INSTRUCTIONS
and
OPERATION
MANUAL

FOR MODEL

UA108

Dedicated Ultrasonic Flow meter

Update Record	Revision:	
	Date:	

Notice

Thank you for choosing the UA108 Ultrasonic Flowmeter with SLSI CMOS and low-voltage wide-pulse sending technology.

This instruction manual contains important information. Please read carefully before the operation of the flowmeter.
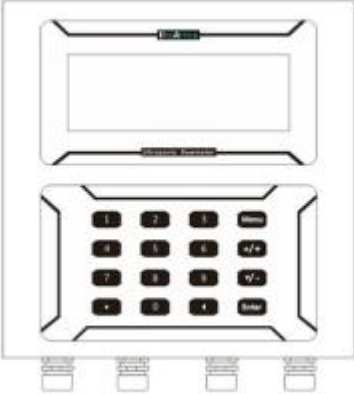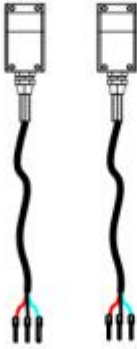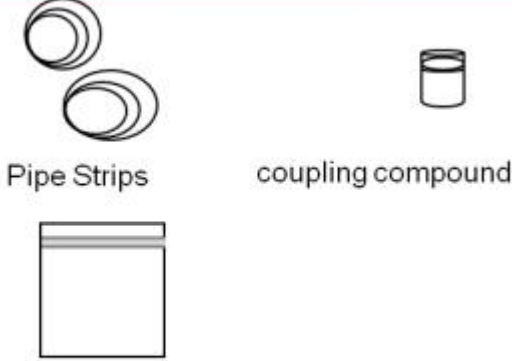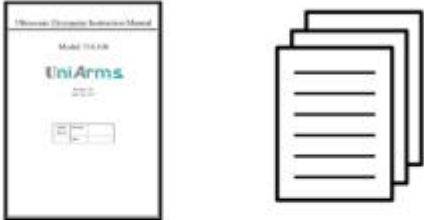

Warning

May cause injury

Attention

May damage the flowmeter

Product Components

Inspection should be made before installing the Flowmeter. Check to see if the spare parts are in accordance with the packing list. Make sure that there is no damage to the enclosure due to a loose screw or loose wire, or other damage that may have occurred during transportation. Any questions, please contact your representative as soon as possible.

Transmitter	Transducer

Accessories	Documents
Pipe Strips coupling compound Screws and bushings	1. Instruction manual; 2. Factory certificte; 3. Packing list.

Content

Update Information:

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1. Transmitter Installation and Connect

1.1. Inspection prior to Transmitter Installation

You will find a mounting plate in our accessories bag.Please drill 2 Installation holes at the screw position shown on the right drawing.
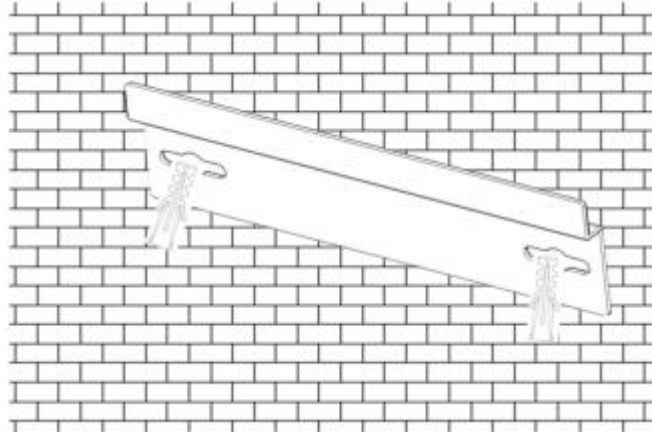
Take out the enclosed screws and bushings.Screw the two aluminum pieces onto the back side of back cover as the right picture indicated.
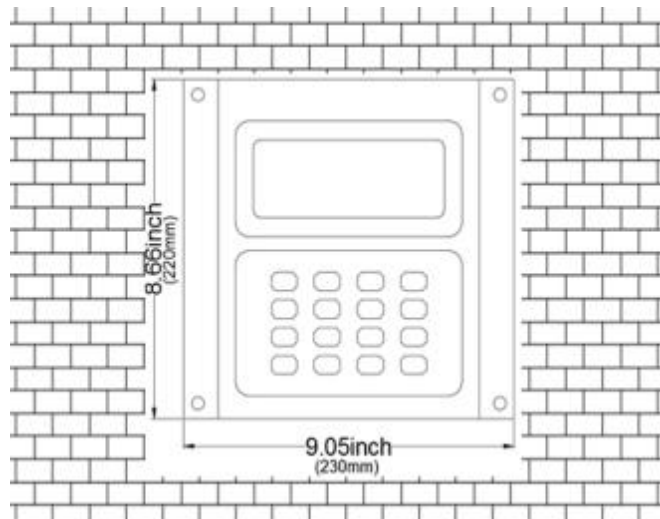
Attention

When installing please ensure the front cover is secure.

1.2. Power Supply Connecting

1.2.1 Direct Mount Method

Customers should pay special attention to specify the desired power supply when placing an order. Factory standard power supply is 90~245 VAC.

Observe the following precautions for installation procedures outlined in this chapter:

Ensure that power connections are made in accordance with the indications shown on the connection terminals.

Transmitters can be powered by two different power supplies: 90~245VAC or 24VDC

1.2.2 Connecting the Wiring

Once the electronics enclosure has been installed, the flowmeter wiring can be connected.

Power board wiring ports, from right to left, are as follows;

Connect to AC power (90-245V), DC power (24V), OCT Output, Relay, Transducer wiring(Transducer cable with red bushing connects to UP, Transducer cable with blue bushing connects to DN.), 4-20mA Output, RS485 Output, Analog Input, RTD input.

For double-shielded transducer cable: "-" on the black wire, "+" on the red wire and "shield" on the shield.
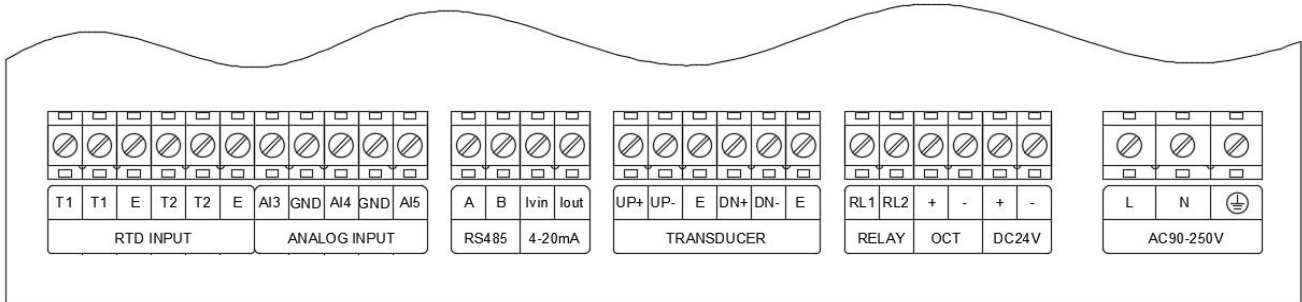
Warning

Wire with power off.

Use either AC or DC power supply. Do not connect them both at the same time.

1.3. Powering on

As soon as the Flowmeter is switched on, the self-diagnosis program will start to run. If any error is detected, an error code will display on the screen (Refer - Error Diagnoses). After that, the system will run automatically according to the last input parameters.

If the installation is accomplished when system is switched on, gain adjustment can be monitored in Window M01. After S1, S2, S3, S4 are displayed on the upper left corner of the screen, the system will activate the normal measurement condition automatically. It is indicated by code "*R" on the upper right corner of the screen.

The system will default to the last window settings and automatically display them at next power on.

1.4. Keypad Functions

Follow these guidelines when using the Flowmeter keypad (Refer to Keypad Figure):

⓪ ~ ⑨ And ⊡ input numbers.

⟨<⟩ Backspace or delete characters to the left.

⟨∧⟩ And ⟨∨⟩ Return to the last menu or to open the next menu. Acts as "+" and "-" functions when entering numbers.

⟨Menu⟩ Select a menu. Press this key first, then input two menu numbers to display the selected menu. For example, To Input a pipe outside diameter, press ⟨Menu⟩ ① ① keys, where "11" is the window ID to display the parameter for pipe outside diameter.

Strength and Signal Quality 、⟨Menu⟩⓪⑧ System Error Codes.
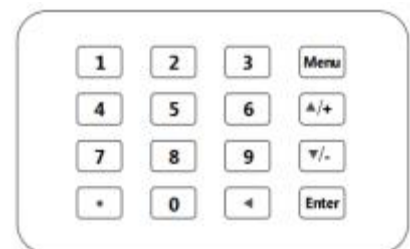
1.5. Keypad Operation

With all of the parameters entered, the instrument setup and measurement displays are subdivided or consolidated into more than 100 independent windows. The operator can input parameters, modify settings or display measurement results by "visiting" a specific window. These windows are arranged by 2-digit serial numbers (including "+" sign) from 00~99, then to +0, +1, etc. Each window serial number, or so-called window ID code, has a defined meaning. For example, Window M11 indicates the parameter input for pipe outside diameter, while Window M25 indicates the mounting spacing between the transducers, etc. (Refer – Windows Display Explanations).

The keypad shortcut to visit a specific window is to press the (Menu) key at any time, then input the 2-digit window ID code. For example, to input or check the pipe outside diameter, just press the (Menu)(1)(1) keys for window ID code 11.

Another method to visit a particular window is to press (∧) (∨) and (Enter) keys to scroll the screen. For example, if the current window ID code is 66, press (∧) key to enter Window M65, press the (∧) button again to enter Window M64; then, press the (∨) key to back Window M65, and press the (∨) key again to enter Window M66.

Example1: To enter a pipe outside diameter of 219.234, the procedure is as follows:

Press (Menu)(1)(1) keys to enter Window M11 (the numerical value displayed currently is a previous value). Now press (Enter) key. The symbol ">" and the flashing cursor are displayed at the left end of the second line on the Screen. The new value can be entered then… (2)(1)(9)(·)(2)(3)(4)(Enter).

Example2: If the pipe material is "Stainless Steel", press keys (Menu)(1)(4) to enter Window M 14 first. Then press (Enter) key to modify the options. Now, select the "1. Stainless Steel" option by pressing (∧) and (∨) keys, and then press (Enter) key to confirm the selection. It is possible to press the (1) key to change the selection and wait until "1. Stainless Steel"is displayed on the second line of the screen. Then press the (Enter) key to confirm.

Attention

Generally, press (Enter) key first if operator wants to enter "modify" condition. If the "modify" is still not possible even after pressing the (Enter) key, it means that system is locked by a password. To "Unlock" it, select "Unlock" in Window M47 and enter the original password. The keypad will not respond if the keypad is locked.

1.6. Flowmeter Window Descriptions

The Flowmeter has the unique feature of windows processing for all operations.
These windows are assigned as follows:

00~09   Flow Totalizer Display: to display flow rate, positive total, negative total, net total, velocity, date & time, analog inputs for present flow, present operation and flow results today, etc.

10~29   Initial Parameter Setup: to enter pipe outside diameter, pipe wall thickness, fluid type, transducer type, transducer mounting and spacing, etc.

30~38   Flow Units Options: to select the flow unit, totalizer unit, measurement unit, turn totalizers on/off and reset totalizes, etc.

40~49   Setup options: Scaling factor, network IDN (Window M46), system lock (Window M47), etc.

50~89   Input and output setup: relay output setup, 4-20mA outputs, flow batch controller, LCD backlit option, date and time, low/high output frequency, alarm output, date totalizer, etc.

90~95   Diagnoses: Signal strength and signal quality (Window M90), TOM/TOS*100 (Window M91), flow sound velocity (Window M92), total time and delta time (Window M93), Reynolds number and factor (Window M94), Data Interval (Window M95) etc.

+0~+5   Appendix: power on/off time, total working hours, on/off times and a single-accuracy function calculator.

Attention

The other windows are for hardware adjustment by the manufacturer.

2. Pipe Parameter Entry Shortcuts

For example, measuring the diameter of DN200, measuring medium is water, Material is carbon steel, No Liner, can be operated as follows：

Step1. Pipe outside diameter:
   Press `Menu` `1` `1` keys to enter Window M11, and enter the pipe outside diameter, and then press the `Enter` key.

```
Pipe Outer Diameter
          200 mm
```

Step2. Pipe wall thickness
   Press the `Menu` `1` `2` key to enter Window M12, pipe wall thickness, and press the `Enter` key.

```
Pipe Wall Thickness
           6 mm
```

Step3. Pipe material
   Press the `Menu` `1` `4` key to enter Window M14, press the `Enter` key, move the `∧` or `∨` key to select pipe material, and press the `Enter` key.

```
Pipe Material      [14
  0. Carbon Steel
```

Step4. Liner material parameters
   (including thickness and sound velocity, if needed)
   Press the `Menu` `1` `6` key to enter Window M16, press the `Enter` key, move the `∧` or `∨` key to select liner material, and press the `Enter` key.

```
Liner  Material [16
0.None, No Liner
```

Step5. Fluid type
   Press the `Menu` `2` `0` key to enter Window M20, press the `Enter` key, move the `∧` or `∨` key to select fluid type, press the `Enter` key.

```
Fluid  Type       [20
   0.    Water
```

Step6. Transducer type
   (The transmitter is available for various transducer types)
   Press the `Menu` `2` `3` key to enter Window M23, press the `Enter` key, move the `∧` or `∨` key to select transducer type, and press the `Enter` key.

```
Transducer Type [23
  0. Standard
```

Step7. Transducer mounting methods
   Press the `Menu` `2` `4` key to enter Window

M24, press the Enter key, move the ∧ or ∨ key to select transducer-mounting method, and press the Enter key.

```
Transducer Mounting
  0.           V
```

Step8. Adjust Transducer spacing

Press the Menu 2 5 key to enter Window M25, accurately install the transducer according to the displayed transducer mounting spacing and the selected mounting method (Refer to Installing the Transducers in this chapter)

```
Transducer Spacing
        159.86  mm
```

Step9. Default settings

Press the Menu 2 6 key to enter Window M26, then press Enter key, move the ∧ and ∨ key to select 1. Solidify Setting, and press the Enter key.

