setup the instrument with default values.

6.9. How to use the damper

The damper acts as a filter for a stable reading. If '0' is entered in window M40, that means there is no damping. A bigger number brings a more stable effect. But bigger damper numbers will prevent the instrument from acting quickly.

.8Numbers 0 to 10 are commonly used for the damper value.

6.10. How to use the zero-cutoff function

The number displayed in window M41 is called the low-cutoff value. The flow meter will replace these flow rate values that are absolutely less than the low-cutoff value

with '0'. This means the flow meter will avoid any invalid accumulation when the actual flow is below the zero-cutoff value.

The low-cutoff value does not affect the flow measurement when the actual flow is absolutely greater than the low-cutoff value.

6.11. How to setup a zero point

There exists a 'Zero Point' with certain installation which means the flow meter will display a non-zero value when the flow is absolutely stopped. In this case, setting a zero point with the function in window M42 will bring a more accurate measurement result.

Make sure that the flow is absolutely stopped, then run the function in window M42 by pressing the ENT key.

6.12. How to get a scale factor for calibration

A scale factor is the ratio between the 'actual flow rate' and the indicated value by the flow meter.

The scale factor can be determined by calibration with flow calibration equipment.

6.13. How to use the operation locker

The system locker provides a means of preventing inadvertent configuration changes or totalizer resets.

When the system is locked, menu window browsing can be done without affecting any change, but any modifications are prohibited.

The system can be locked without a password or with a one 1 to 4 digit password. With a no- password locking, directly press the ENT key when the password input prompt displays.

If the password is forgotten, please contact the factory.

6.14. How to use the built-in data logger

The data logger has a space of 24K bytes of memory, which will hold about 2000 lines of data.

Use M50 to turn on the logger and for the selection for the items that is going to be logged. Use M51 for the times when the logging begins and at how long an interval sustains and how long the data logging will last.

Use M52 for the direction of logging data. The default setting will permit the logging

data to be stored in the logger buffer.

Logging data can be redirected to the RS-232C interface without being stored into the logger buffer.

Use M53 to view the data in the logger buffer.

Dumping the logging data through the RS-232C interface and the clearing of the buffer can be operated with a function in window M52.

6.15. How to use the Frequency Output

There is a Frequency Output in all flow meters. This frequency output signal, which represents the flow rate, is intended to connect with other instruments.

The Frequency Output is totally user-configurable. Generally, four parameters should be configured for the setups.

Enter the lower flow rate value in window M68 and the higher flow rate value in window M69.

Enter the frequency range in window M67.

For example, assume that the flow rate varies in a range 0m³/h to 3000m³/h, and an output signal is at a maximum frequency of 1000Hz, the minimum of 200Hz is going to be required for other instrumentation. The user should enter 0 in M68 and 3000 in M69, and enter 200 and 1000 in window M67.

Please note that the user has to make the selection with OCT setups in window M78 by selecting the 13th option reading like 'FO output' to direct the frequency output to the OCT OUTPUT hardware device.

6.16. How to use the Totalizer Pulse Output

The totalizer output will produce a pulse output with every unit flow of the totalizer. Refer 3.4 and 3.5 for the setups of the totalizer units and multiplier.

The totalizer pulse output can only be realized by mapping the pulse output to the OCT or BUZZER hardware devices.

For example, assume that the POS totalizer pulse output is needed, and every pulse should represent 0.1cubic meter of liquid flow; the pulse output will be mapped to the internal Buzzer,so that with every 0.1 cubic meter of flow the BUZZER will beep for a while. The following setups should be taken/performed:

- (1) Select the unit Cubic Meter under window M32.

(2) Select the Multiplier as '2. X0.1' under window M33.

(3) Select the output option '9. POS INT Pulse' under window M77. (INT stands for totalized)

6.17. How to produce an alarm signal

There are 2 types of hardware alarm signals that are available with this instrument. One is the Buzzer, and the other is the OCT output.

