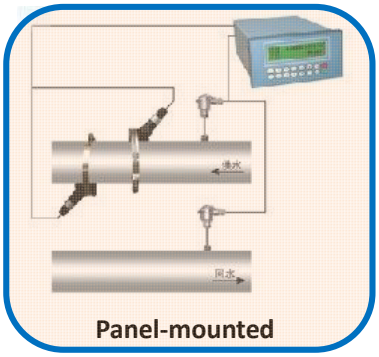
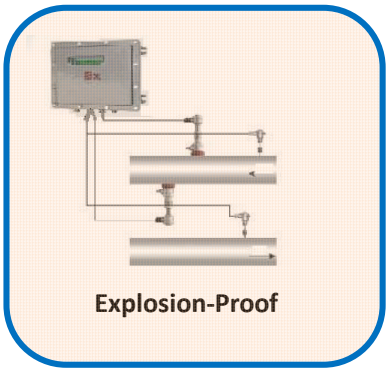
User Manual


Panel-mounted


Explosion-Proof

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1. Introduction

1.1 Preface

Welcome to use new generation transit-time ultrasonic flow meter, please read the user manual carefully before using. The wall-mount ultrasonic flow meter is designed to be installed in a fixed location for long-term flow measurement.

1.2 Features

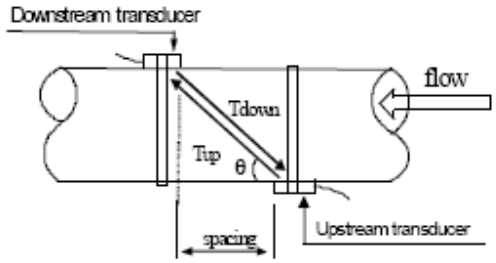
- ◆ Linearity: 0.5%, Repeatability: 0.2%, Accuracy:±0.8%
- ◆ Easy to operate.
- ◆ Several type transducers for selection,measuring pipe size is from DN15mm to DN6000mm
- ◆ Adopt low voltage, multi-pulse technology to improve accuracy, useful life and reliability.
- ◆ Powerful Recording Function, record the totalizer data of the last 64 days/64 monthes/5 years.

1.3 Flow measurement principle

The EU-108 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 EU-108 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, show as follows:

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



Where

θ is the include angle to the flow direction
M is the travel times of the ultrasonic beam
D is the pipe diameter
Tup is the time for the beam from upstream transducer to the downstream one
Tdown is the time for the beam from downstream transducer to the upstream one
△**T**=Tup –Tdown

1.4 Optional transducer

◆ B1 **S1** clamp-on type transducer, pipe size from DN15-100mm
◆ B2 **M1** clamp-on type transducer, pipe size from DN50-1000mm
◆ B3 **L1** clamp-on type transducer, pipe size from DN300-6000mm
◆B4 **S1H** clamp-on type high temperature transducer, pipe size from DN15-100mm
◆B5 **M1H** clamp-on type high temperature transducer, pipe size from DN50-1000mm

1.5 Typical application

The wall-mounting flow meter can be applied to a wide range of pipe flow measurements. Applicable liquids include pure liquids as well as liquid with small quantity of tiny particles.

Examples are:
★ Water (hot water, chilled water, city water, sea water, waste water, etc.);
★ Sewage with small particle content;
★ Oil (crude oil, lubricating oil, diesel oil, fuel oil, etc.);
★ Chemicals (alcohol, acids, etc.);
★ Plant effluent;
★ Beverage, liquid food;
★ Ultra-pure liquids;
★ Solvents and other liquids

1.6 Product Identification

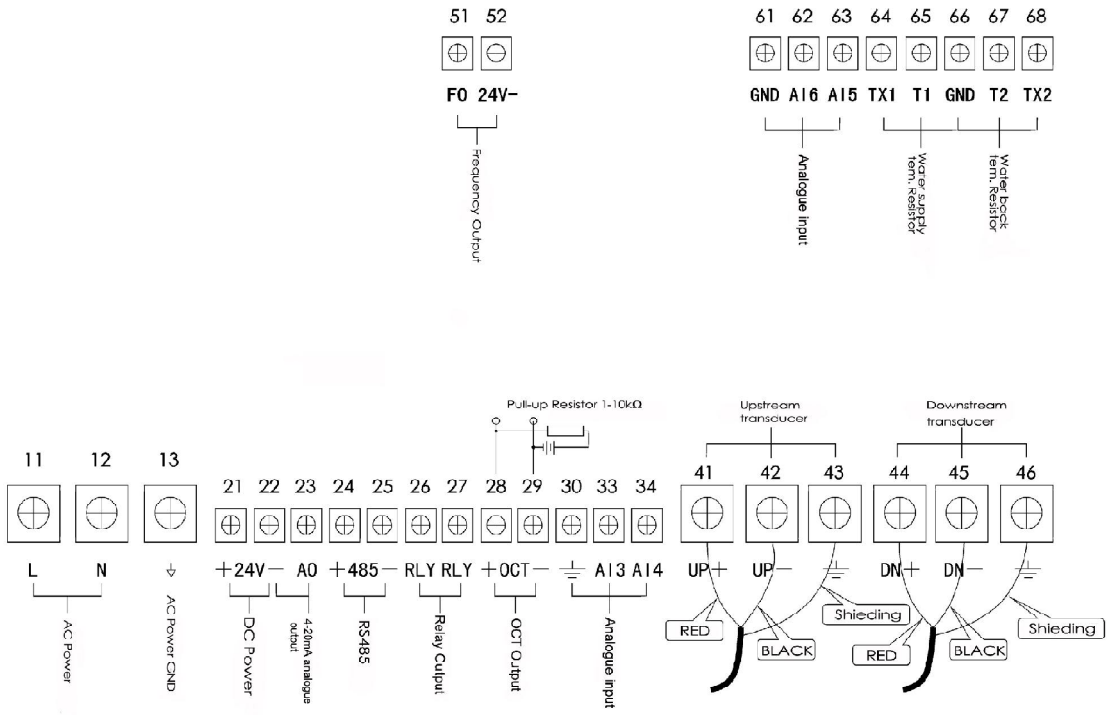
Each set of the flow meter has a unique product identification number or ESN (electronic serial number) written into the software that can only be modified with a special tool by the manufacturer. In case of any hardware failure, please provide this number which is located on menu window **M61** when contacting the manufacturer.

1.7 Specifications

* Accuracy Normally ±0.8% of reading at rates>0.2mps
* Response Time 0-999 seconds, user-configurable
* Pipe Size 1/2" ~ 240" (DN15mm - DN6,000mm)*
* Pipe Material All metals, most plastics, lined pipes
* Units English (U.S.) or metric
* Liquid Types Virtually all liquids and liquids with minor solids (<10,000ppm). Full pipes
* Digital Interface: Relay/OCT/RS-485/4～20mA/ 0～20mA output.
* Power Supply: 220V AC / 24VDC / 85～264VAC

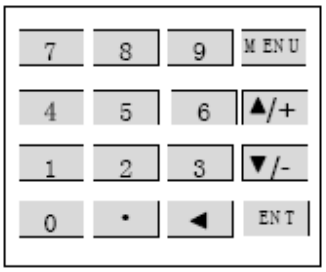
2. Installation and Measurement

2.1 Wiring diagram



2.2 Keypad

The keypad for the operation of the flow meter is as shown by the right picture.



Keys 0 - 9 and . are keys to enter numbers

Key ▲/+ is the going UP key, when the user wants to go to the upper menu window. It also works as the "+" key when entering numbers

Key ▼/- is the going DOWN key, when the user wants to go down-sided menu window. It also works as the "–" key when entering numbers.

Key ◄ is backspace key, when the user wants go left or wants backspace the left character that is

Key ENT is the ENTER key for any inputting or selections.

Key MENU is the key for the direct menu window jump over. Whenever the user wants to

proceed to a certain menu window, the user can press this key followed by 2-digit numbers.

The MENU key is shortened as the 'M' key afterward when referring to the menu windows.

The ON key is for the power on; The OFF key is for the power off.

2.3 Menu Windows

The user interface of this flow meter comprises about 100 different menu windows that are numbered by M00, M01, M02 … M99.

There are 2 methods to enter certain menu window:

1. Direct going/entering. The user can press the MENU key followed by two-digit number keys. For example, the menu window M11 is for the entering of pipe outer diameter. The display will go to the M11 menu window after the user presses MENU 1 1.

2. Pressing ▲/+ and ▼/- keys. Each time of the ▲/+ key pressing will proceed to the lower-numbered menu window. For example, if the current window is on M12, the display will go to the number M11 window after pressing the ▲/+ key.