Note: This step is very necessary to save and solidify the parameters.

```
Default Settings
  1.Solidify Settings
```

Step10. Display measurement result

Press the Menu 0 1 keys to enter Window M01 to display measurement result.
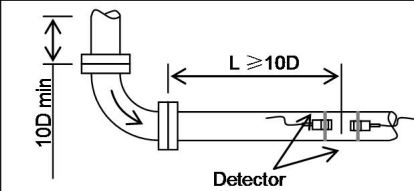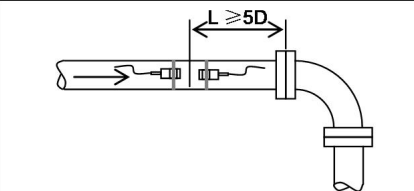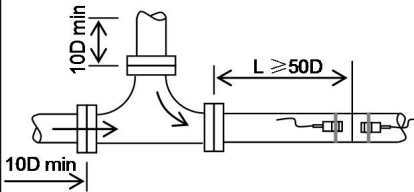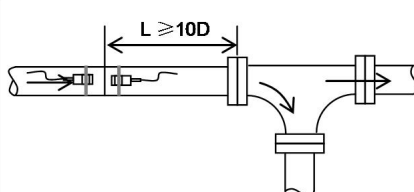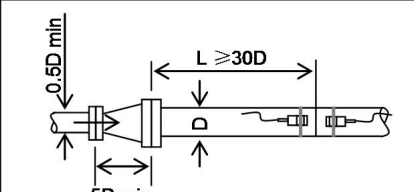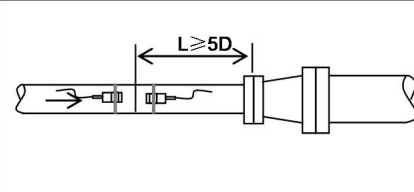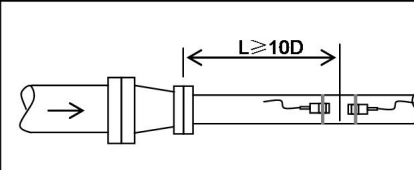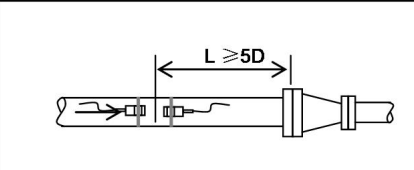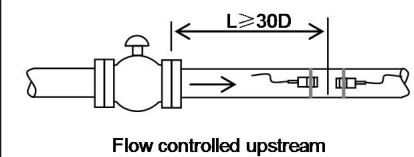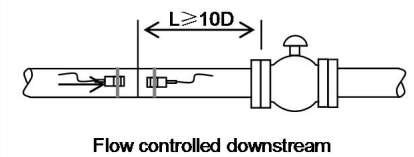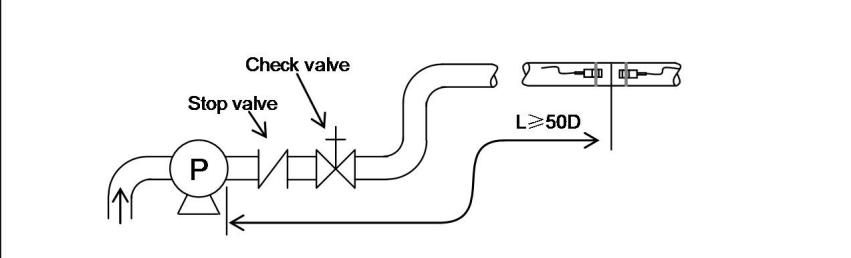
```
Flow  0.1129m3/h    *R
Vel    1.0415m/s
```

3. Measurement Site Selection

When selecting a measurement site, it is important to select an area where the fluid flow profile is fully developed to guarantee a highly accurate measurement. Use the following guidelines to select a proper installation site:

Choose a section of pipe that is always full of liquid, such as a vertical pipe with flow in the upward direction or a full horizontal pipe.

Ensure enough straight pipe length at least equal to the figure shown below for the upstream and downstream transducers installation.

Name	Straight length of upstream piping	Straight length of downstream piping
90° bend		
Tee		
Diffuser		
Reduce		
Valve	Flow controlled upstream	Flow controlled downstream
Pump		

Ensure that the pipe surface temperature at the measuring point is within the transducer temperature limits.

Consider the inside condition of the pipe carefully. If possible, select a section of pipe where the inside is free of excessive corrosion or scaling.

4. Transducer Installation

4.1. Installing the transducers

Before installing the transducers, clean the pipe surface where the transducers are to be mounted. Remove any rust, scale or loose paint and make a smooth surface. Choose a section of sound conducting pipe for installing the transducers. Apply a wide band of sonic coupling compound down the center of the face of each transducer as well as on the pipe surface, and then attach the transducers to the pipe with the straps provided and tighten them securely.

Note:

The two transducers should be mounted at the pipe's center-line on horizontal pipes.

Make sure that the transducer mounting direction is parallel with the flow.

During the installation, there should be no air bubbles or particles between the transducer and the pipe wall. On horizontal pipes, the transducers should be mounted in the 3 o'clock and 9 o'clock positions of the pipe section in order to avoid any air bubbles inside the top portion of the pipe. (Refer to Transducer Mounting). If the transducers cannot be mounted horizontally symmetrically due to limitation of the local installation conditions, it may be necessary to mount the transducers at a location where there is a guarantee full pipe condition (the pipe is always full of liquid).

4.1.1 Transducer spacing

After entering the required parameters, the spacing between the ENDS of the two transducers is considered as the standard transducer spacing (Refer to Top View on transducer mounting methods). Check the data displayed in Window M25 and space the transducers accordingly.

4.1.2 Transducer Mounting Methods

Four transducer mounting methods are available. They are respectively: V method, Z method and N method. The V method is primarily used on small diameter pipes (DN100~400mm, 4"~16"). The Z method is used in applications where the V method cannot work due to poor signal or no signal detected. In addition, the Z method generally works better on larger diameter pipes (over DN300mm, 12") or cast iron pipes.

The N method is an uncommonly used method. It is used on smaller diameter pipes (below DN50mm, 2").

4.1.3 V Method

The V method is considered as the standard method. It usually gives a more accurate reading and is used on pipe diameters ranging from 25mm to 400mm (1~16") approximately. Also, it is convenient to use, but still requires proper installation of the transducer, contact on the pipe at the pipe's centerline and equal spacing on either side of the centerline.

Side View	Section	Top View
Upstream Transducer / Flow / Downstream Transducer	Transducer / Pipe Strap	Flow / Transducer Space
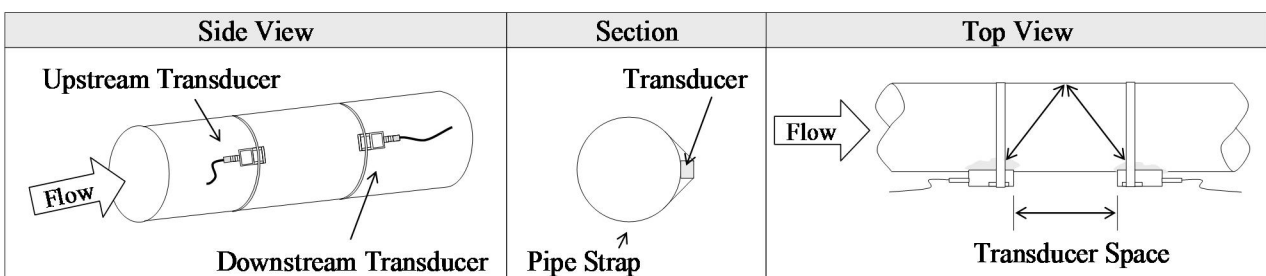
4.1.4 Z Method

The signal transmitted in a Z method installation has less attenuation than a signal transmitted with the V method. This is because the Z method utilizes a directly transmitted (rather than reflected) signal which transverses the liquid only once.

The Z method is able to measure on pipe diameters ranging from 100mm to 3000mm (4"~120") approximately. Therefore, we recommend the Z method for pipe diameters over 300mm (12").
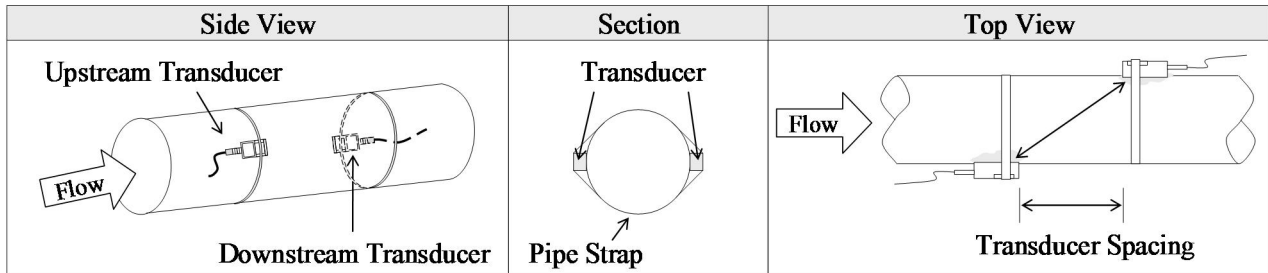
4.1.5 N Method (not commonly used)

With the N method, the sound waves traverse the fluid three times and bounce twice times off the pipe walls. It is suitable for small pipe diameter measurement.

The measurement accuracy can be improved by extending the transit distance with the N method (uncommonly used).
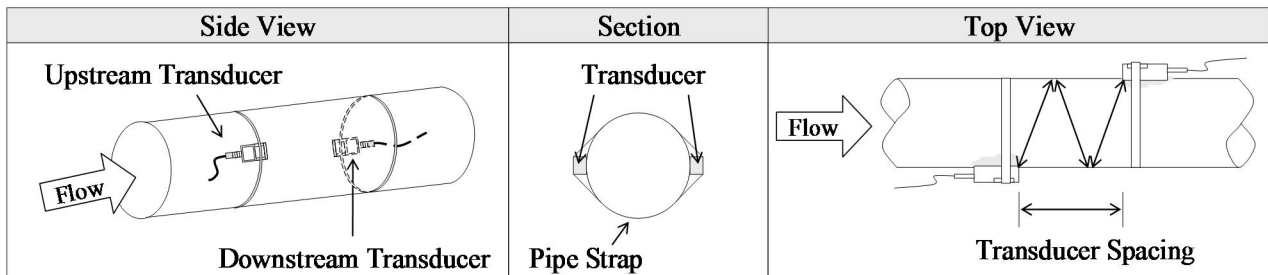
4.2. Transducer Mounting Inspection

Check to see if the transducer is installed properly and if there is an accurate and strong enough ultrasonic signal to ensure proper operation and high reliability of the transducer. It can be confirmed by checking the detected signal strength, total transit time, delta time as well as transit time ratio.

The "mounting" condition directly influences the flow value accuracy and system long-time running reliability. In most instances, only apply a wide bead of sonic coupling compound lengthwise on the face of the transducer and stick it to the outside pipe wall to get good measurement results. However, the following inspections still need to be carried out in order to ensure the high reliability of the measurement and long-term operation of the instrument.

4.2.1 Signal Strength

Signal strength (displayed in Window M90) indicates a detected strength of the signal both from upstream and downstream directions. The relevant signal strength is indicated by numbers from 00.0~99.9. 00.0 represents no signal detected while 99.9 represent maximum signal strength.

Normally, the stronger the signal strength detected, the longer the operation of the instrument reliably, as well as the more stable the measurement value obtained.

Adjust the transducer to the best position and check to ensure that enough sonic coupling compound is applied adequately during installation in order to obtain the maximum signal strength.

System normally requires signal strength over 60.0, which is detected from both upstream and downstream directions. If the signal strength detected is too low, the transducer installation position and the transducer mounting spacing should be re-adjusted and the pipe should be re-inspected. If necessary, change the mounting to the Z method.

4.2.2 Signal Quality (Q value)

Q value is short for Signal Quality (displayed in Window M90). It indicates the level of the signal detected. Q value is indicated by numbers from 00~99. 00 represents the minimum signal detected while 99 represent the maximum.

Normally, the transducer position should be adjusted repeatedly and coupling compound application should be checked frequently until the signal quality detected is as strong as possible.

4.2.3 Total Time and Delta Time

"Total Time and Delta Time", which displays in Window M93, indicates the condition of the installation. The measurement calculations in the flowmeter are based upon these two parameters. Therefore, when "Delta Time" fluctuates widely, the flow and velocities fluctuate accordingly. This means that the signal quality detected is too poor. It may be the result of poor pipe-installation conditions, inadequate transducer installation or incorrect parameter input.

Generally, "Delta Time" fluctuation should be less than ±20%. Only when the pipe diameter is too small or velocity is too low can the fluctuation be wider.

4.2.4 Transit Time Ratio

Transit Time Ratio indicates if the transducer mounting spacing is accurate. The normal transit time ratio should be 100±3 if the installation is proper. Check it in Window M91.

Attention

If the transit time ratio is over 100±3, it is necessary to check:

(1) If the parameters (pipe outside diameter, wall thickness, pipe material, liner, etc.) have been entered correctly,

(2) If the transducer mounting spacing is accordance with the display in Window M25,

(3) If the transducer is mounted at the pipe's center-line.

(4) If the scale is too thick or the pipe mounting is distorted in shape, etc.

4.2.5 Warnings

(1) Pipe parameters entered must be accurate; otherwise the flowmeter will not work properly.

(2) During the installation, apply enough coupling compounds in order to stick the transducer onto the pipe wall. While checking the signal strength and Q value, move the transducer slowly around the mounting site until the strongest signal and maximum Q value can be obtained. Make sure that the larger the pipe diameter, the more the transducer should be moved.

(3) Check to be sure the mounting spacing is accordance with the display in Window M25 and the transducer is mounted at the pipe's centerline.

(4) Pay special attention to those pipes that are formed by steel rolls (pipe with seams), since such pipe is always irregular. If the signal strength is always displayed as 0.00, that means there is no signal detected. Thus, it is necessary to check that the parameters (including all the pipe parameters) have been entered accurately. Check to be sure the transducer mounting method has been selected properly, the pipe is not worn-out, and the liner is not too thick. Make sure there is indeed fluid in the pipe or

the transducer is not very close to a valve or elbow, and there are not too many air bubbles in the fluid, etc. With the exception of these reasons, if there is still no signal detected, the measurement site has to be changed.

(5)   Make sure that the flowmeter is able to run properly with high reliability. The stronger the signal strength displayed, the higher the Q value reached, the longer the flowmeter runs accurately, the higher the reliability of the flow rates displayed. If there is interference from ambient electromagnetic waves or the signal detected is too poor, the flow value displayed is not reliable; consequently, the capability for reliable operation is reduced.

(6)   The transducer spacing in MENU 25 assumes perfect quality conditions.   The flowmeter was calibrated on a "perfect condition" flow calibration loop.   It is necessary to check and perhaps adjust the transducer spacing in the real life application to ensure that the MENU 90 and MENU 91 diagnostic readings are within limits.   MENU 90 should indicate Signal Strength UP and DOWN > 60 and the Quality value "Q" > 50.   MENU 91, the Transit Time Ratio (TOM/TOS) must be 100 +/-3%.

5. Operating Instructions

Attention

Everytime when you exit the set-up menu, if it has been made one or more changes, before exit the set-up mode, pleae do remember to choose 1.solidify settings in Menu 26 and press the Enter key to confirm it.

5.1. System Normal Identification

Press the Menu 0 8 keys. If the letter "*R" displays on the screen, it indicates system normal.

If the letter "E" is displayed, it indicates that the current loop output is over ranged by 120%. This refers to the settings in Window M57. Enter a larger value in Window M57, and the letter "E" will disappear. It can be ignored if no current loop output is used.