Both for the Buzzer and OCT output the triggering sources of the event include the following:

- (1) Alarms on when there is no receiving signal
- (2) Alarms on when there is poor signal received.
- (3) Alarms on when the flow meter is not in normal measurement modes.
- (4) Alarms on reverse flow.
- (5) Alarms on the overflow of the Frequency Output
- (6) Alarms on when the flow is out of a designated range set by the user.

There are two out-of-normal-range alarms in this instrument. They are called #1 Alarm and #2 Alarm. The flow range can be user-configurable through M73, M74, M75, M76.

For example, assume that the Buzzer should start beeping when the flow rate is less than 300 m³/h and greater than 2000m³/h, the following steps for setups would be recommended.

- (1) Enter 300 under M73 for #1 alarm low flow rate
- (2) Enter 2000 under M74 for #1 alarm high flow rate
- (3) Select the item reading like '6. Alarm #1' under M77.

6.18. How to use the built-in Buzzer

The built-in buzzer is user-configurable. It can be used as an alarm. Use M77 for setups.

6.19. How to use the OCT output

The OCT output is user-configurable, which can be performed by selecting the proper input source such as pulse output.

Use M78 for the setups.

Please make sure that the Frequency Output shares the OCT.

The OCT output shares pins with the RS-232C interface, and the terminal is at Pin 6 and the ground is at Pin 6.

6.20. How to modify the built-in calendar

No modification on the built-in calendar will be needed in most cases. The calendar runs on insignificant amount of power supply. Modification will be required only in such cases as when the battery is totally consumed, or when the changing of the battery takes a long time.

Press the ENT key under M61 for Modification. Use the dot key to skip over these digits that need no modification.

6.21. How to adjust the LCD contrast

Use M70 to the LCD contrast. The adjusted result will be stored in the EEPROM so that the MASTER ERASE will make no effect on the contrast.

6.22. How to use the RS232 serial interface

Use M62 for the setup of the RS-232C serial interface.

6.23. How to view the Date Totalizers

Use M82 to view the date totalizers that are comprised of a daily totalizer, a monthly totalizer and a yearly totalizer.

6.24. How to use the Working Timer

Use the working timer to check the time that has passed with a certain kind of operation. For example, use it as a timer to show how long a fully-charged battery will last.

Under M72, press ENT key and then select YES to reset the timer.

6.25. How to use the manual totalizer

Use M28 for the manual totalizer. Press ENT key to start and stop the totalizer.

6.26. How to check the ESN and other minor details

Every set of the flow meter utilizes a unique ESN to identify the meter. The ESN is an 8-digit number that provides the information of version and manufacturing date. The user can also employ the ESN for instrumentation management. The ESN is displayed in window M61.

Other details about the instrument are the total working hours displayed in window M+1, and the total power-on times displayed in window M+4.

6.27. How to know how long the battery will last

Use M07 to check how long the battery will last. Also please refer to .2.1

6.28. How to charge the built-in battery

Refer to 2.1

Chapter 7 Troubleshooting

Ultrasonic flow meter (energy meter) is designed with perfect self-diagnosis function. The problems found are displayed in chronological order in the form of code in the upper right corner of the LCD display. M08 menu can show all the existing problems in order.

Ultrasonic flowmeter (energy meter) is usually used to check the hardware fault every time it is powered on, and part of the hardware fault can be checked when it is working normally. The errors shown are divided into two categories: one is the circuit hardware error message, and the possible questions and solutions are shown in Table 1. If a problem is found during the power self-test, after entering the measurement state, the upper left corner of the display will display "** F". You can repower, view the information displayed, and click the table below to take specific measures. If the problem persists, contact the company.

The other category is error information about measurement, as shown in Table 2. The problems and solutions are given in the following two tables.

7.1. Power-on Error Displays and Counter-Measures

The ultrasonic flow meter provides an automatic power-on diagnosis for the hardware problems. When any message (with the power on) in the following table displays, counter-measures should be taken.