There are three different types of menu windows:
1. Menu windows for number entering, like M11 for the entering of pipe outer diameter.
2. Menu windows for option selection/selecting options, like M14 for the selection of pipe materials.
3. Displaying windows only, like M00 to display Velocity, Flow Rate etc.

For number entering windows, the user can directly press the starting digit key when the user is going to modify the value. For example, when the current window is on M11, and the user is going to enter 219.2345 as the pipe outer diameter, the user can get the numbers entered by pressing the following serial keys: 2 1 9 . 2 3 4 5 ENT.

For the option selection windows, the user should first press the ENT key to a selection modification mode and then select the relevant options by pressing the ▲/+ and ▼/- or the digit keys to select the option with a number antecedent to the option. In the end, the ENT key must be pressed to make the selection. For example, with menu window M14 for the selection of pipe material selection, (the MENU 1 4 should be pressed first to enter this menu window if the current menu window is on a different window. The pipe material is stainless steel which has a number "1" antecedent to "stainless steel" on the display, the user should first press the ENT key to enter into a selection modification mode, then either make the selection by pressing the ▲/+ and ▼/- keys to make the cursor on the line that displays "1. Stainless Steel", or make the selection by pressing the 1 key directly.

Generally, the ENT key must be pressed to enter a modification mode. If the "Locked M47 Open' message is indicated on the lowest line of the LCD display, it means the modification operations is locked out. In such cases, the user should go to M47 to have the instrument unlocked first before any further modification can be made.

2.4 Steps to Configure the Parameters

The following parameters need to be configured for a proper measurement:
(1) Pipe outer diameter
(2) Pipe wall thickness

(3) Pipe materials (for non-standard pipe materials*, the sound speed for the material must be configured too)
*Standard pipe materials and standard liquids refer to those with the sound parameters that have already been programmed into software of the flow meter, therefore there is no need to configure them

(4) Liner material and its sound speed and thickness, if there is any liner.
(5) Liquid type (for non-standard liquids, the sound speed of the liquid is also needed)
(6) Transducer type adapted to the flow meter. Generally the Standard M1 clamp-on transducers will be the selected option.
(7) Transducer mounting methods (the V-method or Z-method is the common option)
(8) Check up the Space displayed on M25 and install the transducers accordingly.
(9) Store the parameter setup

For standard pipe materials and standard liquids, the following detailed step-by-step setup is recommended.
(1) Press keys MENU 1 1 to enter M11 window to input the digits for the pipe outer diameter, and then press ENT key.
(2) Press key ▼/- to enter M12 window to input the digits for the pipe outer diameter and then press ENT key.
(3) Press key ▼/- to enter M14 window, and press ENT key to enter the option selection mode. Use keys ▲/+ and ▼/- to scroll up and down to the intended pipe material, and then press ENT key.
(4) Press key ▼/- to enter M16 window, press ENT key to enter the option selection mode, use keys ▲/+ and ▼/- to scroll up and down to the liner material, and then press ENT key. Select “No Liner”, if there is no liner.
(5) Press key ▼/- to enter M18 window, press ENT key to enter the liner thickness and then press ENT key (if there is liner)
(6) Press key ▼/- to enter M20 window, press ENT key to enter the option selection mode, use keys ▲/+ and to scroll up and down to the proper liquid, and then press ENT key.
(7) Press key ▼/- to enter M23 window, press ENT key to enter the option selection mode, use keys ▲/+ and to scroll up and down to the proper transducer type, and then press ENT key.
(8) Press key ▼/- to enter M24 window, press ENT key to enter the option selection mode, use keys ▲/+ and to scroll up and down to the proper transducer mounting method, and then press ENT key.
(9) Press key ▼/- to enter M25 window and check up the installation space.

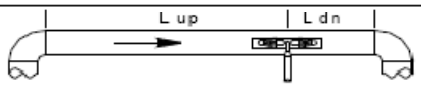
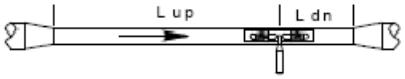
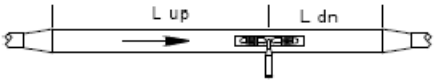
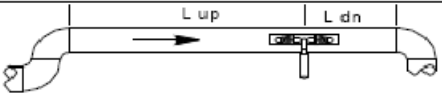
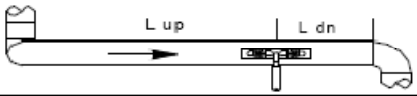
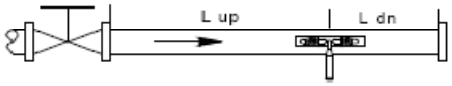
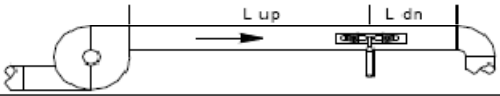
(10) Press MENU 2 6 to store the parameter setup (refer to M26)
(11) Press MENU 9 0 to check up signal strength and quality, the bigger of the value the better. Generally the signal strength should be better than 60.0, and signal quality should be better than 50.0.
(12) Press MENU 9 1 to check up time ratio, the ratio value should be in the range of 100±3%
(13) Press MENU 0 8 to check up the working status, "R" means work well
(14) Press MENU 0 1 to check up the measuring data.

Note: 1. For heat measurement, please connect PT100 which installed in water supply and water back pipe to T1, TX1, T2, TX2, GND terminal.
2. After setting parameter, remember to store parameter in MENU 26, to avoid parameter lose after turn off.

2.5 Transducers Mounting Allocation

The first step in the installation process is the selection of an optimum location in order to obtain a more accurate measurement. For this to be completed effectively, a basic knowledge about the piping and its plumbing system would be advisable.

An optimum location would be defined as a straight pipe length full of liquid that is to be measured. The piping can be in vertical or horizontal position. The following table shows

Piping Configuration and Transducer Position	Upstream Dimension L up x Diameters	Downstream Dimension L dn x Diameters
	10D	5D
	10D	5D
	10D	5D
	12D	5D
	20D	5D
	20D	5D
	30D	5D

Examples of optimum locations.

Principles to selection of an optimum location
(1) Install the transducers on a longer length of the straight pipe. The longer the better, and make sure that the pipe is completely full of liquid.

(2) Make sure that the temperature on the location does not exceed the range for the transducers. Generally speaking, the closer to the room temperature, the better.

(3) Take the pipe fouling into consideration. Select a straight length of a relatively newer pipe. If the condition is not satisfying, consider the fouling thickness as part of the liner for a better result.

(4) Some pipes have a kind of plastic liner, and between the outer pipe and the liner there may be a certain thickness difference that will prevent the ultrasonic waves from direct traveling. Such conditions will make the measurement very difficult. Whenever possible, try to avoid this kind of pipes. If impossible, try our plug-in transducers that are installed permanently on the pipe by drilling holes on the pipe while liquid is running inside.

2.6 Transducers Installation

The transducers used by the EU-108 series ultrasonic flow meter are made of piezoelectric crystals both for transmitting and receiving ultrasonic signals through the wall of liquid piping system. The measurement is realized by measuring the traveling time difference of the ultrasonic signals. Since the difference is very small, the spacing and the alignment of the transducers are critical factors to the accuracy of the measurement and the performance of the system. Meticulous care should be taken for the installation of the transducers.

Steps to the installation of the transducers
(1) Locate an optimum position where the straight pipe length is sufficient, and where pipes are in a favorable condition, e.g., newer pipes with no rust and ease of operation.

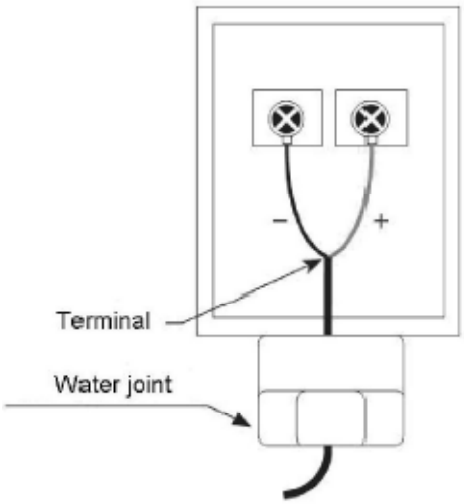
(2) Clean any dust and rust. For a better result, polishing the pipe with a sander is strongly recommended.