If the letter "Q" is displayed, it indicates that the frequency output is over ranged by 120%, and this refers to the settings in Window M69. Increase the input value in Window M69, and the letter "Q" will disappear. It can be ignored if no frequency output is used.

If the letter "H" is displayed, it indicates that the ultrasonic signal detected is poor. For more information, please refer to "Error Diagnoses".

If the letter "G" is displayed, it indicates that system is adjusting the signal gain prior to the measurement. Also, it means system normal. Only when the adjustment takes too long without stopping, can system be identified as abnormal.

Letter "I" indicates no signal is being detected. Check the transducer wiring connections are correct, the transducers are installed firmly, etc.

Letter "J" indicates a hardware defect exists. Normally, such defect is temporary; it could be eliminated by system reboot (power off and restart).

For further information, please refer to "Error Diagnoses".

5.2. Zero Set Calibration

Once zero flow occurs, a zero point may indicate on each measuring instrument, i.e. as the measurement value reaches zero flow, it is indicated as zero. It is necessary to establish the true zero flow condition and program that set point into the instrument.

If the zero set point is not at true zero flow, a measurement difference may occur. The smaller the physical measurement capacity is, the larger the measurement difference from the zero point will exist. Only when zero point reduced to a definite degree, as compared with the physical measurement capacity, can the measuring difference from zero point be ignored.

For an ultrasonic flowmeter, the measurement difference from zero point cannot be ignored at low flow. It is necessary to perform a zero set calibration to improve low flow measurement accuracy.

5.3. Scale Factor

Scale factor refers to the ratio between "actual value" and "reading value". For example, when the measurement is 2.00, and it is indicated as 1.98 on the instrument, the scale factor reading is 2/1.98. This means that the best scale factor constant is 1.

However, it is difficult to keep the scale factor as "1" on the instrument especially in batch control operations. The difference is called "consistency". High quality products always require high consistency.

The scale factor default is "1.XX" for each instrument prior to shipment from the factory. This corresponds to the calibration factors for the transducers.   The reason is that the scale factors in the Flowmeter are only limited by two parameters, i.e. the crystal oscillation frequency and the transducer. It has no relation to any circuit

parameters.

During operation, there still exists possible difference in pipe parameters, etc. The "scale factor" may be necessary when used on different pipes. Thus, scale factor calibration is specially designed for calibrating the differences that result from application on different pipes. The scale factor entered must be one that results from actual calibration.

5.4. System Lock (Unlock)

System lock is intended to prevent operation error due to tampering by unauthorized personnel.

Press the (Menu)(4)(7)(Enter) keys, move (^) or (v) key to select "Lock", press the (Enter) key, enter a 1~4 numerically long password, and then press the (Enter) key to confirm.

Unlock using the selected password only. Press(Menu)(4)(7)(Enter), move (^) or (v) to select "Unlock", press(Enter), enter the correct password, then press (Enter) to confirm.

Keep the password in mind or recorded in a safe place or the instrument cannot be used.

5.5. 4~20mA Current Loop Verification

Possessing a current loop output exceeding an accuracy of 0.1%, the flowmeter is programmable and configurable with multiple output modules such as 4 ~20mA or 0~20mA. Select in Window M55. For details, please refer to "Windows Display Explanations".

In Window M56, enter a 4mA flow value. Enter the 20mA flow value in Window M57. For example, if the flow range in a specific pipe is 0~1000m3/h, enter 0 in Window M56 and 1000 in Window M57. If the flow ranges from -1000~0~2000m3/h, configure the 20~4~20mA module by selecting Window M55 when flow direction is not an issue. Enter 1000 in Window M56 and 2000 in Window M57. When flow direction is an issue, module 0~4~20mA is available. When the flow direction displays as negative, the current output is in range of 0~4mA, whereas the 4~20mA is for the positive direction. The output module options are displayed in Window M55. Enter "-1000" in Window M56 and 2000 in Window M57.

Calibrating and testing the current loop is performed in Window M58. Complete the steps as follows:

Press (Menu)(5)(8)(Enter) ,move (^) or (v) to display "0mA", "4mA", "8mA", "16mA", "20mA" readings, connect an ammeter to test the current loop output and calculate the difference. Calibrate it if the difference is within tolerance. Refer to Section 5.10 for Analog Output Calibration

Check the present current loop output in Window M59 as it changes along with change in flow.

5.6. Frequency Output

The flowmeter is provided with a frequency output transmitter function. The high or low frequency output displayed indicates the high or low flow rate reading. The user can reset the frequency output as well as flow rate per his requirements

For example: if a pipe flow range is 0~3000m3/h, the relative frequency output required is 123~1000Hz, and the configuration is as follows:

In Window M68 (low limit frequency output flow value), input 0;

In Window M69 (high limit frequency output flow value), input 3000;

In Window M67 (low limit frequency), input 123;

There is no output circuit specially assigned to frequency output. It only can be transmitted through OCT, i.e. select Window M78 (item "13. FO").

Typical OCT Output wiring diagram as below:
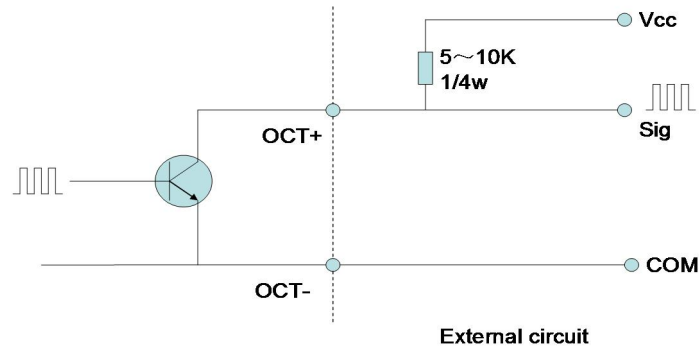
OCT Output wiring diagram

5.7. Totalizer Pulse Output

Each time the flowmeter reaches a unit flow, it may generate a totalizer pulse output to a remote counter. To configure the unit flow, please refer to Windows M32 and M33.

The totalizer pulse output can be transmitted through OCT or a relay. So, it is necessary to configure OCT and the relay accordingly. (Please refer to Window M78 and M79).

For example, if it is necessary to transmit the positive totalizer pulse through a relay, and each pulse represents a flow of 0.1m3,; the configuration is as follows:

In Window M33, select totalizer the flow unit "Cubic Meters (m3)";

In Window M34, select the scale factor "x0.1";

In Window M79, select "9. Positive totalizer pulse output";

Attention

Make sure the totalizer pulse does not transmit more than 1 pulse per second.   If the totalizer is set to transmit faster than 1 pulse per second, you may shorten the life of the output, as well as skip some pulses.

5.8. Alarm Programming

The flowmeter has two programmable alarms: audible alarm and on off output alarm.

The audible alarm generates an internal beeper. Select the BEEPER trigger in Window M77.

The on-off output alarm is generated through OCT or transmission to an external circuit by opening or closing a relay. The on-off output signal is activated under the following conditions:

(1) Signal not detected;

(2) Poor signal detected;

(3) The flowmeter is not ready for normal measurement;

(4) The flow is in the reverse direction (back flow).

(5) The analog outputs exceed span by 120%.

(6) The frequency output exceeds span by 120%.

(7) The flow rate exceeds the ranges configured (Configure the flow ranges using the software alarm system. There are two software alarms: Alarm#1 and Alarm #2. The lower limit value for Alarm#1 is configured in Window M73, and the upper limit value is configured in Window M74. As for Alarm#2, the lower limit value is in M75 and the upper one is in Window M76).

Example 1: To program the relay output alarm, activated when flow rate exceeds 300~1000m3/h:

    (1) In Window M73, input 300;

    (2) In Window M74, input 1000;

    (3) In Window M79, select item 6: "6. Alarm #1 limit exceed".

Example 2: To program OCT output alarm signal, activated when flow rate exceeds 100~500m3/h; relay output alarm signal activated when flow rate exceeds 600~1000m3/h:

    (1) In Window M73, input 100;

    (2) In Window M74, input 500;

    (3) In Window M75, input 600;

    (4) In Window M76, input 1000;

    (5) In Window M78, select item 6: "6. Alarm #1".

    (6) In Window M79, select item 7: "7. Alarm #2".

5.9. Batch Controller

The batch controller is able to perform flow quantity control, or the batching of specific volumes to control events in product production or chemical dosing, etc. The internal batch controller in the flowmeter is able to take the high or low end of analog input signals as an input, or through the keypad, to perform control functions. The output can be transmitted through OCT or a relay.

When taking analog inputs as control signals, input an analog output which is over 2mA through the analog input terminal to indicate the condition of "1"; current "0" indicates the condition of "0".

In Window M78(OCT output)、M79(relay output) or M80(Flow Batch CTRL), select Item 8 "Batch controller" and the OCT or relay output will generate output signals.

Enter the batch value in Window M81. Start the batch controller after that. For details, please refer to "Windows Display Explanations".

5.10. Analog Output Calibration

Attention

Each flowmeter has been calibrated strictly before leaving factory. It is unnecessary to carry out this step except when the current value (detected while calibrating the current loop) displayed in Window M58 is not identical with the actual output current value.

The hardware detect window must be activated prior to calibration. The procedure is as follows:

Press [Menu][V][0][Enter] enter password "4213068", then press [Enter] to activate the detect menu. With no effect to next power on, this window will close automatically as soon as the power is turned off.

Press [Menu][V][1][Enter] to calibrate the current loop 4mA output. Use an ammeter to measure the current loop output current. At the same time, move [∧] or [∨] to adjust the displayed numbers. Watch the ammeter until it reads 4.00. Stop at this point, the 4mA has been calibrated.

Then, press [Enter] to calibrate the current loop 20mA output. The method is as same as in 4mA calibration.

The results are saved in EEPROM. Switching off the power supply will not lose these new settings.

5.11. Use of the memory card

5.11.1.   Specifications

Memory: 512 days/files (Standard)

Data collection update rate: User Selectable: 1s, 5s, 10s, 60s, 600s, 3600s..

Data content: date and time, flow, velocity, cumulated flow, positive totalizer, negative totalizer, energy flow.

File system format: FAT16

File type: plain text file (.txt)

File number: maximum 512pcs

Filename format: yymmdd   (yy - year, mm - month, dd - date)

SD Data format:

Date and Time= yy-mm-dd, hh:mm:ss

Flow Rate= +3.845778E+01m3/h

Flow Velocity= +1.451074E+00m/s

Cumulant Flow= -0000010E+0m3

Positive Totalizer= +0000002E+0m3

Negative Totalizer= -0000012E+0m3

Energy Flow Rate=+7.1429E-01KJ/s

Energy Totalizer=+3.9721E+03KJ

Positive Energy Totalizer=+4.573242E+01

Negetive Energy Totalizer=+4.338866E+01

It can save 120bytes of data each time. When the capacity of the SD card is full, the new data will override the earliest files automatically.

5.11.2.   Install or Remove the SD card while the meter is powered on

Attention:

Before you use the SD card to save the flow data, please make sure the M62 is set in 9600, None,8,1 and M63 is set in MODBUS ASCII TDS7

If the operator desires to insert or remove the SD card with power on, the following operation is to be used shown as the picture below, move the THIRD SWITCH on the right side of the SD card board to the "OFF" position. The switch activates the Memory Logging; It is then safe to remove or install the SD Card. Once reinstalled, move the switch to the "ON" position.
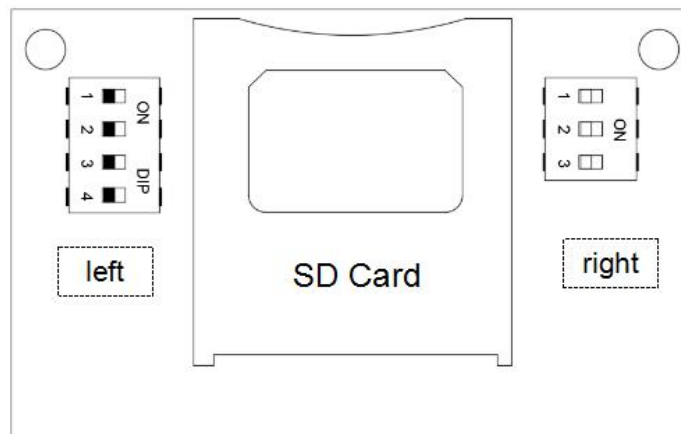
The left side switches control the Flow Data Time Interval Setup as follows:

1s Interval Setup :

Move all four switches on the left side of SD card board to the "off" position;
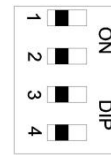
5s interval Setup:

Just move the first switch on the left side of SD card board to the "on" position
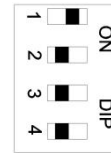
10s interval Setup:

Just move the first and the second switches on the left side of SD card board to the"on"position
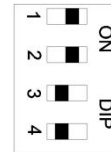
60s(1min) Interval Setup

Just move the first, second and third switches on the left side of SD card board to the"on"position;
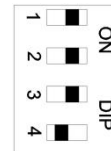
600s(10min) Interval Setup

Move all four switches on the left side of SD card board to the "on" position;
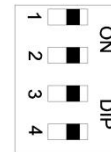
3600s(1h) Interval Setup

Just move the fourth switch on the left side of SD card board to the "on" position;
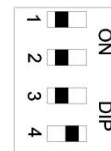
The right side switches control the communication and hot plug of SD card.

When you use RS485 to communicate, please move the first and second switches on right side of SD card board to the "off" position, The SD card is not able to record the flow data.

The third switch on the right side of SD card controls the hot plug of SD card.

5.11.3.   Reading the SD Data Externally

Remove the SD card from the Flowmeter. The operator may then use a card reader to read the data in the card. On the PC the operator can save, edit and print the data in the SD card, and then recall and analyze the data. Care should be taken while working with the data on the SD card on a PC.

Attention:

Do not remove the SD card from the reader while actively working with the data. Data should be saved and stored in a separate location on the PC, and then processed form that file location. Processing the data directly from the SD card file location on the PC could result in lost or corrupt data if the SD card is removed while still being processed.

Attention:

The SD card function is not able to work with RS485 communication at the same time, when you use external RS485 communication, please move the first and second switches on right side of SD card board to the "off" position.When you use the SD card to record the flow data, please move all the three switches on the right side of SD card board to the "on" position.