LCD display information	Reason	Solution
The program ROM checksum is incorrect	Illegal or wrong system ROM	Contact the manufacturer
The data memory is read and written incorrectly	Memory parameter data is incorrect	Power on again/contact the manufacturer
System data memory error	System storage data area error	Power on again/contact the manufacturer

Measurement circuit hardware error	Fatal error in sub-CPU circuit	Power on again/contact the manufacturer
Frequency error! Check crystal	System clock is wrong	Power on again/contact the manufacturer
Date and time error	The system date and time is wrong	Reset date and time
The monitor does not display, or the display is chaotic, and it is not working properly.	Poor contact of the cable connecting the panel	Check whether the cable connecting the panel is in good contact. This state does not affect normal measurement
No response to keystrokes	Poor contact of the connector	Same as above

7.2. Error Code and Counter-Measures

The ultrasonic flow meter will show Error Code in the lower right corner with a single letter like I, R etc. on menu windows M00, M01, M02, M03, M90 and M08.

When any abnormal Error Code shows, counter-measures should be taken.

Code	M08 menu corresponding display	Reason	Solution
*R	System is working fine	*The system is normal	
*J	Measurement circuit hardware error	*hardware malfunction	*Contact the company
*I	No received signal detected	*Not receiving signal	*The sensor is close to the pipeline, with sufficient couplant
		* Poor contact between sensor and pipeline or too little coupling agent	*The surface of the pipeline is clean, no rust, no paint, no corrosion eyes

		*The sensor is not installed properly	*Check whether the initial parameters are set correctly.
		*Too much scaling on the inner wall	*Remove scaling or replace test points
		*New lining	*Wait for the lining to cure and become saturated before testing.
*H	Low received signal strength and poor quality	*Low signal	*The solution is the same as above.
		*The signal quality is too bad	
*F	See Table 1	*Problems found during power-on self-test	*Try to re-power on, and observe the information displayed on the display, and deal with it according to the previous table.
		*Permanent hardware failure	
*G	Gain adjustment in progress>S1	*If the machine stops on S1 or S2 or only switches between S1 and S2, it indicates that the received signal is too low or the waveform is not good.	
	Gain adjustment in progress>S2		
	Gain adjustment is in progress>S3		
	Gain adjustment is in progress>S4		
*K	Pipe empty, M29 menu setting	There is no fluid in the pipe or the setting is wrong	If there is indeed fluid in the pipeline, enter a value of 0 in the M29 menu

7.3. Causes of abnormal measured values and treatment methods

Status	Reason	Handle
The measured value shows a negative value display	The link between the host and the sensor (upstream and downstream sensors) is reversed.	Make the correct connection.
	The actual flow is reverse.	
The measured value drifts abnormally when the flow rate is constant	The straight pipe is not long enough.	Move to a position where the length can be ensured (upstream 10D, downstream 5D).
	There are pumps, valves, etc. nearby that cause fluid flow turbulence.	Keep the installation distance above 30D.
	There is actually a pulsation.	Through the damping setting, increase the corresponding time.
	Ultrasonic waves cannot propagate into the pipeline, and the measured value remains unchanged.	
	1. Improper setting	After confirming the reason, temporarily remove the sensor, clean the installation part and apply couplant, and finally install the sensor in a place slightly staggered from the previous part.
	*The pipe specification is wrong.	
	*A sensor is installed at the welding part.	
	*The sensor size is wrong.	
	*Insufficient application of	

	couplant during sensor installation.	
	*The connector of the sensor is connected badly.	
	*The pipe surface is dirty.	
	2. Problems with pipes and fluids	Same as above
	*If the current method is V method, change to Z method.	
	*If the sensor extension cord is currently used, please stop using it.	
	*If the problem still cannot be solved, please thoroughly investigate the following reasons as the main cause and eliminate the cause of the fault.	
Although the flow rate is changing, the measured value has not changed	Water dissatisfaction	Look for a part of the same pipeline that is full of water, and move the sensor here.
	Air bubbles mixed in	Eliminate the mixing of bubbles
	When the water stops flowing and the measurement is in a normal state, mixing of bubbles is the cause of the failure.	* Increase the water level of the pump well.
	When the sensor is installed near the back of the valve, cavitation occurs, which is the same phenomenon as air bubbles.	*Confirm the shaft seal of the pump.
		*Tighten the flange of the negative pressure pipeline.