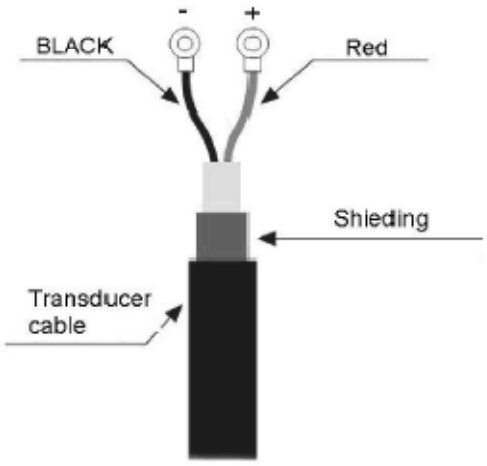
(3) Apply adequate coupler to the spot where the transducers are to be installed and leave no gap between the pipe surface and the transducers.

Extra care should be taken to avoid any sand or dust particles left between the pipe outer surface and the transducers.

To avoid gas bubbles inside the upper part of the pipe, the transducers should be installed horizontally by the side of the pipe.

2.6.1 Wiring diagram of transducer



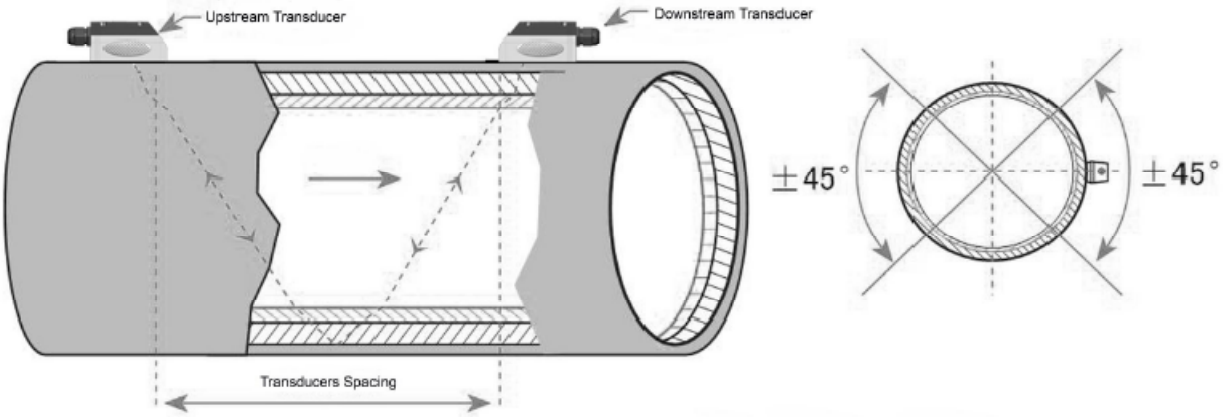


2.6.2 Transducers Spacing

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.

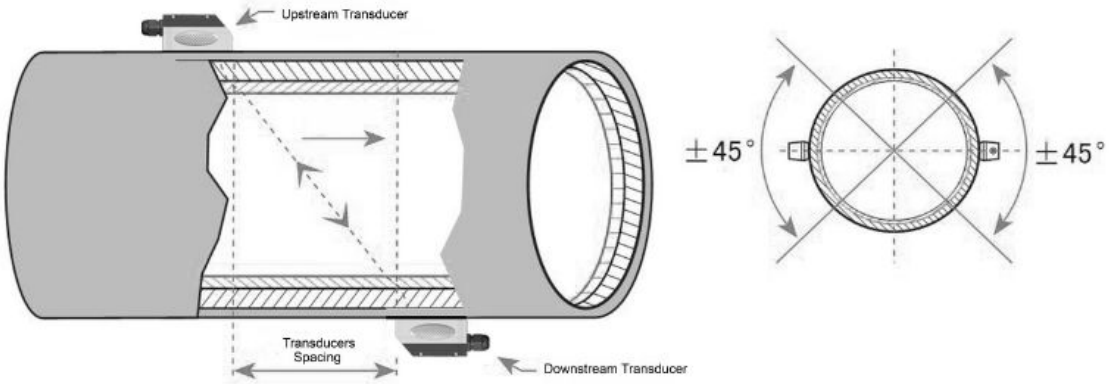
2.6.3 V-method Installation

V-method installation is the most widely mode for daily measurement with pipe inner diameters ranging from 15 mm to 200 mm. It is also called reflective mode.



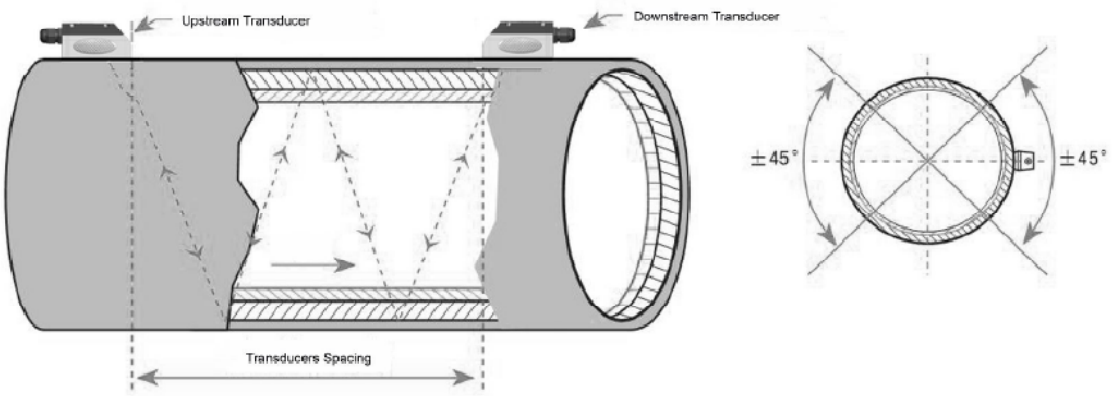
2.6.4 Z-method Installation

Z-method is commonly used when the pipe diameter is above 200mm.



2.6.5 W-method Installation

W-method is usually used on pipes with a diameter from 15mm to 50mm.



2.7 Installation Checkup

Through the checkup of the installation, one can: check the receiving signal strength, the signal quality Q value, the traveling time difference of the signals, the estimated liquid speed, the measured traveling time of the signals and the calculated traveling time ratio. Therefore, optimum measurement result and longer running time of the instrument can be achieved.

2.7.1 Signal Strength

Signal strength indicates the amplitude of receiving ultrasonic signals by a 3-digit number. [00.0] means there is no signal detected and [99.9] refers to the maximum signal strength that can be received.

Although the instrument works well if the signal strength ranges from 50.0 to 99.9, stronger signal

strength should be pursued, because a stronger signal means a better result. The following methods are recommended to obtain stronger signals:

(1) Relocate a more favorable location, if the current location is not good enough for a stable and reliable flow reading, or if the signal strength is lower than 60.0.

(2) Try to polish the outer surface of the pipe, and apply more coupler to increase the signal strength.

(3) Adjust the transducers both vertically and horizontally while checking the varying signal strength, stop at the highest position, and then check the transducers spacing to make sure the transducers spacing is the same as what the M25 shows.

2.7.2 Signal quality

Signal quality is indicated as the Q value in the instrument. A higher Q value would mean a higher Signal and Noise Ratio (short for SNR), and accordingly a higher degree of accuracy would be achieved. Under normal pipe condition, the Q value is in the range 60.0-90.0, the higher the better.

Causes for a lower Q value could be:
(1) Interference of other instruments and devices such as a powerful transverter working nearby. Try to relocate the flow meter to a new place where the interference can be reduced.

(2) Bad sonic coupling for the transducers with the pipe. Try to apply more coupler or clean the surface, etc.

(3) Pipes are difficult to be measured. Relocation is recommended.

2.7.3 Time Ratio between the Measured Total Transit and the Calculated

This ratio would be used to check the transducer installation. If the pipe parameters are entered correctly and the transducers are installed properly, the value for this ratio should be in the range of 100±3. If this range is exceeded, the user should check:

(1) If the pipe parameters are correctly entered.
(2) If the actual spacing of the transducers is right and the same as what the window M25 shows.
(3) If the transducers are installed properly in the right directions.
(4) If the mounting location is good and if the pipe has changed shape or if there is too much fouling inside the pipes
(5) Other poor condition

3. Menu Window Details

3.1 Menu Windows Arrangement

M00~M09 windows for the display of the flow rate, velocity, date time, totalizers, battery voltage and estimated working hours for the battery.
M10~M29 windows for entering the pipe parameter.
M30~M38 windows for flow rate unit selections and totalizer unit selections.
M40~M49 windows for response time, zeroing, calibration and modification password setup.
M50~M53 windows for the built-in logger
M60-M78 windows for time-keeper initialization, version and ESN information viewing and alarms.
M82 window for viewing date totalizer.
M90~M94 are diagnostic windows for a more accurate measurement.
M97~M99 are not windows but commands for the outputting of display copying and pipe parameter setups.
M+0~M+8 are windows for some additional functions, including a scientific calculator, viewer on records such as total working hours, turn-on and turn-off times, dates and times when the flow meter has been turned on or turned off.