The operator can read and work with the data in the SD card with the "FlowData" software provided with the flowmeter:
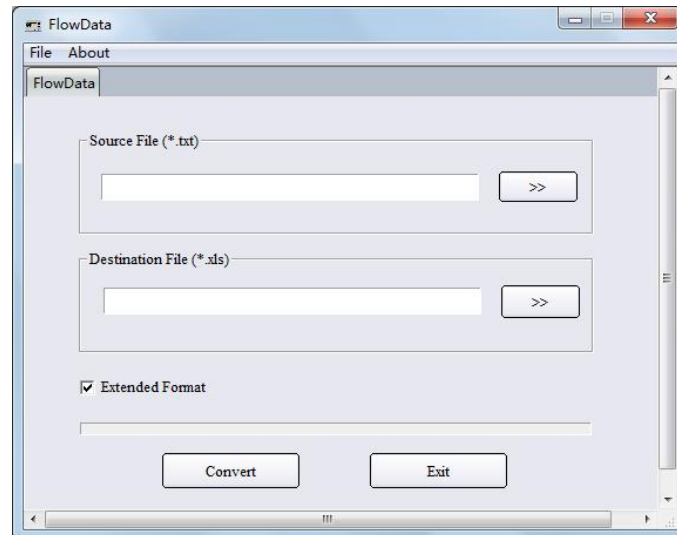
Due to the expanded memory (EMS) capacity of the flowmeter being extremely small as compared with the SD memory card; the transfer speed is rather slow for some commands. So we suggest: it is better to read the SD data externally (remove the card from the flowmeter to insert it into your PC).

The files saved in the SD card are in text format (.TXT). If the operator desires to convert it to Excel format (.XLS), the FlowData.EXE could offer the assistance.

This program must be run in the WINDOWS operating system, the interface is as follows:
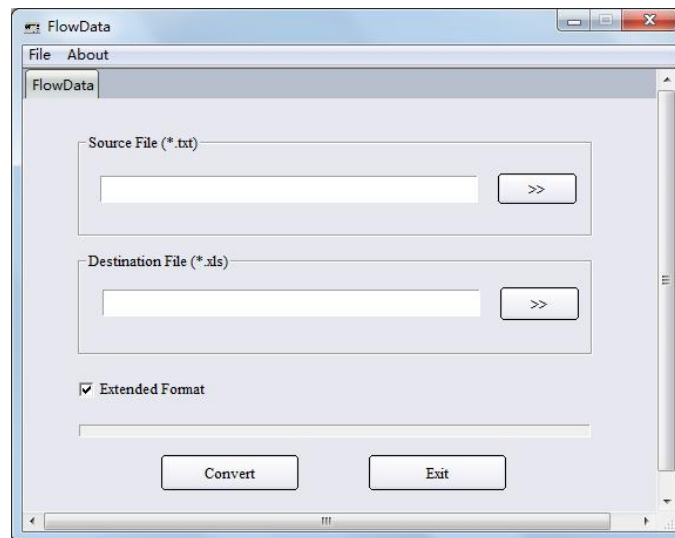
Select the file to be converted in "Source File (*.txt), enter the directory path and the filename in "Destination File (*.xls), then press "Convert". The conversion is completed.

5.12. Recover the Factory Default

If it is necessary to recover the factory default, Press MENU 37, then

Press ⊙ ⊘ keys after the above-mentioned characters are displayed on the screen.

Generally, it is unnecessary to activate this function except during the initial installation.

5.13. ESN

We provide the flowmeter with a unique electronic serial number to identify each flowmeter for the convenience of the manufacturer and customers. The ESN, instrument types and versions are able to view in Window M61.

6. Windows Display Explanations

6.1. Windows Display Codes

Flow Totalizer Display	
00	Flow Rate/Net Totalizer
01	Flow Rate/Velocity
02	Flow Rate/POS Totalizer
03	Flow Rate/NEG Totalizer
04	Date Time/Flow Rate
05	Energy/Totalized Energy
06	Analog Input T1, T2
08	System Error Codes
09	Net Flow Today
Initial Parameter setup	
10	Pipe Outer Perimeter
11	Pipe Outer Diameter
12	Pipe Wall Thickness
13	Pipe Inner Diameter
14	Pipe Material
15	Pipe Sound Velocity
16	Liner Material
17	Liner Sound Velocity
18	Liner Thickness
20	Fluid Type
21	Fluid Sound Velocity
22	Fluid Viscosity
23	Transducer Type
24	Transducer Mounting
25	Transducer Spacing
26	Parameter Settings
27	Save/Load Parameters
28	Holding with Poor Signal
29	Empty Pipe Setup
Flow Units Options	
30	Measurement Units
31	Flow Rate Units
32	Totalizer Units
33	Totalizer Multiplier
34	Net Totalizer
35	POS Totalizer
36	NEG Totalizer
37	Totalizer Reset
38	Manual Totalizer

Setup Options	
40	Damping
41	Low Flow Cutoff Value
42	Set Zero
43	Reset Zero
44	Manual Zero Point
45	Scale Factor
46	Network identifying address code
47	System Lock
52	Set Log-Data
53	Analog Input AI5
54	OCT Pulse Width
Input and output setup	
55	CL Mode Select
56	CL 4mA Output Value
57	CL 20mA Output Value
58	CL Check
59	CL Current Output
60	Date and Time
61	Software Version and ESN
62	RS485 Setup
63	Select Comm Protocol
64	AI3 Value Range
65	AI4 Value Range
66	AI5 Value Range
67	FO Frequency Range
68	Low FO Flow Rate
69	High FO Flow Rate
70	LCD Backlit Option
71	LCD Contrast
72	Working Timer
73	Alarm #1 Low Value
74	Alarm #1 High Value
75	Alarm #2 Low Value
76	Alarm #2 High Value
77	Beeper Setup
78	OCT Output Setup
79	Relay Output Setup
80	Flow Batch CTRL
81	Flow Batch Controller
82	Date Totalizer
83	Automatic Correction

Energy Calculation Methods	
84	Energy Units Select
85	Temperature Select
86	Specific Heat Select
87	Energy Totalizer ON/OFF
88	Delt
89	Reset Energy Totalizer
Diagnoses	
90	Signal Strength and Quality
91	TOM/TOS*100
92	Fluid Sound Velocity
93	Total Time and Delta
94	Reynolds Number and Factor
95	ETP and ETN
96	Communications Mode
Appendix	
+0	Power ON/OFF time
+1	Total Working Hours
+2	Last Power Off Time
+3	Last Flow Rate
+4	ON/OFF Times
+5	Calculator
+6	Velocity threshold
+7	Total Flow for Month
+8	Total Flow this year
+9	Running Time in bad signal

NOTE：The menu features from other manufacturers to retain.

6.2. Display explanation

While reading this section, please compare it with the instrument in order to improve your understanding.

(Menu) (0) (0)

Flow Rate / Net Totalizer

Display flow rate and net totalizer.

If the net totalizer has been turned off (refer to M34), the net totalizer value displayed is the total prior to its turn off.

```
Flow 0.1154m3/h   *R
NET    0x1m3
```

(Menu) (0) (1)

Flow Rate / Velocity

Display flow rate and velocity.

```
Flow 0.1129m3/h   *R
Vel    1.0415m/s
```

(Menu) (0) (2)

Flow Rate / Positive Totalizer

Display flow rate and positive totalizer.

Select the positive totalizer units in Window M31.

If the positive totalizer has been turned off, the positive totalizer value displayed is the total prior to its turn off.

```
Flow   0.1129m3/h   *R
POS        0x1m3
```

(Menu) (0) (3)

M36), the value displayed is the total prior to turn off.

Flow Rate / Negative Totalizer

Display flow rate and negative totalizer.

Select the negative totalizer value in Window M31.

If the negative totalizer has been turned off (refer to

```
Flow   0.1120m3/h  *R
NEG        0x1m3
```

(Menu) (0) (4)

Date Time / Flow Rate

Display the current date time and flow rate.

The time setting method is found in Window M60.

```
03-04-03 15:49:40 *R
Flow    0.1116  m3/h
```

(Menu) (0) (5)

Energy / Totalized Energy

Display Instantaneous Energy and Totalized Energy.

Instantaneous Energy Unit is determined by the unit selected in M84 and M85. Totalized Energy Unit is determined by the unit select in M84.

```
EFR   0.0000GJ/h   *R
E.T       0E+0 GJ
```

Menu 0 6

Analog Temperature Input Value T1, T2

Display Temperature Input T1, T2 current value and corresponding temperature value.

```
T1=36.173C,   114.07
T2=36.178C,   114.07
```

Menu 0 7

Analog Input Value AI3,AI4

Display Analog Input AI3, AI4 current value

```
AI3=0.0163,   0.0833
AI4=0.0086,   0.0556
```

Diagnoses".

Menu 0 8

System Error Codes

Display the working condition and the system error codes. More than one error code can occur at the same time.

The explanations of error codes and detailed resolution methods can be found in "Error

```
*R ---------------------------
System   Normal
```

Menu 0 9

Net Flow Today

Display net total flow today.

```
Net Flow Today    M09
        0.458748    m3
```

Menu 1 0

Pipe Outer Perimeter

Enter the pipe outer perimeter. If the diameter of the pipe is known, enter it in window M11.

```
Pipe Outer Perimeter
        157   mm
```

Menu 1 1

Pipe Outer Diameter

Enter the pipe outside diameter; the pipe outside diameter must range from 10mm to 6000mm.

```
Pipe Outer Diameter
        50  mm
```

Menu 1 2

Pipe Wall Thickness

Enter the pipe wall thickness. If the pipe inside diameter is already known, skip this window and enter it in Window M13.

```
Pipe Wall Thickness
        4  mm
```

Menu 1 3

Pipe Inner Diameter

Enter the pipe inside diameter. If the pipe outside diameter and pipe wall thickness has been entered, press ⌄ to skip this window.

Note: Enter either pipe wall thickness or pipe inside diameter.

```
Pipe Inner Diameter
        52  mm
```

Menu 1 4

Pipe Material

```
Pipe Material     M4
 0. Carbon Steel
```

Enter pipe material. The following options are available (by ∧、 ∨ buttons or numerical keys):

0.	Carbon Steel	1.	Stainless Steel
2.	Cast Iron	3.	Ductile Iron
4.	Copper	5.	PVC
6.	Aluminum	7.	Asbestos
8.	Fiber Glass-Epoxy	9.	Other

Refer to item 9 "Other"; it is possible to enter other materials, which are not included in previous eight items. Once item 9 is selected, the relevant pipe sound velocity must be entered in Window M15.

Menu 1 5

Pipe Sound Velocity

```
Pipe Sound Velocity
      2800 m/s
```

Enter pipe sound velocity. This function is only used when item 9 "Other" is selected in Window M14. Otherwise, this window cannot be viewed.

Menu 1 6

Select the Liner Material

```
Liner  Material M6
0.None, No Liner
```

The following options are available:

0.	None ,No Liner	1.	Tar Epoxy
2.	Rubber	3.	Mortar
4.	Polypropylene	5.	Polystryol
6.	Polystyrene	7.	Polyester
8.	Polyethylene	9.	Ebonite
10.	Teflon	11.	Other

Item 11 "Other" is available to enter other materials that are not included in previous ten items. Once the "Other" is selected, the relevant liner sound velocity must be entered in Window M17.

Menu 1 7

Liner Sound Velocity

```
Liner Sound Velocity
        2270  m/s
```

Enter liner sound velocity. This function is only used when Item 11 "Other" is selected in M16.

Menu 1 8

Liner Thickness

```
Liner Thickness M8
        10 mm
```

Enter liner thickness. It only can be visited when a definite liner is selected in Window M16.

(Menu)(2)(0)

Select Fluid Type

The following options are available:

Fluid Type   [20
   0.   Water

0.	Water	1.	Sea Water
2.	Kerosene	3.	Gasoline
4.	Fuel Oil	5.	Crude Oil
6.	Propane (-45℃)	7.	Butane (0℃)
8.	Other	9.	Diesel Oil
10.	Castor Oil	11.	Peanut Oil
12.	Gasoline #90	13.	Gasoline #93
14.	Alcohol	15.	Water (125℃)

"Other" refers to any fluid. The relevant sound velocity must be entered in Window M21.

(Menu)(2)(1)

Fluid Sound Velocity

Enter the fluid sound velocity. It can only be used when item "Other" is selected in Window M20, i.e. it is unnecessary to enter all the fluids listed in Window M20.

Fluid Sound Velocity
      1482.3   m/s

(Menu)(2)(2)

Fluid Viscosity

Enter fluid's kinematics viscosity. It only can be used when item "Other" is selected in Window M20, i.e. it is unnecessary to enter all the fluids that listed in Window M20.

Fluid Viscosity [22
      1.0038   cST

(Menu)(2)(3)

Transducer type.

Please select "10.Standard-M1".

Transducer Type [23
   0. Standard

Press the (Menu) (2) (3) key to enter Window M23, press the (Enter) key, move the (∧) or (∨) key to select transducer type, and press the (Enter) key.

(Menu)(2)(4)

Transducer Mounting

Four mounting methods are available:

V(sound wave bounces 2 times)

Z(sound wave bounces once. The most commonly use method)

N (small pipe, sound wave bounces 3 times.)

Transducer Mounting
   0.   V

(Menu)(2)(5)

Transducer Spacing (this value is calculated by the

flowmeter)

The operator must mount the transducer according to the transducer spacing displayed (be sure that the transducer spacing is measured precisely during installation). The system will display the data automatically after the pipe parameter had been entered.

```
Transducer Spacing
       148.666  mm
```

Menu ② ⑥
Default Settings
Solidify setting parameters.
   0.   Use RAM Settings (not common use) ;
   1.   Solidify Settings.

```
Default Settings
    1.Solidify Settings
```

Select "1. Solidify Settings", press Enter   to save the parameters you have already entered.

Menu ② ⑦
Save/Load Parameters.
Load and save the parameters. 8 different sets of setup conditions/groups are available to load and save (i.e.you can load and save 8 different application parameters):
   1．Entry to Save
   2．Entry to Load

```
Save/Load Parameters
5: 325mm,V,PVC
```

Select "Entry to Save", press Enter. An ID code and the original parameters are displayed in the window. Press UP or DOWN ARROW to move the ID code, then press the Enter key again to save the current parameter in the current ID room.
When selecting "Entry to Load", press ENT, and the system will read and calculate the parameters automatically and display the transducer mounting

Menu ② ⑧
Holding with Poor Sig
Select "Yes" to hold last good flow signal displayed if the flowmeter experiences a poor signal condition. This function will allow continued data calculation without interruption.

```
Holding with PoorSig
        NO
```

Menu ② ⑨
Empty Pipe Setup
This parameter is used to overcome the possible problems that usually show up when the pipe being measured is empty. Since signals can be transmitted through the pipe wall, the flow meter may still read a flow while measuring an empty pipe. To prevent this from happening, you can specify a value. When the signal quality falls below this value, the measurement stops automatically. If the flow meter is already able to stop measuring when the pipe is empty, a value in the range of 30 to 40 should also be entered in this window to ensure no measurement when the pipe is empty. It should be understood that the instrument is not designed to function correctly on an empty pipe.

```
Empty Pipe Setup [29
        0
```

(Menu)(3)(0)

Measurement Units Options
Select the measurement unit as follows:

0. Metric
1. English

Factory default is metric.

```
Measurement Units In
   0.   Metric
```

(Menu)(3)(1)

Flow Rate Units Options
The following flow rate units are available:

0. Cubic Meters   (m3)
1. Liters   (1)
2. USA   Gallon   (GAL)
3. UK Gallons   (Imp gal)
4. Million US Gallon   (mg)
5. Cubic Feet   (cf)
6. US Oil Barrel   (OB)
7. UK Oil Barrel   (IB)

The following time units are available:
/Day   /Hour
/Min   /Sec
Factory default is Cubic Meters/hour.

```
Flow Rate Units    [31
        m3/h
```

(Menu)(3)(2)

Totalizer Units Options

Select totalizer units. The available unit options are as same as those found in Window M31. The user can select units as their required. Factory default is Cubic

Meters.

```
Totalizer  Units  [32
     Cubic  Meter (m3)
```

(Menu)(3)(3)

Totalizer Multiplier Options
The totalizer multiplier acts as the function to increase the totalizer indicating range. Meanwhile, the totalizer multiplier can be applied to the positive totalizer, negative totalizer and net totalizer at the same time. The following options are available:

0. X0.001(1E-3)
1. X0.01
2. X0.1
3. X1
4. X10
5. X100
6. X1000
7. X10000(1E+4)

Factory default factor is x1.

```
Totalizer  Multiplier
   0.   x0.001(1E-3)
```

(Menu)(3)(4)

ON/OFF Net Totalizer
On/off net totalizer. "ON" indicates the totalizer is turned on, while "OFF" indicates it is turned off.
When it is turned off, the net totalizer displays in Window M00 will not change. Factory default is

"ON".

```
Net  Totalizer    [34
        ON
```

(Menu)(3)(5) ON/OFF POS Totalizer

On/off positive totalizer. "ON" indicates the flowmeter starts to totalize the value. When it is turned off, the positive totalizer displays in Window M02. Factory default is "ON".

```
POS Totalizer    C35
         ON
```

Menu 3 6

ON/OFF NEG Totalizer

ON/OFF negative totalizer. "ON" indicates the totalizer is turned on. When it is turned off, the negative totalizer displays in Window M03.