		* Avoid the water flowing into the pump well forming a waterfall and rushing down. Move the sensor to a place where air bubbles are not easy to get in.
		* The inlet side of the pump.
		*Upstream side of the valve.
	High turbidity: Higher than the turbidity of injected sewage and returned sludge.	The sensor installation V method is changed to Z method.
		Move the sensor to the smaller part of the pipeline on the same pipeline.
		Move the sensor to other parts or other pipes.
		Try the large sensor option.
		Move the sensor to the straight pipe.
	A large amount of scale deposits inside the old pipe.	
	Lining peeling: There is a gap between the lining and the pipe.	
	Thicker lining: Due to the use of mortar lining, the thickness is more than tens of millimeters.	
	The sensor is installed at the elbow or tapered pipe.	
	3、The influence of external noise	Try to shorten the cable length between the host and the sensor.
	*There is a radio signal transmitting station nearby.	

	*Measurement is carried out near frequent roads such as cars and trains.	
	4. Hardware abnormality	Contact our company when an abnormality occurs.
Although the water flow stops, the measured value is not zero	There is convection of water in the pipeline.	normal
	When performing zero adjustment.	Please reset the zero when the water flow is completely stopped.
	When the water flow stops, the water in the pipe is not full or the pipe is empty.	Keep the value when the ultrasonic wave cannot propagate. normal.
Error in measured value	The pipe spec entered does not match the actual one.	When the inner diameter differs by 1%, the measured value has an error of about 3%. Enter the inner diameter value correctly.
		Enter the scale thickness as the lining value.
	Scale deposits in old pipes.	
	The length of the straight pipe is not enough.	
	The pipeline is in a state of water dissatisfaction or sediment accumulation.	The reduced cross-sectional area leads to an increase in measurement error. Transfer to the vertical pipeline.

7.4. Other Problems and Solutions

1. The display of the flowmeter measures normal "R", and the received signal strength and signal goodness are good. The fluid in the pipeline under test has been flowing, but the flow rate of the flowmeter has been shown to be 0.0000 at this time, what is the reason?

A: It is possible that the user used the "static zero" operation in the presence of fluid flow. The solution is to go to window M43 to "clear static zero zero" and select "YES".

2. What is the reason for the flow data displayed by the flowmeter to be smaller or larger than that of the pipeline?

A : (1) Incorrect Settings were made in the M44 window; The solution is to enter the M44 window and enter the value "0".

(2) The sensor is not installed correctly.

(3) There is a zero point in the flow meter. Under the condition of confirming that the fluid in the pipeline is completely stationary, it enters into the M42 window for "static zero setting" operation.