Other menu windows such as M88 have no functions, or functions were cancelled because they are not applied to this version of the software.

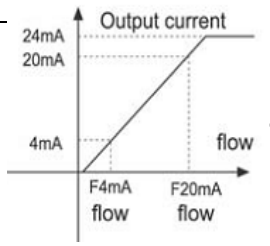
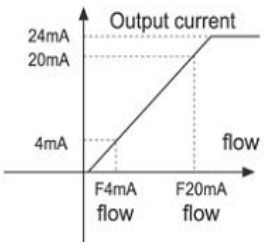
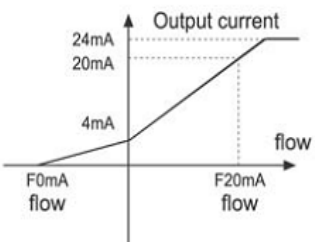
The major reason why the menu windows are arranged in this way is that the software programmer hopes that the menu window arrangement for this version can be compatibility with the previous versions of the flow meter software. This will make it easier for the former version users with this flow meter series.

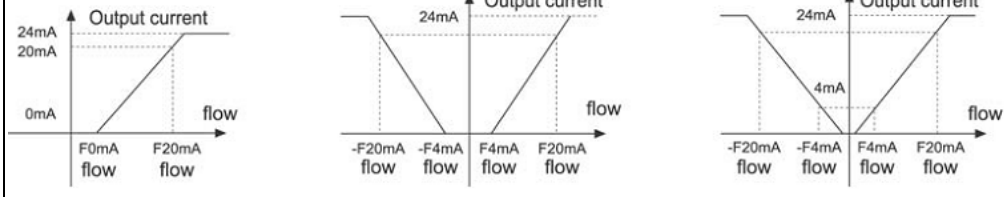
3.2 Menu Window Details

Menu No.	Function
M00	Display flow rate and NET totalizer If the net totalizer is turned off, the net totalizer value shown on the screen is the value prior to its turn off Select all totalizer unit in menu M31
M01	Display flow rate, velocity
M02	Display date time and POS(positive) totalizer If the positive totalizer is turned off, the positive totalizer value shown on the screen is the value prior to its turn off
M03	Display flow rate and NEG(negative) totalizer If the negative totalizer is turned off, the negative totalizer value shown on the screen is the value prior to its turn off
M04	Display the current date time and flow rate. The time setting method is found in M60.
M05	Display Instantaneous Caloric and Totalized Caloric.
M06	Display Analogue Input AI1 / AI2 current value and its corresponding temperature, pressure or liquid level value.

M07	Display Analogue Input AI3/ AI4 current value and its corresponding temperature, pressure or liquid level value.
M08	System Error Codes Display the working condition and the system error codes.
M09	Display today's total NET flow
M10	Window for entering the peripheral of the pipe.(If pipe outer diameter is known, skip this menu and go to menu M11 to enter the outer diameter.)
M11	Window for entering the outer diameter of the pipe, Valid range: 10 to 6000mm (you just need to enter either outer diameter in M11 or pipe peripheral in M10)
M12	Window for entering pipe wall thickness. You may skip this menu and enter inner diameter in M13 instead.
M13	Window for entering the inner diameter of the pipe. If pipe outer diameter and wall thickness are entered correctly, the inner diameter will be calculated automatically, thus no need to change anything in this window.
M14	Window for selecting pipe material. Standard pipe materials (no need to enter the material sound speed) include: (0) carbon steel (1) stainless steel (2) cast iron (3) ductile iron (4) copper (5) PVC (6) aluminum (7) asbestos (8) fiberglass-epoxy (9) Other (need to enter sound speed in M15)
M15	Window for entering the sound speed of non-standard pipe materials
M16	Window for selecting the liner material. Select none for pipes without any liner. Standard liner materials (no need to enter liner sound speed) include: (1) Tar Epoxy (2) Rubber (3) Mortar (4) Polypropylene (5) Polystryol (6)Polystyrene (7) Polyester (8) Polyethylene (9) Ebonite (10) Teflon (11) Other (need to enter sound speed in M17)
M17	Window for entering the sound speed of 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 (no need to enter liquid sound 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 (need to enter sound speed in M21 and viscosity in M22) (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 sound speed of non-standard liquids. Used only when item 8 "Other"is selected in menu M20.
M22	Window for entering the viscosity of non-standard liquids. Used only when item 8 "Other"is selected in menu M20.
M23	Window for selecting transducer type. There are 13 types: 0. Standard M 7. Not Used 1. Plug-in Type C 8. Standard-HS 2. Standard-S 9. Standard-HM 3. User Type 10. Standard-M1 4. Standard-B 11. Standard-S1 5. Plug-in Type B45 12. Standard-L1 6. Stand-L
M24	Window for selecting the transducer mounting methods Four methods can be selected:

	0. V-method (commonly used); 1. Z-method (most commonly used); 2. N-method (for small pipe. rarely used); 3.W-method (for small pipe).
M25	Display the transducer mounting spacing or distance
M26	Entry to store/load the system setup parameters (pipe parameters, fluid parameters, transducer parameters, etc.). Three operation methods available: 1. Entry to Save 2. Entry to Load 3. To Browse To save the current setup parameters, select "Entry to Save"and press ENT . An address number and original parameters will be displayed. Use ▲/+ or ▼/- key to change address number. Press ENT again will save the current setup parameters into the selected address space.
M27	Display the cross-sectional area inside the pipe.
M28	Entry to determine whether or not to keep the last good value when poor signal condition occurs. This function allows continued flow totalizing. YES is the factory default.
M29	Entry to set empty pipe signal threshold. When the signal strength is less than this threshold, the pipe is classified as empty pipe, and the flow meter will not totalize the flow. This is based on the fact that, when the pipe is empty, the transducer can still receive signal, just smaller than normal. As a result, the flow meter will show normal operation, which is not correct.
M30	Window for selecting unit system. The conversion from English to Metric or vice versa will not affect the unit for totalisers.
M31	Window for selecting flow rate unit system. Flow rate can be in 0. Cubic meter short for (m3) 1. Liter (l) 2. USA gallon (gal) 3. Imperial Gallon (igl) 4. Million USA gallon (mgl) 5. Cubic feet (cf) 6. USA liquid barrel (bal) 7. Imperial liquid barrel (ib) 8. Oil barrel (ob) 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 totalisers'unit. Available unit options are the same as those in M31.
M33	Window for setting the totaliser multiplying factor The multiplying factor ranges from 0.001 to 10000. Factory default is 1.
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	(1) Totaliser reset (2) Restore the factory default settings. Press the dot key followed by the backspace key. Attention, it is recommended to make notes on the parameters before doing the restoration.
M38	Manual totaliser used for calibration. Press any key to start and press the key again to stop the totaliser.
M39	Interface language selection in Chinese and English. This selection could also be changed automatically by the system, if English LCD display is