Factory default is "ON".

```
NEG Totalizer    C36
         ON
```

Menu 3 7

Totalizer Reset

Totalizer reset; all parameters are reset. Press Enter; move ∧ or ∨ arrow to select "YES" or "NO". After "YES" is selected, the following options are available:

   None, All, NET, POS, NEG

If it is necessary to recover the factory default, press · < keys after the above-mentioned characters are displayed on the screen.

Generally, it is unnecessary to activate this function

except during the initial installation.

```
Totalizer Reset? C37
      Selection
```

Menu 3 8

Manual Totalizer

The manual totalizer is a separate totalizer. Press Enter to start, and press Enter to stop it. It is used for flow measurement and calculation.

```
Manual Totalizer  C38
Press ENT When Ready
```

Menu 4 0

Damping

The damping function will stabilize the flow display. Essentially, it is a part of the signal filter. Enter a coefficient. Increasing the coefficient increases the stability. However, the measurement displayed may be slightly delayed due to over damping. Logging too long may result in no response to real-time fluctuation, especially when flow rate fluctuates wildly.

Therefore, damping should be kept at a minimum and

increased just enough to reduce the fluctuation to an acceptable degree by 3 to 10 seconds.

The damping factor ranges from $0 \sim 999$ seconds.0 indicates no damping; 999 indicate the maximum damping. Usually a damping factor of 3 to 10 is recommended in applications.

```
Damping          C40
        10 sec
```

Menu 4 1

Low Flow Cutoff Value

If the flow rate falls below the low flow cutoff value, the flow indication is driven to zero. This function can prevent the flowmeter from reading flow after a pump

is shut down but there is still liquid movement in the pipe, which will result in totalization error.

Generally, 0.03m/s is recommended to enter as the low flow cutoff point. The low flow cutoff value has no relation to the measurement results once the velocity increases over the low flow cutoff value

```
Low Flow Cutoff Val.
      0.01 m/s
```

Menu 4 2

Set Zero

When fluid is in the static state, the displayed value is called "Zero Point". When "Zero Point' is not at zero in the flowmeter, the difference is going to be added into the actual flow values and measurement differences will occur in the flowmeter.

```
Set Zero          [42
     Press ENT to go
```

Set zero must be carried out after the transducers are installed and the flow inside the pipe is in the absolute static state (no liquid movement in the pipe). Thus, the "Zero Point" resulting from different pipe mounting locations and parameters can be eliminated. The measuring accuracy at low flow is enhanced by doing this and flow offset is eliminated.

Press (Enter), wait for the processing instructions at the bottom right corner to reach 0.

Performing Set zero with existing flow may cause the flow to be displayed as "0". If so, it can be recovered via Window M43.

Menu 4 3

Reset Zero
Select "YES"; reset "Zero Point" which was set by the user.

```
Reset  Zero       [43
        NO
```

Menu 4 4

Manual Zero Point

This method is not commonly used. It is only suitable for experienced operators to set zero under conditions when it is not preferable to use other methods. Enter the value manually to add to the measured value to obtain the actual value.

For example:
Actual measured value ＝250 m3/H

Flowmeter Display ＝240 m3/H

```
Manual Zero Point [44
        0 m3/h
```

Value Deviation ＝-10 m3/H

Normally, set the value as "0".

Menu 4 5

Scale Factor

The scale factor is used to modify the measurement results. The user can enter a numerical value other than "1" according to calibration results.

```
Scale Factor      [45
         1
```

(Menu)(4)(6)

Network IDN

Input system identifying code, these numbers can be selected from 0~65535 except that 13 (0DH ENTER), 10 (0AH Newline), 42 (2AH ＊) and 38 (26H&) are reserved. System IDN is used to identify the flowmeter to a network.

```
Network IDN    [46
              88
```

(Menu)(4)(7)

System Lock

Lock the instrument.

Once the system is locked, any modification to the system is prohibited, but the parameter is readable. "Unlock" using your designated password. The password is composed of 1 to 4 numbers.

```
System Lock    [47
xxxx Unlocked xxxx
```

(Menu)(4)(9)

Communication Tester

The data transmitted from upper computer could estimate the communication problem

```
Serial Port Traffic
 [data display here]
```

(Menu)(5)(0)

Data Logger Option
1．On
2．Off

```
Data Logger Option
 on
```

(Menu)(5)(1)

Data Logger Time Setup

Enter to setup logger time,which include start time, time internal.Minimum time unit is second. Maximum time interval is 24 hours.

```
Data Logger Setup[51
Next=21:52:00
```

(Menu)(5)(2)

Send Log-Data to

Press (Enter) and move (∧) or (∨) arrow to select

1. Internal SerBus
2. RS485

```
Send Log-Data to [52
1. Send to RS-485
```

(Menu)(5)(3)

Analog Input AI5
Enter into this menu to check AI5 value.

```
Analog Input AI5 [53
AI5=0.0258,1.5097
```

Menu 5 4

OCT Pulse Width

Press Enter and input the right parameter, then press Enter to confirm

```
OCT Pulse Width  [54
     4.97436  ms
```

Menu 5 5

```
CL  Mode  Select [55
   0.  4 -  20 mA
```

Current Loop Mode Select
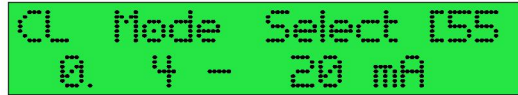
Select the current loop mode. The following options are available:

0. 4-20mA   set up the output range from 4-20mA

1. 0-20mA   set up the output range from 0-20mA

2. 0-20mA via RS232   set up to be controlled by Serial Port

3. 4-20mA VS.Fluid   set up the CL output 4-20mA corresponding sound velocity

4. 20-4-20mA   set up the CL output range from 20-4-20mA

5. 0-4-20mA   set up the CL output range from 0-4-20mA

6. 20-0-20mA   set up the CL output range from 20-0-20mA

7. 4-20mA vs. Vel   set up the CL output range from 4-20mA corresponding flow velocity

8. 4-20mA vs. Energy   set up the CL output range from 4-20mA corresponding heat flow

20-4-20mA mode output	20-0-20mA mode output	0-20mA mode output
4-20mA mode output	0-4-20mA mode output	Fluid velocity / 4-20mA mode output
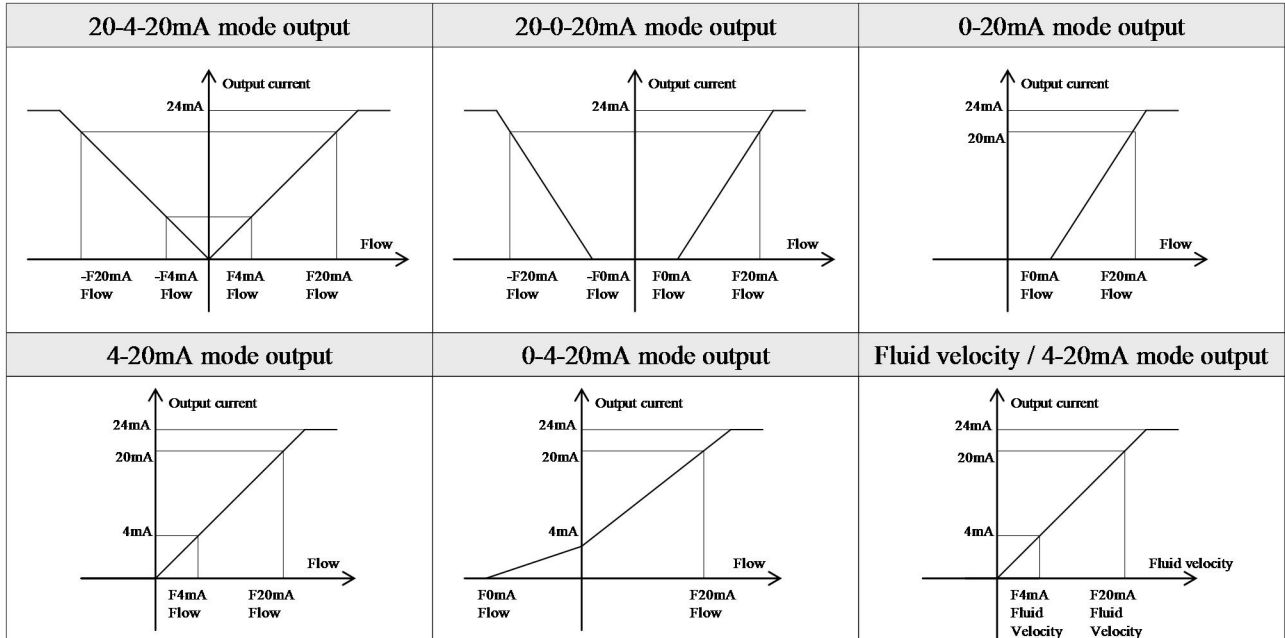
The Serial Port controls the output according to the command and parameter entered in the RS232 to output a definite current value through the current loop. The command formats are narrated in the command explanations to Serial Port controls. For example, if it is necessary to output a 6mA current through the current loop, it can be realized by setting Window M56 to the mode "0-20mA Via RS232" and giving a command as "AO6 (CR)". This function is able to make the flowmeter operate a control valve conveniently.

Other different current output characteristics are displayed in above figures. The user can select one of them

according to his actual requirements.

In six graphs shown above, flow F_{0mA} or F_{4mA} indicates the value that user entered in Window M57; and flow F_{20mA} indicates the value that customer entered in Window M58. In the 4-20mA and 0-20mA modes, F_{0mA}(or F_{4mA})and F_{20mA} can be selected as a positive or negative flow value as long as the two values are not the same. As for modes 20-4-20mA and 20-0-20mA, the flowmeter ignores the positive and negative value of the actual flow; therefore, both F_{0mA} (or F_{4mA}) and F_{20mA} must be selected as positive flow values.

In mode 0-4-20mA, F_{0mA} must be select as a negative value and F_{20mA} as a positive value. Furthermore, in mode 4-20mA, the output current is indicated as velocity.

Menu 5 6

CL 4mA or 0mA Output Value

Set the CL output value according to the flow value at 4mA or 0MA. (4mA or 0mA are determined by the

settings in Window M56). The flow unit's options are as same as those in Window M31. Once "velocity 4-20mA"is selected in Window M56, the unit should be set as m/s.

When select "4-20mA vs Energy" the value unit in M55 is consistent with the energy unit displayed in M05.It is determined by the unit selection in M84 and M85.

When the energy unit changes ,need to reset the corresponding4-20mA output value.

```
CL 4 mA Output Value
          0 m3/h
```

```
CL 4 mA Output Value
 0         Tonnes/s
```

(Menu) (5) (7)

20mA Output Value

Set the CL output value according to the flow value at 20mA. The flow unit is the as same as that found in Window M31.

When select "4-20mA vs Energy" the value unit in M55 is consistent with the energy unit displayed in M05. It is determined by the unit selection in M84 and M85.

When the energy unit changes ,need to reset the

corresponding 4-20mA output value.

```
CL 20mA Output Value
       14400 m3/h
```

```
CL 20mA Output Value
 0          Tonnes/s
```

(Menu) (5) (8)

CL Check Verification

Check if the current loop has been calibrated before leaving the factory. Press (Enter) move (∧) or (∨) separately to display 0mA, 4mA till 24mA, and at the same time, check with an ammeter to verify that CL output terminals M31 and 32 agree with the displayed values. It is necessary to re-calibrate the CL if over the permitted tolerance. For more information, refer to "Analog Outputs Calibration".

```
CL Checkup        [58
Press ENT WhenReady
```

(Menu) (5) (9)

CL Current Output

Display CL current output. The display of 10.0000mA indicates that CL current output value is 10.0000mA. If the difference between displaying value and CL output value is too large, the current loop then needs to be re-calibrated accordingly.

```
CL Current Output [59
      15.661 mA
```

(Menu) (6) (0)

Date and Time Settings

Generally, it is unnecessary to modify date time as the system is provided with a highly reliable perpetual calendar chip.

The format for setting time setting is 24 hours. Press (Enter), wait until ">" appears, the modification can be made.

```
YY-MM-DD   HHMMSS
03-04-04  10:05:04
```

(Menu) (6) (1)

ESN

Display electronic serial number (ESN) of the instrument. This ESN is the only one assigned to each flowmeter ready to leave the factory. The factory uses

it for files setup and for management by the user.

```
Ultrasonic  Flowmeter
   S/N=05071188
```

(Menu) (6) (2)

UniArms

COM Setup

The window used to set serial port. The Serial port for communications and other equipment. It connection with the equipment of its serial port set of parameters must match. Window the first choice of data that baud rate, 9600,19200,38400,56000,57600,115200 choice. The second option that in check, None.