Chapter 8 Appendix

1. Commonly used liquid sound velocity and viscosity

Liquid	Sound speed (m/s)	Viscosity	Liquid	Sound speed (m/s)	Viscosity
Water 20°C	1482	1	Glycerin	1923	1180
Water 50°C	1543	0.55	Gasoline	1250	0.8
Water 75°C	1554	0.39	66# Gasoline	1171	
Water 100°C	1543	0.29	80# Gasoline	1139	
Water 125°C	1511	0.25	0# Diesel	1385	
Water 150°C	1466	0.21	Benzene	1330	
Water 175°C	1401	0.18	Ethylbenzene	1340	
Water 200°C	1333	0.15	Toluene	1170	0.69
Water 225°C	1249	0.14	Carbon tetrachloride	938	0.608
Water 250°C	1156	0.12	Kerosene	1420	2.3
Acetone	1190	0.407	Oil	1290	
Methanol	1121		Pine oil	1280	
Ethanol	1168		Trichloroethylene	1050	0.82
Alcohol	1440	1.5	Dagang Jet Fuel	1298	
Ethyl ketone	1310		Daqing 0# Jet Fuel	1290	
Acetaldehyde	1180		Peanut oil	1472	
Ethylene glycol	1620	21.112	Castor oil	1502	
Aniline	1659	1.762	Ether	1006	0.336
N-octane	1192		O-xylene	1360	
Trichloromethane	1001	0.383	Chlorobenzene	1289	
Glycerol	1923	1188.5	Acetic acid	1159	1.162
Methyl acetate	1181	0.411	Ethyl acetate	1164	

Dicarboxylic acid	1389		Heavy water	1388	1.129
Mercury	1451	0.114	Nitrobenzene	1473	1.665
Carbon disulfide	1158	0.29	Tribromomethane	931	
N-propanol	1225		N-pentane	1032	0.366
N-ethane	1083	0.489	Light oil	1324	
Transformer oil	1425		Spindle lubricant	1342	15.7
Oil	1295		Gasoline	1250	0.4-0.5

2. Speed of sound for common materials

Pipe material	Sound speed (m/s)
Steel	3206
Iron	3230
Cast iron	2460
Lead	2170
ABS	2286
Aluminum	3048
Brass	2270
Cast iron	2460
Bronze	2270
FRP	3430
Glass	3276
Polyethylene	1950
Allyl	2644
PVC	2540
Mortar	2500

Lining material	Sound speed (m/s)
Teflon	1225
Nodular cast iron	3000
Stainless steel	3206
Vinyl chloride	2640
Titanium	3150
Cement	4190
Asphalt	2540
Enamel	2540
Glass	5970
Plastic	2280
Polyethylene	1600
Polytetrafluoroethylene	1450
FRP	2505
Rubber	1600
Asphalt epoxy	2505

3. Sound velocity meter in water (at 1 standard atmosphere)

t	v	t	v	t	v	t	v
0	1402.3	25	1496.6	50	1542.5	75	1555.1
1	1407.3	26	1499.2	51	1543.5	76	1555.0
2	1412.2	27	1501.8	52	1544.6	77	1554.9
3	1416.9	28	1504.3	53	1545.5	78	1554.8
4	1421.6	29	1506.7	54	1546.4	79	1554.6
5	1426.1	30	1509.0	55	1547.3	80	1554.4
6	1430.5	31	1511.3	56	1548.1	81	1554.2
7	1434.8	32	1513.5	57	1548.9	82	1553.9
8	1439.1	33	1515.7	58	1549.6	83	1553.6
9	1443.2	34	1517.7	59	1550.3	84	1553.2
10	1447.2	35	1519.7	60	1550.9	85	1552.8
11	1451.1	36	1521.7	61	1551.5	86	1552.4
12	1454.9	37	1523.5	62	1552.0	87	1552.0
13	1458.7	38	1525.3	63	1552.5	88	1551.5
14	1462.3	39	1527.1	64	1553.0	89	1551.0
15	1465.8	40	1528.8	65	1553.4	90	1550.4
16	1469.3	41	1530.4	66	1553.7	91	1549.8
17	1472.7	42	1532.0	67	1554.0	92	1549.2
18	1476.0	43	1533.5	68	1554.3	93	1548.5
19	1479.1	44	1534.9	69	1554.5	94	1547.5
20	1482.3	45	1536.3	70	1554.7	95	1547.1
21	1485.3	46	1537.7	71	1554.9	96	1546.3
22	1488.2	47	1538.9	72	1555.0	97	1545.6
23	1491.1	48	1540.2	73	1555.0	98	1544.7
24	1493.9	49	1541.3	74	1555.1	99	1543.9

Unit: t(°C)v(m/s)