	used as the display device.
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	Low flow rate (or zero flow rate) cutoff to avoid invalid accumulation.
M42	Zero calibration / Zero point setup. Make sure the liquid in the pipe is not running while doing this setup.
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 address identification number (IDN). Any integer can be entered except 13(0DH, carriage return), 10 (0AH, line feeding), 42 (2AH*), 38 (26H&), 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer to chapter 6 for communications.
M47	System locker to avoid modification of the parameters by mistake
M48	Entry to linearity correct data inputs. There are as many as 12 point-data can be input
M49	Displays the input contents for the serial port
M50	Switches for the built-in data logger. There are as many as 22 different items can be chosen
M51	Time setup for the data logger
M52	(1) Data logging direction control. If 'Send to RS-485' is selected, all the data produced by the data logger will be transmitted out through the RS-232/RS-485 interface (2) If 'To the internal serial BUS ' is selected, the data will be transmitted to the internal serial bus which allows a thermal printer,4-20mA analog output module
M53	Display the converted value and current value for analog input AI5 Display the current loop value and corresponding temperature / pressure / liquid level of analogue input channel AI5.
M54	Pulse width setup for the OCT(OCT1) output
M55	Analog output mode selection. 9 modes to be chosen Select the current loop (CL) mode. Available options: 0. 4-20mA Output Mode (set up the output range from 4-20mA) 1. 0-20mA Output Mode (set up the output range from 0-20mA) 2. RS232 controls 0-20mA (set up to control by Serial Port) 3. Turn off the current loop (turn off the current loop to save battery life. Default.) 4. 20-4-20mA Mode (set up the output range from 20-4-20mA) 5. 0-4-20mA Mode (set up the output range from 0-4-20mA) 6. 20-0-20mA Mode (set up the output range from 20-0-20mA) 7. 4-20mA Corresponding Velocity (set up the current loop output range from 4-20mA) 8. 4-20mA Corresponding Heat Flow (set up the current loop output range from 4-20mA) The output current value is controlled by sending a parameterized command to the flow meter through its RS232 serial port. The command formats are explained in chapter 6. Example, if you want to output a 6mA current through the current loop, you need to select mode "0-20mA Via RS232"in menu M55 and send command "A06 (CR)"to the flow meter. This function allows the flow meter to control valve openness. Other different current output characteristics are illustrated in the following figures. The user can select one of them according to his actual requirements. The minimum and maximum values indicated in the figure are those set in menu windows M57 and M58. In the 4-20mA and 0-20mA modes, the minimum and maximum can be a positive or negative flow value as long as the two values are not the same. In the 20-4-20mA and 20-0-20mA modes, the polarity of the actual flow reading is ignored. In 0-4-20mA mode, the minimum must be negative, and the maximum must be positive. The last one in the following figures is for velocity output. The output current represents flow velocity.   

	
M56	4mA or 0mA output value Set the flow rate value which corresponds to 4mA or 0mA output current (4mA or 0mA is determined by the settings in M55). The flow unit options are the same as those in M31. If "velocity 4-20mA"is selected in M55, the unit should be set to m/s.
M57	Setup for the value via 20mA of the analog output Set the flow rate value which corresponds to 20mA output current. Refer to M31 for flow unit options.
M58	Analog output checkup
M59	Current output form the analog output
M60	Calendar. Press ENT for modification. Use the dot key to skip the digits that need no adjusting.
M61	Display software version information and Electronic Serial Number (ESN) that are unique for each series flow meter. The user can use the ESN for instrumentation management
M62	RS-232 configuration. All the devices connected with RS232 link should have matched serial configuration. The following parameters can be configured: Baud rate (75 to 115,200 bps), parity, data bits and stop bit.
M63	AI1 value range Used to enter the temperature / press values corresponding to 4mA and 20mA input current. The displayed values have no unit, so that they can represent any physical Parameter
M64	AI2 value range Used to enter the temperature / press values represented by 4mA and 20mA input current.
M65	AI3 value range Used to enter the temperature / press values represented by 4mA and 20mA input current.
M66	AI4 value range Used to enter the temperature / press values represented by 4mA and 20mA input current.
M67	Window to set up the frequency range (lower limit and upper limit) for the frequency output function. Valid values: 1Hz-9999Hz. Factory default is 1-1001 Hz. Note that the frequency signal can only be transmitted through the OCT output. Therefore, you need to set the OCT to be in frequency output mode.
M68	Window to set up the minimum flow rate which corresponds to the lower frequency limit of the frequency output
M69	Window to set up the maximum flow rate which corresponds to the upper frequency limit of the frequency output
M70	LCD backlight control. Available options: Always OFF; Always ON and Lighting For. When Lighting For option is selected, you need to enter a value which indicates how many seconds the backlight will be on with every key pressing.

M71	LCD contrast control. The LCD will become darker or brighter when a value is entered.
M72	Working timer. It can be cleared by pressing ENT key, and then select YES.
M73	Alarm #1 lower threshold setup. When flow rate is below this threshold, the Alarm #1 OCT circuit or relay will be activated. There are two alarming methods, OCT and relay. User must select the alarming output method in window M78 or M79.
M74	Alarm #1 upper threshold setup. When flow rate is above this threshold, the Alarm #1 OCT circuit or relay will be activated. There are two alarming methods, OCT and relay. User must select the alarming output method in window M78 or M79.
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. The available trigger sources are: 0. No Signal 9. POS Int Pulse 1. Poor Signal 10. NEG Int Pulse 2. Not Ready 11. NET Int Pulse 3. Reverse Flow 12. Energy Pulse 4. AO Over 120% 13. ON/OFF via RS232 5. FO Over 120% 14. Fluid Sound Speed Changed 6. Alarm #1 15. Buzzer on when key down 7. Alarm #2 16. Buzzer off 8. Batch Control
M78	OCT (Open Collector Transistor output) setup. By selecting a proper triggering source, the OCT circuit will close when the trigger event occurs. The OCT wiring diagram is shown in Appendix §9.1. The available triggering sources are: 0. No Signal 9. POS Int Pulse 1. Poor Signal 10. NEG Int Pulse 2. Not Ready 11. NET Int Pulse 3. Reverse Flow 12. Energy Pulse 4. AO Over 120% 13. FO (frequency output) 5. FO Over 120% 14. FO via RS232C 6. Alarm #1 15. ON/OFF via RS232 7. Alarm #2 16. Fluid Sound Speed Changed 8. Batch Control 17. OCT off
M79	Relay output setup. By selecting a proper triggering source, the relay circuit will close when the trigge event occurs. The relay is single-pole and constant-on. The available triggering sources are: 0. No Signal 9. POS Int Pulse 1. Poor Signal 10. NEG Int Pulse 2. Not Ready 11. NET Int Pulse 3. Reverse Flow 12. Energy Pulse 4. AO Over 120% 13. ON/OFF via RS232 5. FO Over 120% 14. Fluid Sound Speed Changed 6. Alarm #1 15. Relay off 7. Alarm #2 8. Scheduled Output

	The relay output is a single-pole single-throw (SPST), always on type drive. Its maximum operating frequency is 1Hz. Its load current is 1A at 125VAC, or 2A at 30VDC.
M80	For batch process controller. Select the triggering signal of the internal batch process controller: 0. Key ENT down 4. AI2 Falling Edge 1. AI1 Rising Edge 5. AI3 Rising Edge 2. AI1 Falling Edge 6. AI3 Falling Edge 3. AI2 Rising Edge 7. AI4 Rising Edge For the input analogue current signal, 0mA indicates “0”and 20mA indicates “1”.
M81	For batch process controller. Set the flow batch value (dose). M81 and M80 should be used together to configure the internal batch process controller.
M82	View the daily, monthly and yearly totaliser values. The flow total data of the last 64 days, last 64 months and last 5 years are saved in memory. Use ENT , ▲/+ (this should be the “UP” arrow) or ▼/- to display them. The first line on the screen has a dash line “ -------“. Be aware if there is other letter after the dash line. If a “G”appeared, the system gained was adjusted automatically at least once. This could happen when the flow meter was offline once on that day. If a “H”appeared, poor signal was detected at least once. It indicates that there was interference or the installation was not good. Refer to the next chapter for diagnosis information.
M83	Automatic Amending function for automatic offline compensation. Select YES to enable this function, select NO to disable it. When the function is enabled, the flow meter will estimate the average flow uncounted (or “lost”) during the offline session and add the result to the totaliser. The estimation of the uncounted flow is made by computing the product of the offline time period and the average flow rate, which is the average of the flow rate before going offline and the one after going online.
M84	Set the thermal energy unit.
M85	Select temperature source: 0. temperature from input AI1 and AI2; 1. fixed difference. When selecting ”1. fixed difference”, you need to enter the temperature difference in this window.
M86	Specific heat select
M87	Energy totalizer switch
M88	Set energy multiplier factor.
M89	(1) display the temperature difference. (2) the window to set the lowest temperature difference.
M90	Display the signal strength S (one for upstream and one for downstream) and signal quality Q. S, Q and R (see M91) are the so-called installation triplet. They are the key criteria for justifying whether an installation is bad, operational or optimal. Your installation is bad if S<60, Q<60 and R<97% or R>103%. Your installation is operational if S≥60, Q≥60 and 97%≤R≤103%. Your installation is optimal if S≥80, Q≥80 and 99%≤R≤101%. Note, for high velocity flow, the optimal range for R may be relaxed.
M91	Display the transit time ratio R. It is one of the installation triplet. Refer to the above menu (M90) for more details.
M92	Display the fluid sound speed estimated by using the measured transit-time. If this value has