  Data length fixed to eight;

Stop bit for a fixed length;

Factory serial port parameters for the default "9600, 8, None, 1".

```
RS-232 Setup   [62
    9600,   None
```

Menu 6 3

Select Common Protocol

In window 63,Press Enter ,and move ∧ or ∨ to choose

1．MODBUS-RTU

2．MODBUS ASCII

```
Select Comm Protocol
    MODBUS RTU
```

Menu 6 4

AI3 Value Range

In window 64 enter temperature value which 4mA and 20mA analog input represented. See this window "20" represent 4mA corresponding value, "100" represent 20mA corresponding value.

```
AI3 Value Range
20-100
```

Menu 6 5

AI4 Value Range

In window 65 enter temperature value which 4mA and 20mA analog input represented. See this window "10" represent 4mA corresponding value, "100" represent 20mA corresponding value.

```
AI3 Value Range
20-100
```

Menu 6 6

AI5 Value Range

```
AI5 Value Range
0-6
```

Menu 6 7

Set FO Frequency Range

Set up low FO Frequency and high FO frequency range. The high FO must be higher than the low FO

frequency. Ranges from 1-9999Hz. Factory default is 2000 Hz.

```
F0 Frequency Range
  1 -   5000
```

Note: The frequency output is transmitted through OCT Serial Port; therefore the OCT must be set to the frequency output mode.

(Menu)(6)(8)

Low FO Flow Rate

Set up low FO flow rate, i.e. the corresponding flow value when output signal frequency is at the lowest

FO frequency. For example, when the low FO frequency is 1000Hz, low FO flow rate is 100m3/h (when the frequency output is 1000Hz, then the low

flow at this moment measured by the flowmeter is 100m3/h.

```
Low F0 Flow Rate [68
        0  m3/h
```

(Menu)(6)(9)

High FO Flow Rate

Enter the high FO flow rate, i.e. the corresponding flow value when frequency output signal is at highest FO frequency.

```
High F0 Flow Rate [69
     26550 m3/h
```

(Menu)(7)(0)

LCD Backlit Option

Press (Enter), and enter the desired backlighting time for "n" seconds; it indicates that after pressing the button, the backlighting will

keep on for "n" seconds then turn off automatically. This function saves energy.

```
LCD Backlight Option
>_             Sec
```

(Menu)(7)(1)

LCD Contrast
Enter this Menu to input the contrast ratio

```
LCD Contrast    [71
>20
```

(Menu)(7)(2)

Working Timer
Display the totalized working hours of the flowmeter since last reset. It is displayed by HH:MM: SS. If it is necessary to reset it, press (Enter), and select "YES".

```
Working Timer   [72
  00000011:16:38
```

(Menu)(7)(3)

Alarm #1 Low Value
Enter the low alarm value. Both relevant alarms are

turned on in Windows M78 and M79; any of the

measured flow, which is lower than the low value, will activate the alarm in the OCT hardware or relay output signal.

```
Alarm #1 Low Value
           0 m3/h
```

Menu 7 4

Alarm #1 High Value

Enter the high alarm value. Both relevant alarms are turned on in Windows M78 and M79; any of the measured flow, which is higher than the high value, will activate the alarm in the OCT hardware or relay output signal.

```
Alarm #1 High Value
        14400 m3/h
```

Menu 7 5

Alarm #2 Low Value

Enter the alarm low value. Both relevant alarms are turned on in Windows M78 and M79; any measured flow, which is lower than the low value, will activate the alarm in the OCT hardware or relay output signal.

```
Alarm #2 Low Value
           0 m3/h
```

Menu 7 6

Alarm #2 High Value

Enter the alarm high value.

```
Alarm #2 High Value
        14400 m3/h
```

Menu 7 7

Beeper Setup

If a proper input source is selected, the buzzer will beep when the trigger event occurs.The available trigger sources are as follow:

```
Beeper Setup       C77
1. Poor Signal
```

0.No signal	1.Poor signal
2.Not ready	3.Reverse flow
4.AO Over 100%	5.FO Over 120%
6.Alarm #1	7.Negative Alarm #2
8.Batch Controller	9.POS Int Pulse
10.NEG Int Pulse	11. NET Int Pulse
12. Energy POS Pulse	13.Energy NEG Pulse
14.Energy NET Pulse	15.MediaVel=>Thresh
16.MediaVelo<Thresh	17.ON/OFF via RS485
18.Timer(M51 Daily)	19.Timed Alarm #1
20.Timed Alarm #2	21.Batch Total Full
22.Timer by M51	23.Batch 90% Full
24.Key Stroking on	25.Disable BEEPER

Menu 7 8

OCT Output Setup

The OCT output in the flowmeter is a kind of isolated collector open circuit output with programmable open and close qualifications. The user can program the open and close functions under the following conditions: the system alarm signals are being activated or the totalizer pulse is being transmitted.

The frequency output signal is also transmitted from the OCT. When it functions as the frequency output, other functions are unavailable.

```
OCT Output Setup [78
  16. Fluid changed
```
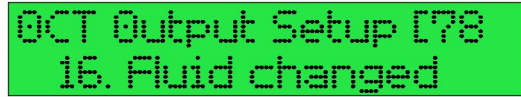
The following signal options are available:

0.	No Signal	1.	Poor Signal
2.	Not Ready (No*R)	3.	Negative Flow Alarm
4.	AO Over 100%	5.	FO Over 120%
6.	Alarm #1	7.	Alarm #2
8.	Batch Control	9.	POS Int Pulse
10.	NEG Int Pulse	11.	NET Int Pulse
12.	Energy Pulse	13.	FO
14.	FO via RS-232C	15.	ON/OFF viaRS232
16.	Fluid changed	17.	Not Using
18.	Timer(M51 Daily)	19.	Time Alarm#1
20.	Time Alarm#2	21.	Batch Total Full
22.	Timer by M51	23.	Batch 90% Full
24.	Flow Rate Pulse	25.	Disable OCT

Menu 7 9

Relay Output Setup

```
RELAY  Output  Setup
  8.  Batch  Control
```

The relay output in the flowmeter is programmable. The user can program the open and close functions under the following conditions: the system alarm signals are activated or the totalizer pulse is transmitting. The relay is single-pole and constant-on for external instrument controls. The following options are available:

0.	No Signal	1.	Poor Signal
2.	Not Ready (No*R)	3.	Reverse Flow
4.	AO Over 100%	5.	FO Over 120%
6.	Alarm #1	7.	Alarm #2
8.	Batch control	9.	POS Int Pulse
10.	NEG Int Pulse	11.	NET Int Pulse
12.	Energy Pulse	13.	ON/OFF via RS232
14.	Fluid changed	15.	Fluid Vel.=>Thresh
16.	Fluid Vel.<Thresh	17.	On/OFF via RS485
18.	Timer(M51 Daily)	19.	Timed Alarm #1
20.	Timed Alarm #2	21.	Batch Total Full
22.	Timer by M51	23.	Batch 90% Full
24.	Disable Relay		

Menu 8 0

Batch Trigger Select

```
Flow Batch CTRL by
0.Key Input
```

Set the input trigger for the batch control function on the flow meter. The following options are available:

0.Key Pressing	1.Serial Port
2.AI3 Rising Edge	3.AI3 Falling Edge
4.AI4 Rising Edge	5.AI4 Falling Edge
6.AI5 Rising Edge	7.AI5 Falling Edge

8.Timer-Periodical   9.Timer-daily

(Menu)(8)(1)

Flow Batch Controller

The internal batch controller in the flowmeter is able to control the input signals through keypad or analog input Serial Port. Output signals can be transmitted through OCT or relay.

The flow batch value can be modified in this window. The screen will enter the batch control display as soon as the modification completed.

```
FlowBatch Controller
      1000   x1 m3
```

(Menu)(8)(2)

Date Totalizer

The following options are available:

0.   Day

1.   Month

2.   Year

```
Date Totalizer     C82
      0.   Day
```

In this window, it is possible to review the historical flow data totalizer for any day for the last 64 days, any month for last 64 months and any year for last 5 years. Press(Enter), use the (∧) or (∨) to review totalizer in days, months and years. Left upper corner: "00-63" indicates the serial numbers;

In the middle: "03-04-05" indicates the date; Upper right

corner: "G-H-I" indicates the working condition. If there

is only "--------" displayed, it indicates the system was

normal during that time period. If other characters displayed, please refer to the "Error Code and Resolutions".

```
00 03-04-05 G-H-I
-0 m3
```

For example, to display the flow total for July 18, 2000, the display "-----------" at the upper right corner of the screen indicates that it was working properly the whole day. On the contrary, if "G" is displayed, it indicates that the instrument gain was adjusted at least once. Probably it was offline once on that day. If "H" is displayed, it indicates that poor signal was detected at least once. Also, it indicates that the operation was interrupted or problems occurred in the installation.

```
00 03-04-05 ---------
>4356.78 m3
```

(Menu)(8)(3)   Automatic Flow Correction

meter was offline. Select "NO" to cancel this function.

```
Automatic Correction
       YES
```

With the function of automatic flow correction, the flow lost in an offline session can be estimated and

automatically adjusted. The estimate is based on the average value, which is obtained from flow rate before going offline and flow measured after going online the next time, multiplied times the time period that the

Menu (8)(4)

Energy Units Select

The following options are available:

```
Energy Units Select
  0.  Giga Joule (GJ)
```

Select Energy Units: Giga Joule (GJ) and Kilocalories.
The factory default unit is GJ.
    0.   Giga Joule (GJ)
    1.   Kilocalorie (Kc)
    2.   KWh
    3.   BTU

Menu (8)(5)

Temperature Select

```
Temperature Select
0. From T1,T2
```

    0.   From T1.T2
    1.   From AI3,AI4
    (Select with $\wedge$、$\vee$)

Menu (8)(6)

Specific Heat Select
Select the following 2 kinds of specific heat value:

```
Specific Heat Select
  0.  Standard
```

    0.   Standard Specific Heat
    1.   Fixed Specific Heat

Generally specific heat water is 0.0041868GJ/M3℃

Menu (8)(7)

Energy Totalizer Switch
Select "ON" represent to open Energy Totalizer
Select "OFF" represent to close Energy Totalizer

```
Energy  Totalizer
      ON
```

Menu (8)(8)

Energy Multiplier
Select Energy Multiplier range: 10^{-4}~10^6 (E-4~E6)

```
Energy Multiplier [88
  4.  x1          (E0)
```

Menu (8)(9)

Temperature difference and set the temperature sensitive

```
Temperaure Diff. [89
      0.2000 ℃
```

Menu (8)(·)

Heat Meter Installation Position
1.   Inlet;
2.   Outlet

```
Heat Meter is on [8.
  1. Inlet
```
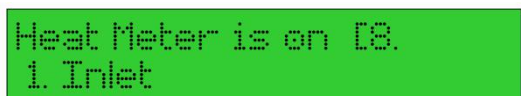
(Menu)(9)(0)

Signal Strength and Signal Quality Display the

measured signal strength and signal quality Q value upstream and downstream.

Signal strength is indicated from 00.0 ~ 99.9. A reading of 00.0 indicates no signal detected, while 99.9 indicates maximum signal strength. Normally the signal strength should be ≥60.0. Signal quality Q is indicated by 00~99. Therefore, 00 indicates the

(Menu)(9)(1)

TOM/TOS*100

Display the ratio between the actual measured transmit time and the calculated transmit time according to customer's requirement. Normally the ratio should be 100±3％. If the difference is too large, the user should check that the parameters are entered correctly, especially the sound velocity of the fluid and the installation of the transducers. This data is of no use before the system is ready.

(Menu)(9)(2)

Fluid Sound Velocity

Display the measured fluid sound velocity. Normally this value should be approximately equal to the

entered value in Window M21. If the difference is too large, it probably results from an incorrect value

(Menu)(9)(3)

Total Time and Delta Time

Display the measured ultrasonic average time (unit: nS) and delta time of the upstream and downstream (unit: nS) time. The velocity calculation in the flowmeter is based on the two readings.   The delta time is the best indication that the instrument is running steadily. Normally the fluctuation in the ratio.of the delta time should be lower than 20%. If it is not, it is necessary to check if the transducers are installed properly or if the parameters have been entered correctly.

(Menu)(9)(4)

Reynolds Number and Factor

Display the Reynolds number that is calculated by the flowmeter and the factor that is set currently by the flowmeter. Normally this scaling factor is the average of the line and surface velocity factor inside the pipe.

(Menu)(9)(5)

Display the readout of positive energy totalizer and negative energy totalizer

poorest signal while 99 indicates the best signal. Normally, signal quality Q value should be better than 50.

```
Strength+Quality [90
UP:00.0 DN:00.0  Q=00
```

```
TOM/TOS*100      [91
        0.0000%
```

entered in Window M21 or improper installation of the transducers.

```
Fluid Sound Velocity
      1443.4   m/s
```

```
Totl Time,Delta Time
 8.9149uS, -171.09nS
```

```
Reynolds Number [94
 0.0000      1.0000
```

```
ETP        0E+0 GJ
ETN        0E+0 GJ
```

`

[Menu][∧][0]

Power ON/OFF Time

To view the power on/off time and flow rate for the last 64 update times to obtain the offline time period and the corresponding flow rate. Enter the window, press [Enter] to display the last update before the last 64 times of on/off time and flow rate values. "ON" on right hand indicates that time power is on; "00" on the upper left corner indicates "00-07-18 12:40:12" the date time; flow rate is displayed in the lower right corner.

```
ON/OFF  Time        [+0
Press ENT When Ready
```

```
00-07.18    12:40:12
*ON 123.65 m3/h
```

[Menu][∧][1]

Total working hours

With this function, it is possible to view the total working hours since the flowmeter left the factory. The figure on the right indicates that the total working hours since the flowmeter left the factory is 1107 hours 1 minute 41 seconds.

```
Total Work Hours  [+1
     00001107:01:41
```

[Menu][∧][2]

Last Power Off Time
Display the last power off time.

```
Last Power Off Time
   03-04-04    11:33:02
```

[Menu][∧][3]

Last Flow Rate
Displays the last flow rate.

```
Last Flow Rate      [+3
    100.43    m3/h
```

[Menu][∧][4]

Total ON/OFF Times
Display total on/off times since the flowmeter left the factory.

```
ON/OFF  Times       [+4
                    40
```

[Menu][∧][5]

Calculator

This window works as a calculator with an internal calculation function. To use the calculator, enter the first parameter X, select a calculating operator; if there is a second parameter, enter it as parameter Y, then combine the calculation results into parameter X. For example:

To calculate 1+2, then it is necessary to press [Menu][∧][5][1][Enter], use [∧] or [<] to select "+", press [Enter][2][Enter] to confirm. This calculator is also provided with a register function.

Note: Using the calculator while the system is running will not influence the measurement.

```
Calculator : Input X=
                    0
```

[Menu][∧][6]

Media Vel. Threshold

```
Media Vel. Threshold
          1400 m/s
```

Press [Enter] to input the fluid velocity threshold.

[Menu][∧][7]

Total Flow for Month

```
Total Flow for Month
          0  m3
```

Enter this menu to view the total flow of this month.

[Menu][∧][8]

Total Flow This Year

```
Total Flow for This Year
               0  m3
```

Enter this menu to view the total flow of this year.

7. Error Diagnoses

The ultrasonic flowmeter has advanced self-diagnostics functions and displays any errors in the upper right corner of the LCD via definite codes in a date/time order. Hardware error diagnostics are usually performed upon each power on. Some errors can be detected during normal operation. Undetectable errors caused by incorrect settings and unsuitable measurement conditions can be displayed accordingly. This function helps to detect the errors and determine causes quickly; thus, problems can be solved in a timely manner according to the solutions listed in the following tables.