	an obvious difference with the actual fluid sound speed, the user is recommended to check if the pipe parameters are correct and if the transducer installation is good.
M93	Display the average transit time and the delta time (transit time difference between upstream and downstream traveling). Normally, the delta time should not fluctuate over 20%. If it does, the system is not in stable condition. You need to check your transducer installation and the entered installation parameters. For small pipe, the transit time value may not be stable. In such case, try to adjust transducer position until the transit time becomes stable.
M94	Display the Reynolds number and the pipe factor used by the flow rate measurement program. Pipe factor is calculated from the line-averaged velocity and cross-section-averaged velocity information
M95	Upon entering into this window, the circular display function is started automatically. The following windows will be displayed one by one, each window will stay for about 4 seconds: M95 ->M00 -> M01 -> M02 -> M03 -> M04 -> M05 -> M06 -> M07 -> M08 -> M09 -> M90 -> M95. This function allows the user to visit all the important information without any manual action. To disable the function, simply switch to anther window.
M96	Command for the thermal printer to advance 5 lines of paper
M97	Command to record the pipe parameters entered by the user. The printing data can be directed either to the internal serial bus or to RS-232C serial interface
M98	Command to print the diagnostic information. The printing data can be directed either to internal serial bus or to RS-232C serial interface
M99	Command to copy the current display. The printing data can be directed either to the internal serial bus or to RS-232C serial interface
M+0	View the last 64 records of power on and off events. The recorded information include the date and time as well as the corresponding flow rate when the power on or off occurs
M+1	Display the total working time of the instrument since the flow meter left the factory
M+2	Display the date and time of the last power-off event.
M+3	Display the flow rate of the last power-off event.
M+4	Display the total number of times the flow meter has been powered on and off since the flow meter left the factory.
M+5	A scientific calculator for the convenience of field applications. All the values are in single accuracy. All the mathematic operators are selected from a list. The calculator can be used while the flow meter is conducting flow measurement.
M+6	Set fluid sound speed threshold. When the estimated sound speed (M92) exceeds this threshold, an alarm signal will be generated and transmitted to OCT or relay. This function can be used to generate an alarm when fluid material changes.
M+7	No Used
M+8	Display the received signal. In normal condition, this signal should be stable and signal amplitude does not vary much.
M+9	Display the present temperature values (integer portion) of analogue input AI1 and AI2. Display water heat capacity at this temperature.
M-0	Entry to hardware adjusting windows. Valid for the manufacturer only.

4. Troubleshooting

The flowmeter series flow meters utilized high-reliability design, thus, their malfunction probability is quite low. However, due to improper settings, harsh environment or misusage, problem could occur. Therefore, flowmeter is equipped with a complete set of self-diagnosis functions. The errors are displayed in the upper right corner of the menu window via identification code in a timely order. Hardware self-diagnosis is conducted every time when power is on. Some errors can even be detected during normal operation. For those errors undetectable due to incorrect settings or improper testing conditions, the flow meter will also display useful information to help the user to quickly debug the error and solve the problem.

There are two types of errors, one is hardware error, another is operational error. Details are presented in the following sections.

Power-on Errors

When powered on, the ultrasonic flow meter automatically starts the self-diagnosis process to find if there are any hardware and software problems. If a problem is identified, an error message will be displayed. The following table shows the possible error messages, the corresponding causes and their solutions.

Hardware self-diagnosis errors and solutions

	Causes	Solutions
ROM Parity Error	ROM operation illegal / error	(1) Reboot the system (2) Contact the manufacturer.
Stored Data Error	User-entered parameters lost.	(1) Reboot the system (2) If problem persists, press ENT key to restore the factory default configuration.
SCPU Fatal Error	SCPU hardware fatal error	(1) Reboot the system (2) Contact the manufacturer.
System Clock Slow or Fast Error	Problem with the system clock or the crystal oscillator.	
CPU or IRQ Error	Problem with CPU or IRQ hardware	
System RAM Error	Problem with RAM chip	
Time Date Error	Problem with date/time chip	(1) Initialize the calendar in menu window M61. (2) Contact the manufacturer.
No Display. Erratic or Abnormal Operation	Problem with wiring	Double check wiring connections.
No response to key pressing	Keypad is locked Bad plug connection	Unlock the keypad.
Reboot repetitively	Hardware problems	Contact the manufacturer

Working Status Errors

The ultrasonic flow meter will show an Error Code (a single letter like I, R, etc.) in the upper right corner on menu windows. When any abnormal Error Code shows, counter-measures should be taken.

Table 5.2 Working status errors and solutions

Error code	Message on window M08	Causes	Solutions
R	System Normal	No error	
I	No Signal	(1)Unable to receive signal (2)Transducers installed improperly (3)Loosen contact or not enough couplant between transducer and pipe surface. (4)Pipe liners are too thick or the deposition inside of the pipe is too thick. (5)Transducer cables are not properly connected	(1)Polish the pipe surface and clean the spot. Remove paint. (2)Make sure the couplant is enough (3)Make sure the transducer is in tight contact with pipe surface (4)Check the transducer cables (5)Check installation parameter settings (6)Find a better measurement SIte. Newer pipe, no corrosion, no deposition
J	Hardware Error	Hardware problem	Contact the manufacturer
H	Poor Sig. Detected	Poor signal detected Similar to error code I	Similar to error code I
E	Current Loop Over 20mA	4-20mA loop output over 120% Improper settings for current loop output	(1) Ignore it if current loop output is not used (2) Check current loop settings in M56. (3) Confirm if the actual flow rate is too high.
Q	Frequency Output Over	(1) The frequency output is 120% over. (2) Improper settings for frequency output (3) The actual flow rate is too high	(1) Ignore it if frequency output is not used (2) Check the values entered in window M66, M67, M68 and M69. (3) Use a larger value in M69 if needed. (4) Confirm if the actual flow rate is too high.
F	System RAM Error Date Time Error CPU or IRQ Error ROM Parity Error	(1) Temporary problems with RAM, RTC (2) Permanent problems with hardware	(1) Reboot the system (2) Contact the manufacturer
G	Adjusting Gain >s1 Adjusting Gain >s2 Adjusting Gain >s3 Adjusting Gain >s4 (shown in M00-M03)	Instrument is in the progress of adjusting the gain for the signal, and the number indicates the progressive steps	No need for action
K	Empty pipe	(1) No liquid inside the Pipe (2) Incorrect setup in M29	(1) If the pipe is not full, relocate the meter to where the pipe is full of liquid (2) If the pipe is full, enter 0 in M29

Other Problems and Solutions

(1) Q: Why the instrument displays 0.0000 flow rate while the liquid in the pipe is actually flowing? The signal strength is checked to be good (the working status is "R") and the signal quality Q has a satisfactory value.

A: The problem is likely to be caused by the incorrect “Zero Point”setting. The user may have conducted the “Zero Point”setup while the flow was not standstill. To solve this problem, use the ‘Reset Zero’ function in menu window M43 to clear the zero point.

(2) Q: The displayed flow rate is much lower or much higher than the actual flow rate in the pipe under normal working conditions.Why?

A: The entered offset value might be wrong. Enter ‘0’offset in window M44.

(a) Incorrect transducer installation. Re-install the transducers carefully.

(b) The ‘Zero Point’ is wrong. Go to window M42 and redo the “ Zero Point”setup. Make sure that the flow inside the pipe is standstill. No velocity is allowed during this setup process.

(3) Q: Why there is no signal? The installation requirements are met, pipe is new and pipe material is in good quality.

A: Check the following:

(a) Is the installation method suitable for your pipe size?

(b) Are the entered installation parameters correct?

(c) Are the wirings correct?

(d) Adequate couplant? Transducers are in good contact with pipe?

(e) Is pipe full?

(f) Is the transducer distance in consistency with the one shown in M25?

(g) Is transducer head/tail in the right direction?

(4) Q: How to conduct measurement on an old pipe? Heavy scale inside, no signal or poor signal detected.

A: (a) Check if the pipe is full of liquid.

(b) Try Z method. If the pipe is close to a wall and it is hard to do Z-method installation, you may work on a vertical or inclined pipe with flow upwards.

(c) Carefully select a good pipe section and fully polish/clean the installation area of the pipe surface. Apply a wide band of couplant on each transducer face. Install the transducer properly.

(d) Slowly and slightly move each transducer with respect to each other around the installation point until the maximum signal is found. Be careful that the new installation location is free of scale inside the pipe and that the pipe is concentric (not distorted) so that the sound waves do not bounce outside of the proposed area.

(e) For pipe with thick scale inside or outside, try to clean the scale off, if it is accessible from the inside. (Note: Sometimes this method might not work and sound wave transmission is not possible because of the layer of scale between the transducers and pipe inside wall).

(5) Q: Why no current in the current loop output?