Errors displayed in the flowmeter are divided into two categories:

Table 1 is for errors displayed during self-diagnostics upon power on. "* F" may be displayed on the upper left corner of the screen after entering the measuring mode. When this occurs, it is necessary to power on for self-diagnostics once again to detect and solve possible errors using the table below. If a problem still exists, please contact the factory or the factory's local representative for assistance.

Table 2 applies when errors caused by incorrect settings and signals are detected and are announced by error codes displayed in Window M08.

7.1. Table 1. Self-diagnoses and error solutions (upon power on)

LCD Display	Cause	Solution
Rom Parity Error	System ROM illegal or error	Contact the factory
Stored Data Error	System stored data block error	Power on again or contact the factory
SCPU Fatal Error	SCPU circuit fatal error	Power on again or contact the factory
Timer Slow Error Timer Fast Error	System clock error	Contact the factory
CPU or IRQ Error	CPU or IRQ problem	Power on again
System RAM Error	System RAM questionable	Power on again or contact the factory
Time or Bat Error	System date time chip error	Power on again or contact the factory
No Display, Erratic or Abnormal Operation	Bad wiring connection	Check wiring connections
Stroke Key - No Response	Keypad locked or bad plug connection	Enter the unlock password if the keypad is locked

7.2. Table 2. Error codes and solutions (during operation)

Code	M08 Display	Cause	Solution
*R	System Normal	System normal	No errors
*J	SCPU Fatal Error	Hardware defect	Contact the factory
*I	Signal Not Detected	Signal not detected.	Attach transducer to the pipe and tighten it securely. Apply a plenty of coupling compound on transducer and pipe wall.
		Spacing is not correct between the transducers or not enough coupling compound applied to face of transducers.	Remove any rust, scale, or loose paint from the pipe surface. Clean it with a file.
		Transducers installed improperly.	Check the initial parameter settings.
		Scale is too thick.	Remove the scale or change the scaled pipe section. Normally, it is possible to change a measurement location. The instrument may run properly at a new site with less scale.
		New pipe liner.	Wait until liners solidified and saturated.
*H	Low Signal Strength	Low signal strength. Cause refers to above-mentioned reasons.	Solution refers to above-mentioned solutions.
*H	Poor Signal Quality	Poor signal quality All reasons are included in the above-mentioned causes.	Solution refers to above-mentioned solutions.
*E	Current Loop over 20mA (No influence normally. Ignore it if no current output is being used.)	4-20mA current loop over 120%. Improper settings to current loop output.	Check settings (refer to Window M56) and confirm if actual flow is too high.
*Q	Frequency output over set value No influence normally. Ignore it if no frequency output is being used.	Frequency output over 120%. Improper settings to frequency output or actual flow are too high.	Check settings (refer to Window M66-M69) and confirm if the actual flow is too high.
*F	Refer to Table 1.	Error in self-diagnoses during power on.	Power on again; resolve it by the method listed in Table 1. If it is still a problem, contact the factory.
		Permanent hardware error.	Contact the factory.
*G	Adjusting Gain>S1 Adjusting Gain>S2 Adjusting Gain>S3 Adjusting Gain>S4 (Display in Windows M00,M01,M02,M03)	Adjusting gain for normal measurement. Stop in S1 or S2 and only switch between S1 and S2 indicates a poor waveform or low signal strength. All reasons may be included in above-mentioned items.	
*K	Pipe Empty. Set in Window	No fluid in pipe or settings	Once fluid is detected in the pipe, set 0 in

| M29 | incorrect. | Window M29. |

7.3. Frequently Asked Questions and Answers

Question: New pipe, high quality material, and all installation requirements met: why still no signal detected?

Answer: Check pipe parameter settings, installation method and wiring connections. Confirm if the coupling compound is applied adequately, the pipe is full of liquid, transducer spacing agrees with the screen readings and the transducers are installed in the right direction.

Question: Old pipe with heavy scale inside, no signal or poor signal detected: how can it be resolved?

Answer: Check if the pipe is full of fluid. Try the Z method for transducer installation (If the pipe is too close to a wall, or it is necessary to install the transducers on a vertical or inclined pipe with flow upwards instead of on a horizontal pipe).

Carefully select a good pipe section and fully clean it, apply a wide band of coupling compound on each transducer face (bottom) and install the transducer properly.

Slowly and slightly move each transducer with respect to each other around the installation point until the maximum signal is detected. 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.

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 a layer of scale between the transducers and pipe inside wall).

Question: Why is there no CL (current loop) output?

Answer: Check if the desired current output mode is set in Window M55. See if the CL is powered off by " CL Off" settings.

Open the electronics enclosure to inspect the hardware circuit. Check to see if the short-circuit terminal near terminal 3 is in place between 1-2, i.e. Direct Output Mode(at location 2-3, set CL output as Transmitter Mode with external power supply).

Question: Why is the CL output abnormal?

Answer: Check to see if the desired current output mode is set in Window M55.

Check to see if the maximum and minimum current values are set properly in Windows M56 and M57.

Re-calibrate CL and verify it in Window M49.

Question: Why is the flow rate still displayed as zero while there is fluid obviously inside the pipe and a symbol of "R" displayed on the screen?

Answer: Check to see if "Set Zero" was carried out with fluid flowing inside the pipe(Refer to Window M42). If it is confirmed, recover the factory default in Window M43.

Question: With a poor measurement site environment in the plant and the voltage and power supplies fluctuating widely, is the instrument really able to keep running 24 hours a day repeatedly without stopping and last for several years under such conditions?

Answer: Flowmeter is designed to work with high reliability under such conditions. It is provided with an intelligent signal conditioning circuit and internal correction circuitry. It will work under strong interference conditions and is able to adjust itself with strong or weak sound waves. It will work in a wide band of voltage: 90-245VAC or 10V~36VDC voltage.

8. Product Overview

8.1. Introduction

The UA108 is a state-of-the-art universal transit-time flowmeter designed using SLSI technology and low voltage broadband pulse transmission. While principally designed for clean liquid applications, the instrument is tolerant of liquids with small amounts of air bubbles or suspended solids found in most industrial environments.

8.2. Features of UA108

With distinctive features such as high precision, high reliability, high capability and low cost, the flowmeter features other advantages:

Low consumption power, high reliability, anti-jamming and outstanding applicability.

Clear, user-friendly menu selections make flowmeter simple and convenient to use.

U.S., British and Metric measurement units are available. Meanwhile, almost all-universal measurement units worldwide may be selected to meet customer's requirements.

Daily, monthly and yearly totalized flow: Totalized flow for the last 64 days and months as well as for the last 5 years are may be viewed.

Power on/off function: allows the viewing of time and flow rate as power is switched on and off 64 times. Also, the flowmeter has manual or automatic amendment during offline sessions.

Self-contained signal output, including relay, open collector, frequency and 4~20mA current loop analog outputs, etc.

Parallel operation of positive, negative and net flow totalizes with scale factor (span) and 7 digit display, while the output of totalize pulse and frequency output are transmitted via relay and open collector.

Internally configured batch controller makes batch control convenient.

8.3. Theory of Operation

When the ultrasonic signal is transmitted through the flowing liquid, there will be a difference between the upstream and downstream transit time (travel time or time of flight), which is proportional to flow velocity, according to the formula below.

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

Remarks:

V	Medium Velocity
M	Ultrasonic frequency of reflection
D	Pipe Diameter
θ	The angle between the ultrasonic signal and the flow
T_{up}	Transit time in the forward direction
T_{down}	Transit time in the reverse direction

$\Delta T = T_{up} - T_{down}$
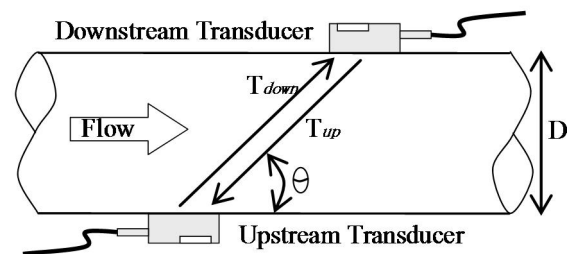
8.4. Applications

Water, sewage (with low particle content) and seawater

Water supply and drainage water

Power plants (nuclear power plant, thermal and hydropower plants), heat energy, boiler feed water and energy management system

Metallurgy and mining applications (cooling water and acid recovery, for example)

Petroleum and chemicals

Food, beverage and pharmaceutical

Marine operation and maintenance

Energy economy supervision and water conservation management

Pulp and paper

Pipeline leak detection

Regular inspection, tracking and collection

Energy measuring and balance

Network monitoring systems and energy/flow computer management

8.5. Specifications

Performance specifications	
Flow range	0～±40 ft/s (0～±12 m/s)
Accuracy	±0.5% of measured value (for 1.5～40 ft/s or –1.5～-40 ft/s)
Repeatability	0.15%
Linearity	±0.5%
Pipe size	1 in to 200 in (25mm to 5000mm)
Function specifications	
Outputs	Analog output: 0/4～20mA (max load 750Ω) Pulse output: 0～9999Hz, OCT, (min. and max. frequency is adjustable) Relay output: SPST, max 1Hz, (1A@125VAC or 2A@30VDC)
Communication	RS485
Power supply	90 to 245 VAC, 48 to 63Hz. Or 24 VDC
Keypad	16 keys with tactile action
Display	40 character, 2 line (20×2) lattice alphanumeric, backlit LCD
Temperature	Transmitter: -40℃ ～ 60℃ Transducer: -40℃ ～ 120℃ (standard)
Humidity	Up to 99% RH, non-condensing
Physical specifications	
Transmitter	Die-cast aluminum, IP65.
Transducer	Encapsulated design double-shielded transducer cable Standard/maximum cable length: 33ft/1000ft (10m/305m)
Weight	Transmitter: approximately 6.4 lb (2.9kg) Transducer: approximately 2.64 lb (1.2kg) (standard)

9. Appendix1 – Energy Meter

Note: For UA108, there are 2 methods to perform energy meter function:

1. If the customer does not select the RTD module, then the AI3, AI4 (4~20mA input ports) are open to connect temperature transmitters supplied by the customer.

2. If the customer chooses to select the RTD module, then the RTD inputs can be used

9.1. Energy Meter Function

The flowmeter has an energy meter function. The meter can calculate automatically caloric content of water under various temperatures, and obtain instantaneous caloric value and totalized caloric value. A separate customer-provided Temperature signal input is sent to the meter via the AI3,AI4 terminals, which can be configured for a 4～20mA or 0～20mA current signal.

9.2. Wiring

AI3, AI4 are connected with 2 temperature sensors by connection cable. The 2 temperature sensors are installed on the flow pipe and return pipe, they can input 4-20mA signals to AI3 AI4 of the transmitter (see wiring connection).
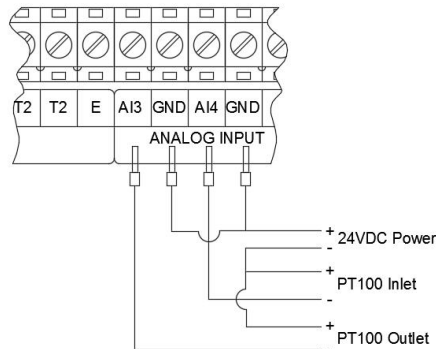
Temperature Transmitter connection

9.3. Set Temperature Value Range

Input temperature signal via AI3, AI4 terminals, set its measurement range in window M64 and window M65.

For example, the inlet temperature sensor outputs a 4-20mA current signal to the meter, and this is set to represent a temperature range of 10℃ to 50℃. Connect this sensor to the AI3 terminal, enter 10, 150 in window M64. Current mA value and temperature value of AI3 will display in window M06. The same procedure is then followed for the outlet temperature sensor; the zero and span for this sensor is entered into window M65

Related energy meter window as follows:

    Window M05: Display energy and totalized energy

    Window M07: DisplayAI3, AI4 current value and the corresponding temperature value

    Window M64: Enter temperature value which AI3 4mA and 20mA analog input represent

Window M65: Enter temperature value which AI4 4mA and 20mA analog input represent

Window M84:Select energy unit.

Window M85: Select temperature source

Window M86: Specific heat value

Window M88: Select energy multiplier

10.   Appendix2—RTD Module and PT100 Wiring (Module optional)

Note: For UA108, there are 2 methods to perform energy meter function:

1.   If the customer does not select the RTD module, then theAI3 AI4 (4~20mA input ports) are open to connect temperature transmitters supplied by the customer.
2.   If the customer chooses to select the RTD module, then the RTD inputs can be used.

10.1. RTD Energy Meter Function

The RTD Module's main function is to input the temperature values for the energy measurement. The UA108 can automatically calculate the caloric content of water at different temperatures and deriving an instantaneous energy value and totalized energy value. Customers can connect PT100 sensors to the RTD module.

10.2. Wiring

There are 2 wiring methods for the RTD module and PT100 temperature sensors — three-wire connections.

To connect the three wires, directly connect the PT100 sensors to the RTD module according to the following diagram on the right. (Note: T1 T1, T2, T2 are the same color, E and E are the same color).
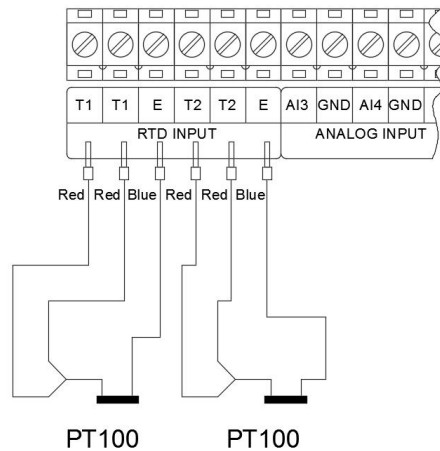
Three wire connection

The two PT100 temperature sensors are installed on the inlet and return pipes and they will input temperature signals to the UA108 transmitter.

10.3. Energy Measurement Methods

There are 2 formulas for flow meters to perform energy measurement functions:

Formula 1: $Q = V \times C \times (T_1 - T_2)$

   Q—Energy Value
   V—Transit time water volume
   C—Specific heat of the water
T_1—Temperature value on the inlet side

   T2—Temperature value on the return side

Notes:

Select energy units in window M84

Differential temperature: Temperature difference of Analog Input T1, T2 (transmitted from 2 temperature sensors)

Specific heat (C): Enter the specific heat in window M86 (generally select the fixed specific heat of 0.0041868GJ/M3 for water.

Formula 2: *Q= m (h₁-h₂)*

   Q—Energy value

   m—quality of the medium(density $\times$ transit time water volume)

   h1—enthalpy value of the inlet water

   h2—enthalpy value of the return water

The temperature and pressure at the inlet and return water points can be measured by temperature sensors and a transmitter, and pressure sensors and a transmitter. Then the enthalpy value at the inlet and return water points can be calculated through the enthalpy values table. The flow of the medium can be measured via the ultrasonic flow sensors and UA108 transmitter, and the caloric value can be derived according to the above formulas and the caloric calibration index.