A: Check if the current output mode is set correct in M55. You need to turn the current loop on in M55. Check the hardware connection: open the electronics enclosure, check to see if the short-circuit terminal near terminal 22 is in place between 1-2, i.e. Direct Output Mode. Note that positions 2-3 are used for Transmitter Mode in which an external power supply is needed for the current loop output.

(6) Q: Why is the current output not correct?

A: (a) Check if the current output mode is set correct in M55.

(b) Check the upper and lower current settings in M56 and M57.

(c) Re-calibrate the current loop. Verify the output with M49.

(7) Q: Can the flow meter work normally for a few years without stop under harsh environment where power supply voltage varies widely?

A: Yes. The flow meter employed intelligent signal processing algorithms to handle strong interference coming from either power line or radiation. It also automatically adjusts itself to the optimal operation status when sound wave strength varies due to changing environment.

5. Communication Protocol

The ultrasonic flow meter integrates a standard RS-232C communication interface and a complete set of communication protocol. Its hardware supports MODEM for phone-line based data networking. With the aid of a RS232-RS485 converter, the flow meter can be connected to a RS485 network bus. You may also use our GSM short-message module to transmit flow data to a remote computer. With the GSM module, you are even able to check the flow data and flow meter status from your cell phone.

When using RS232 for networking, you may use the flow meter's IDN as its network address, and use [W]-extended command set as the communication protocol. The current loop output and OCT output can be used to control analogue-based or stepper-based valve openness, and the relay output can be used to turn on and off other devices. The four channel analogue inputs can be used to input pressure, temperature and other signals. In brief, complete flow measurement or thermal energy measurement RTU.

The maximum transmission distance is 15m for RS232C and 1000m for RS485. If longer distance is needed, current loop, MODEM, GSM can serve the purpose. All the flow meter operations can be made on a remote computer, except the modification of IDN which can only be done locally through the flow meter's keypad. The communication protocol is based on master-slave principle. Master (remote computer) sends a command, slave (the flow meter) responses the command.

You may use the Hyper Terminal software in your computer to send commands to and view responses from the flow meter. Please refer to your computer's manual on how to configure the Hyper Terminal. Note that the COM port settings need to match those in menu window M62.

5.1 RS232 Connector Pin-out

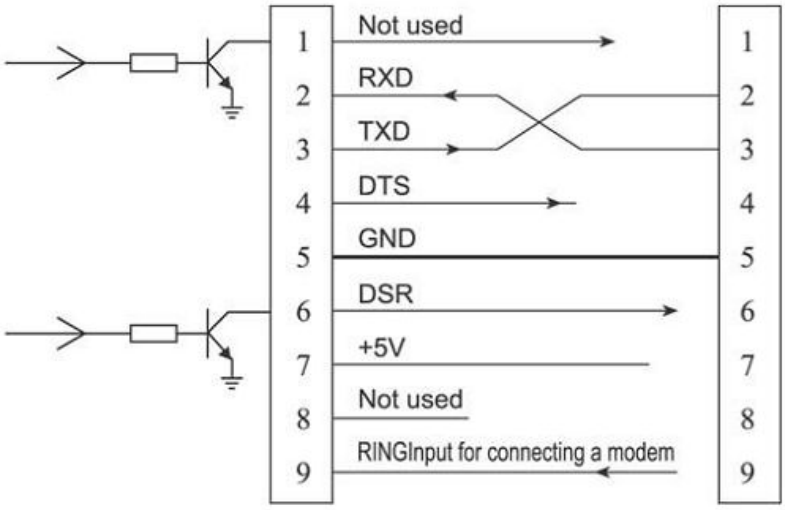


Figure 1:RS232 Wiring Diagram

5.2 RS232 Wiring

Figure 1 for connecting the flow meter to a remote computer through RS232. Lines 2 and 3 of the connecting cable are crossed over. Note that the regular RS232 cable obtained in the stores cannot be used directly. You need to make modification according to Figure 6.1. Consult the User's Manual of your computer for RS232 wiring as well.

5.3 Communication Protocol

The protocol is comprised of a set of basic commands that are strings in ASCII format, ending with a carriage (CR) and line feed (LF). Commonly used commands are listed in the following table.

5.3.1 Basic Commands

Command	Function	Data Format
DQD(CR)[0]	Return flow rate per day	±d.dddddd E±dd(CR)[1]
DQH(CR)	Return flow rate per hour	±d.dddddd E±dd(CR)
DQM(CR)	Return flow rate per minute	±d.dddddd E±dd(CR)
DQS(CR)	Return flow rate per second	±d.dddddd E±dd(CR)
DV(CR)	Return instantaneous flow velocity	±d.dddddd E±dd(CR)
DI+(CR)	Return POS totaliser	±ddddddd E± d(CR)[2]
DI-(CR)	Return NEG totaliser	±ddddddd E± d(CR)
DIN(CR)	Return NET totaliser	±ddddddd E± d(CR)
DIE(CR)	Return Caloric Totaliser Value	±ddddddd E± d(CR)
DID(CR)	Return Identification Number (IDN)	ddddd(CR) 5-digit
E(CR)	Return Instantaneous Caloric Value	±d.dddddd E±dd(CR)
DL(CR)	Return signal strength and signal quality	UP:dd.d,DN:dd.d, Q=dd(CR)
DS(CR)	Return the percentage of analogue output A0.	±d.dddddd E±dd(CR)

More information, please contact with the thchnologist, email: tech@ayite.net

5.3.2 Protocol Prefix Usage

(1) Prefix P

The prefix P can be added before any command in the above table to have the returning data followed with two bytes of CRC check sum, which is the adding sum of the original character string.

Take command DI+(CR) (Return POS Totaliser Value) as an example. The binary data for DI+(CR) is 44H, 49H, 2BH and 0DH. Assume the return value of this command is +1234567E+0m3(CR)(LF) (the string in hexadecimal is 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H, 0DH, 0AH).

Then, the P-prefixed command, PDI+(CR), would return +1234567E+0m3!F7(CR)(LF). The '!'acts as the starter of the check sum (F7) which is obtained by adding up the string, 2BH+ 31H+ 32H+ 33H+ 34H+ 35H+ 36H+ 37H+ 45H+ 2BH+ 30H+ 6DH+ 33H+ 20H = (2) F7H.

Please note that it is allowed to not have data entry or to have SPACES (20H) character before the '!' character.

(2) Prefix N

N + single byte address string + basic command.

The prefix N is a single byte IDN network address, not recommended in a new design. Recommending W command.

(3) Prefix W

The prefix W is used for networking commands. The format of a networking command is:
W + IDN address string + basic command.

The IDN address should have a value between 0 and 65534, except 13(0DH), 10 (0AH), 42(2AH,*), 38(26H, &).

For example, if you want to visit the instantaneous flow velocity of device IDN=12345, the following command should be sent to this device: W12345DV(CR). The corresponding binary code is 57H, 31H, 32H, 33H, 34H, 35H, 44H, 56H, 0DH.

(4) Command binder &

The & command binder or connector can connect up to 6 basic commands to form a longer command so that it will make the programming much easier.

For example, assume we want device IDN=4321 to return the flow rate, velocity and POS totaliser value simultaneously. The combined command would be W4321DQD&DV&DI+(CR), and the result would be: +1.234567E+12m3/d(CR) +3.1235926E+00m/s(CR) +1234567E+0m3(CR)

5.3.3 Codes for the keypad

The protocol provides the capability of virtual key-pressing. A remote RS-232C terminal can send an 'M' command along with a key code to simulate the scenario that the key is pressed through the keypad of the flow meter. This functionality allows the user to operate the flow meter in the office far away from the testing site.

For example, the command "M1"is sent to the flow meter through the RS-232C link, the flow meter will treat the command as if the user has pressed the 1 key through the keypad.

The ASCII codes and corresponding key values of the keypad keys are listed in the following table.

Key	Hexadecimal Key code	Decimal Key code	ASCII Code		Key	Hexadecimal Key code	Decimal Key code	ASCII Code
0	30H	48	0		8	38H	56	8
1	31H	49	1		9	39H	57	9
2	32H	50	2		.	3AH	58	:
3	33H	51	3		◄	3BH(0BH)	59	;
4	34H	52	4		MENU	3CH,(0CH)	60	<
5	35H	53	5		ENT	3DH,(0DH)	61	=
6	36H	54	6		▲/+	3EH	62	>
7	37H	55	7		▼/-	3FH	63	?

5.3.4 Programming Examples

Example 1: VB requests the instantaneous (in second) flow rate.

VB Code: mscom1.input = "dqs"+ vbcrlf;

Example 2: VB requests the 4321 flow meter to return the following data with checksum: (a)

instantaneous flow rate; (b) instantaneous flow velocity; (c) Positive totaliser value; (d) Heat totaliser value; (e) AI1 input current; (f) AI2 input current.

VB Code: mscom1.input = “W4321PDQD&PDV&PDI+&PDIE&PBA1&PAI2”+ vbcrlf;

Example 3: VB requests to change the pipe OD to 345mm.

VB Code: mscom1.input = ”M<”+VBCRLF +” M1”+VBCRLF +”M1”+VBCRLF+”M3”+VBCRLF +”M4” +VBCRLF +” M5”+VBCRLF +”M=”+VBCRLF

Note that “M<”represents the MENU key, “M=”represents the ENT key,, “ M1”represents the “1”key.

6. Measurements of thermal and Other physical parameters

6..1 Introduction

Ultrasonic flowmeter is designed with the function of measuring energy, which can automatically compute the enthalpy of the corresponding water temperature based on the international standards, and thus calculate energy flow and energy accumulation.

Temperature signals are entered from the analog input hardware AI1and AI2 of Ultrasonic flowmeter. AI1and AI2 can only accept current signal of 4-20mA or 0-20mA. Ultrasonic flowmeter also has other three analog inputs, known as AI3, AI4 and AI5, which can be used to input such signals as pressure, temperature and residual chlorine, etc.

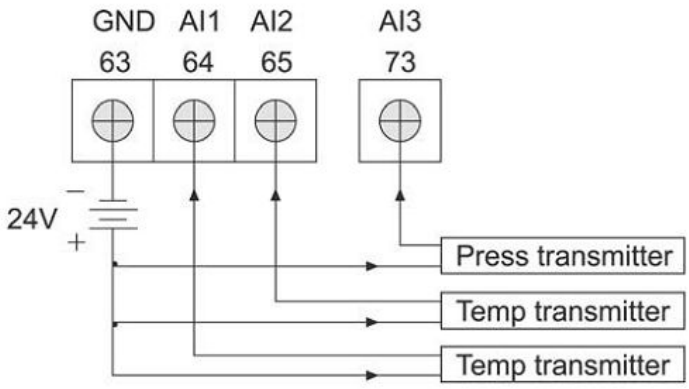
All results about the above-mentioned measurements can be transferred to the main unit through the communication protocols of Ultrasonic flowmeter. In this way, Ultrasonic flowmeter play a role of data monitoring network of RTU, which can greatly reduce hardware complexity, save costs and improve reliability.

Please note that the precision of analog input AI1, AI2, AI3, AI4 and AI5 is 12 bits and no electrical isolation is made for the inside lines. If the meter is used in occasions of high demands or serious interference, outside isolation measures should be taken.

6.2 Wiring Analogue Inputs

For caloric measurement, the supply side temperature transmitter should be connected to channel AI1 (terminal blocks 64 and 63), and the return side transmitter should be connected to channel AI2 (terminal blocks 65 and 63) with twisted-pair wiring (Figure 1). An internal +24VDC power is proved to the terminals, thus, no external power supply is needed. This means that the temperature (or pressure) transmitter must be two-wire type transmitter.

Figure1：Analogue input wiring



Menu window M06 displays the current analogue input data and its corresponding pressure or temperature value.

The flowmeter can accommodate five analogue signals with its five analogue input modules. AI1 and AI2 are available in standard options. The other three modules are available only upon request.

6.3 Thermal Energy Measurement

There are two methods for thermal energy calculation:

(1) Qt = Q x (T2 –T1) x Ct,
(2) Qt = Q x (TC2 –TC1)

Where Qt is the thermal energy (or caloric) consumed, Q is the flow rate, T1 and T2 are the temperature at supply and return points, respectively. Ct is the specific heat (or the thermal capacity coefficient) of the fluid, which can be entered in menu M86. For water, it is normally about 0.0041868GJ/m3°C. TC1 and TC2 are the thermal capacities corresponding to temperature T1 and T2, which are calculated by the flow meter according to international standards and displayed in M05.

The following menu windows might be used when performing thermal energy measurement:

Menu window M05: display energy and totalized energy.
Menu window M06: display the current values of input AI1 and AI2 and their corresponding temperature values.
Menu window M63: set the minimum and maximum temperature values which correspond to the minimum current (4mA) and maximum current (20mA) of channel AI1.
Menu window M64: set the minimum and maximum temperature values which correspond to the minimum current (4mA) and maximum current (20mA) of channel AI2.
Menu window M84: thermal unit selection. KCAL/s - Kilocalories/second, GJ/s –Giga Joules/second
Menu window M85: temperature source selection: 0. temperature from input AI1 and AI2; 1. fixed difference. When selecting fixed difference, enter the difference in this menu.
Menu window M86: specific heat (or thermal capacity coefficient) input
Menu window M87: thermal totaliser on/off switch
Menu window M88: thermal totaliser multiplier factor
Menu window M89: thermal totaliser reset

Note that, if the fluid temperatures at both supply and return points are stable, you may choose not to use temperature transmitters. Instead, you can directly enter the temperature difference of the two points on menu window M85.

6.4 Configure Analogue Measurement Ranges

Temperature, pressure and other signals are entered into the flow meter through analogue channels AI1-AI4. Their measurement ranges can be set on windows M63-M66. The first number of these windows is the minimum of the measurement range, corresponding to an analogue input of 4mA. The second number is the maximum, corresponding to 20mA input current.

Example 1: assume a temperature transmitter provides 4mA at 10°C and 20mA at 150°C. And this transmitter is connected to channel AI1. Then, you need to enter 10 and 50 at menu window M63 for the first and second numbers, respectively. You can view the present current signal value and corresponding temperature data from window M06.

Example 2: assume a pressure transmitter outputs current 4mA at 0.98kg pressure and 20mA at 10.5kg pressure. The transmitter is connected to channel AI3. Then, you need to enter 0.98 and 10.5 in window M65. The present values of input current and corresponding temperature are shown in M07.

If you find the current value from the transmitter is different from the one shown in M06 (or M07), you need to calibrate the corresponding analogue channel. Please see section §3.16 for calibration detail.

6.5 Analog Input Calibration

In normal situations, unless users found that the current value shown in M06 and M07 is inconsistent with the actual one added to the analog input, do not conduct this operation. Before calibration, the hardware debug window should be opened and the method is as follows:

Type MENU ▼/- 0 ENT and enter the password “4213068”, and then type ENT to open the debug menu. The opening of the window is only effectively during this power-on period and the window is closed automatically when power is off.

Open M-2 to calibrate 4MA input signal of AI1. 10 seconds after AI1 input terminals (37 and 38 signal terminals) are connected with standard 4mA current signal, type MENU ▼/- 0 ENT (see the diagram. “0.58”in the bottom line is the last calibration result); then type ENT and calibration instructions occur. If "?" is shown, it indicates connecting problems; if ">", it indicates good connections. In box of calibration error, “ press ENT when ready”is shown to demand re-calibration. After calibration, the result is shown, and the number should be between -255 to +255.

Open M-3 to calibrate 20MA input signal of AI1. The calibration method is to make AI1 input terminals be connected with standard 20mA and then follow the same steps as the 4mA input calibration of AI1.

Open M-4 and M-5 to calibrate the current input signal of AI2. Follow the same steps as the current input signal calibration of AI1

Open M-6 and M-7 to calibrate the current input signal of AI3. Follow the same steps as the current input signal calibration of AI1

Open M-8 and M-9 to calibrate the current input signal of AI4. Follow the same steps as the current input signal calibration of AI1

6.6 Read Input Analogue Values from a Network Computer

When the flow meter is networked, all the analogue data can easily be visited from a remote computer.

For visiting the present analogue input current, use command BA1, BA2, BA3 or BA4.
For visiting the temperature/pressure value represented by the analogue input current, use command AI1, AI2, AI3 or AI4.

7. Warranty & Service

7.1 Guarantee

“A.YITE Electronic” supply one year guarantee on all electronic products, free of charge, but the user should be responsible for the one-way transportation fee from the customer to the factory.

7.2 Service

If any hardware failure of the instrument, we recommend that our customers sent back the instrument to our factory for service, due to the fact that the instrument is made of microprocessors and it will be difficult to perform field maintenance. Before sending back the instrument, please try to contact the branch of “A.YITE Electronic”, to make sure what problem.

7.3 Software Upgrade Service

“A.YITE Electronic” will make a record for every buyer, when the software need to upgrade, my company we sent the lately develop software to the buyer.

For to record the customer information, every buyer should sent his contact information to the “Email: support@ayite.net”, with the copy of Invoice.

A.YITE Electronic Group

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