Related energy meter windows include:

  Window M05: Display transit-time energy value and totalized energy value

  Window M06: Display temperature values of T1, T2 or the RTD module

  Window M84: Energy units selection

  Window M85: Temperature source selection

  Window M86: Calorific capacity

  Window M87: Energy totalizer switch

  Window M88: Energy multiplier

  Window M89: Reset energy totalizer

10.4. RTD Module Calibration Methods

There are two methods to calibrate the RTD module (customers can choose the proper one to calibrate according to the actual situation).

Method One: Liquid standard temperature calibration method

Note: It is used to calibrate the internal circuit of RTD module and the PT100 temperature sensors together

Calibrate it under the medium with the standard temperature of 50℃ and 84.5℃. Prepare two automatic thermostat,One is setted with temperature of 50±0.05℃,The other is setted with temperature of 84.5±0.05℃. Follow the following steps:

  1．Put two PT100 resistors into the thermostat tank with 50ºC

  2．Enter into Menu〔V〕0，input hardware debugging code 4213068 to open the debugging window;

  3．Enter into Menu〔V〕9, and press 〔V〕 to enter into M-A window, display Temp Calibration 50℃ and T1,T2 original temperature;

  4．After the PT100 comes stable(it approximately needs two minutes), press the key 〔Enter〕, it will display "Enter the key 〔·〕 to confirm and proceed", press the key 〔·〕again to enter into window M06 to show the temperature value.

  5．Once more, put two PT100 resistors into the thermostat tank with 84.5℃

  6．Enter into Menu〔V〕9, and press 〔V〕 to enter into M-B window, display Temp Calibration 84.5ºC and

T1,T2 original temperature;

7．After the PT100 comes stable(it approximately needs two minutes), press the key (Enter), it will display "Enter the key (·) to confirm and proceed", press the key (·) again to enter into window M06 to show the temperature value.

8．Calibration completed, and then proceed to do the inspection of calibration result.

If the first line of LCD display shows "Standard temp is wrong ? confirm" It indicates that standard temp is wrong, or there may be something wrontemp measuring circuit has some problem

Method Two: Resistance box calibration method

Note: The purpose is to calibrate the internal circuit of RTD module

In the condition of no thermostat tank, we could use the resistance box to realize the calibration of temperature circuit, for the temperature of 50℃, we could connect two resistors with the resistance value of 119.397ohm onto the temperature input circuits respectively.For the temperature of 84.5℃, the equivalent resistance value is 132.613ohm. Repeat the steps as method to do the calibration job.

11. Appendix3 - Serial Interface Network Use and Communications Protocol

11.1. Overview

The flowmeter has communication protocol. Its hardware directly supports a modem, a composition of flow data monitoring system that is economical, reliable and based on telephone line transmission. It can also be connected to a RS-485 bus through a RS232-RS485 change-over panel.

Two basic schemes can be chosen for networking, i.e. the analog current output method only using the flowmeter or the RS485 communication method via serial port directly from the flowmeter. This method is suitable to replace dated instruments in old monitoring networks. The later method is used in new monitoring network systems. It has advantages include low hardware investment and reliable system operation.

When the serial port communications method is directly used to implement a monitoring network system, the address identification code (in window M46) of the flowmeter is used as a network address code. Expanded command set with [W] is used as communication protocol. Thus the analog current loop and OCT output of flowmeter can be used to control the opening/closing of a control valve. The relay output can be used to power-on/off other equipment. The analog input of the system can be used to input signals such as pressure and temperature. The system provides an RTU function for flow measurement.

RS-485(cable length 0~1000m) can be directly used for data transmission links for a short distance. Current loop, radio transmission and modem can be used in medium or long distance transmission.

When the flowmeter is used in a network environment, various operations can be performed by a host device, except for programming of the address identification code, which needs to be done via the flowmeter keyboard.

The command answer mode is used in data transmission, i.e. the host device issues commands and the flowmeter answers correspondingly.

Common/special flow/thermal data monitoring system developed by our company can be used for flow data collection. Based on characteristics of the flowmeter, the system makes full use of software and hardware designs with flowmeter features. The system is simple, clear, economical, and reliable in operation.

11.2. Communications protocol and the use

The flowmeter meter supports these two communication protocols: FUJI Protocol, MODBUS Protocol Refer to Menu 63 for the protocol selection.

⚠️ Notice:
A wrong flow meter protocol setting will lead to abnormal communications.

11.2.1. FUJI Protocol

Choose "MODBUS ASCII+TDS7(FUJI)" in Menu 63 for FUJI Protocol.

The communication protocol format used by the ultrasonic flowmeter is an expanded set of the Fuji FLV series flowmeter protocol. The host device requests the flowmeter to answer by sending a "command". The baud rate of asynchronous communication (Primary station: computer system; Secondary station: ultrasonic flowmeter) is generally 9600BPS. A single byte data format (10 bits): one start bit, one stop bit and 8 data bits. Check bit: none.

A data character string is used to express basic commands and a carriage return (ENTER) is used to express the end of a command. The order applies to both RS232 and RS485. The characteristic is that the string of data is flexible. Frequently used commands are as follows:

Communications commands

Command	Description	Data format
DQD(cr)(lf)*0	Return daily instantaneous flow	±d.dddddE±dd(cr) *1
DQH(cr)(lf)	Return hourly instantaneous flow	±d.dddddE±dd(cr)
DQM(cr)(lf)	Return instantaneous flow per minute	±d.dddddE±dd(cr)
DQS(cr)(lf)	Return instantaneous flow per second	±d.dddddE±dd(cr)
DV(cr)(lf)	Return instantaneous velocity	±d.dddddE±dd(cr)
DI+(cr)(lf)	Return positive accumulative flow	±dddddddE±d(cr) *2
DI-(cr)(lf)	Return negative accumulative flow	±dddddddE±d(cr)
DIN(cr)(lf)	Return net increment	±dddddddE±d(cr)
DIE(cr)(lf)	Return totalized energy value	±dddddddE±d(cr)
E(cr)(lf)	Return instantaneous energy value	±dddddddE±d(cr)
T1(cr)(lf)	Return analog input value of T1 (Temperature,Pressure,etc.)	±dddddddE±d(cr)
T2(cr)(lf)	Return analog input value of T2 (Temperature,Pressure,etc.)	±dddddddE±d(cr)
AI3(cr)(lf)	Return analog input value of AI3 (Temperature,Pressure,etc.)	±dddddddE±d(cr)
AI4(cr)(lf)	Return analog input value of AI4 (Temperature,Pressure,etc.)	±dddddddE±d(cr)
DID(cr)(lf)	Return identification code of instrument (address code)	ddddd(cr) 5 bits in length
DL(cr)(lf)	Return signal intensity	UP:dd.d，DN:dd.d，Q=dd(cr)
DS(cr)(lf)	Return percentage of analogous output (AO)	±d.dddddE±dd(cr)
DC(cr)(lf)	Return current error code	*3
DA(cr)(lf)	Alarm signal of OCT or RELAY	TR:s，RL:s(cr) *4
DT(cr)(lf)	Current date and time	yy-mm-dd，hh:mm:ss(cr)
M@(cr)(lf)	Analogous key value @ sent to flowmeter	M@(cr) *5
LCD(cr)(lf)	Return currently displayed content on LCD display	
C1(cr)(lf)	OCT actuated	
C0(cr)(lf)	OCT not actuated	

R1(cr)(lf)	RELAY actuated	
R0(cr)(lf)	RELAY not actuated	
FOdddd(cr)(lf)	Frequency output value n	Fdddd(cr)(lf)
Aoa(cr)(lf)	Current output value a of current loop	AOa(cr)(lf) *6
ESN(cr)(lf)	Return electronic serial number	ddddddddt(cr)(lf) *7
W	Networking command prefix of numeric string address	*8
P	Prefix of return command with check	
&	Function sign of command "add"	
RING(cr)(lf)	Modem request handshake command	ATA(CR)(lf)
OK(cr)(lf)	Modem answer signal	No output

Note:

0. (cr)expresses carriage return. Its ASCII value is 0DH. (lf) expresses line feed. Its ASCII value is 0AH.

1. "d" expresses 0-9 number. 0 value is expressed as +0.000000E+00.

2. "d" expresses 0-9 numbers. There is no decimal point in integral part before "E".

3. The status of the machine is expressed by 1-6 letters. See the error code section for the meaning of the characters. For example, "R" and "IH".

4. "s" expresses ON or OFF or UD. For example, "TR:ON, RL:ON" expresses that the OCT and relay are in an actuated status; "TR:UD，RL:UD" expresses that the OCT and relay are not actuated.

5. "@" expresses the key value. For example, 30H expresses "0" key; Command "M4" is equivalent to pressing the key "4".

6. "a" expresses the current value. The value range is 0-20. For example, AO2.34567 and AO0.2.

7. Eight "dddddddd" expresses the electronic serial number of the machine. "t" expresses the type of machine.

8. If there are multiple flowmeters in a data network then the basic commands cannot be used alone. The prefix N or W must be added. Otherwise, multiple flowmeters will answer simultaneously, which will cause chaos in the system.

11.2.1.1.   Function prefix and function sign

Prefix P

The character P can be added before every basic command. It means that the transferred data has CRC verification. The method of counting the verified sum is achieved by binary system addition.

For example: Command DI+(CR) (the relative binary system data is 44H, 49H, 2BH, 0DH) transferred data is +1234567E+0m3. (CR) (the relative binary system data is 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H, 0DH, 0AH). And command PDI+ (CR) transferred data is +1234567E+0m3! F7 (CR), "!" means the character before it is the sum character, and the verified sum of the two bytes after it is (2BH+31H+32H+33H+34H+35H+ 36H+37H+45H+2BH+30H+6DH+33H+20H =(2)F7H)

Note: there can be no data before "!", and also may be a blank character.

Prefix W

Usage of prefix W: W+ numeric string address code +basic command. Value range of the numeric string is 0~65535, except 13 (0DH carriage return), 10 (0AH line feed), 42 (2AH *) and 38 (26H &). If the instantaneous velocity of No. 12345 flowmeter is to be accessed, the command W12345DV(CR) can be issued. Corresponding binary code is 57H, 31H, 32H, 33H, 34H, 3 5H, 44H, 56H and 0DH

Function sign &

Function sign & can add up to 5 basic commands (Prefix P is allowed) together to form a compound command sent to the flowmeter together. The flowmeter will answer simultaneously. For example, if No. 4321 flowmeter is requested to simultaneously return: 1] instantaneous flow, 2] instantaneous flow velocity, 3] positive total flow, 4] energy total, 5] T1 analogous input current value, the following command is issued:
W4321PDQD&PDV&PDI+&PDIE&PBA1(CR)
Simultaneously returned data are likely as follows:
+0.000000E+00m3/d!AC(CR)
+0.000000E+00m/s!88(CR)
+1234567E+0m3 !F7(CR)
+0.000000E+0GJ!DA(CR)
+7.838879E+00mA!59(CR)

11.2.1.2. Key Code

In a network environment, a key code is used to simulate the use of keys at the host device.

For example, the instruction "M1" is input through the serial port, which is equivalent to pressing Key 1 on the keyboard of the ultrasonic flowmeter.

Codes：

Key	Key Code (Hexadecimal system)	Key Code (Decimal system)	ASCII
0	30H	48	0
1	31H	49	1
2	32H	50	2
3	33H	51	3
4	34H	52	4
5	35H	53	5
6	36H	54	6
7	37H	55	7
8	38H	56	8
9	39H	57	9
·	3AH	58	:
<	3BH (0BH)	59	;
Menu	3CH (0CH)	60	<

Enter	3DH (0DH)	61	=
∧	3EH	62	>
∨	3FH	63	?

11.2.2.   MODBUS Protocol

Choose "MODBUS RTU" in Menu 63 for Modbus Protocol.

This MODBUS-I Protocol uses RTU transmission mode. The Verification Code uses CRC-16-IBM (polynomial is $X^{16}+X^{15}+X^2+1$, shield character is 0xA001) which is gained by the cyclic redundancy algorithm method. MODBUS RTU mode uses hexadecimals to transmit data.

1)   MODBUS-I Protocol Function Code and Format

The flow meter protocol supports the following two-function codes of the MODBUS:

Function Code	Performance data
0x03	Read register
0x06	Write single register

2)   MODBUS Protocol function code 0x03 usage

The host sends out the read register information frame format:

Slave Address	Operation Function Code	First Address Register	Register Number	Verify Code
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01~0xF7	0x03	0x0000~0xFFFF	0x0000~0x7D	CRC(Verify)

The slave returns the data frame format:

Slave Address	Read Operation Function Code	Number of Data Bytes	Data Bytes	Verify Code
1 byte	1 byte	1 byte	N*x2 byte	2 byte
0x01~0xF7	0x03	2xN*	N*x2	CRC(Verify)

N*＝data register number

3)   MODBUS Protocol function code 0x06 usage

The host sends a command to write a single register information frame format (performance code 0x06):

Slave Address	Operation Function Code	Register Address	Register Data	Verify Code
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01~0xF7	0x06	0x0000~0xFFFF	0x0000~0xFFFF	CRC(Verify)

The slave returns the data frame format (performance code 0x06):

Slave Address	Operation Function Code	Register Address	Register Data	Verify Code
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01~0xF7	0x06	0x0000~0xFFFF	0x0000~0xFFFF	CRC(Verify)

The range of flow meter addresses 1 to 247 (Hexadecimal: 0x01~0xF7), and can be checked in the Menu 46. For example, decimal number "11" displayed on Menu 46 means the address of the flow meter in the MODBUS protocol is 0x0B.

The CRC Verify Code adopts CRC-16-IBM (polynomial is $X^{16}+X^{15}+X^2+1$, shield character is 0xA001) which is gained by the cyclic redundancy algorithm method. Low byte of the verify code is at the beginning while the high byte is at the end.

For example, to read the address 1 (0x01) in the RTU mode, if the instantaneous flow rate uses hour as a unit （m3/h）, namely reads 40005 and 40006 registers data, the read command is as follows:

    0x01   0x03   0x00 0x04   0x00 0x02   0x85 0xCA

Flowmeter Address   Function Code   First Address Register   Register Numbers   CRC Verify Code

Flowmeter returned data is (assuming the current flow=1.234567m3/h)

    0x01   0x03   0x04   0x06 0x51 0x3F 0x9E 0x3B 0x32

Flowmeter Address   Function Code   Data Bytes   Data（1.2345678）   CRC Verify Code

The four bytes 3F 9E 06 51 is in the IEEE754 format single precision floating point form of 1.2345678.

Pay attention to the data storage order of the above example. Using C language to explain the data, pointers can be used directly to input the required data in the corresponding variable address, the low byte will be put at the beginning, such as the above example 1.2345678 m/s, 3F 9E 06 51 data stored in order as 51 06 9E 3F.

For example, it converts the address 1 (0x01) to 2（0x02）under the RTU mode, so to write the data of flowmeter 44100 register as 0x02, the write command is as follows:

    0x01   0x06   0x10 0x03   0x00 0x02   0xFC 0xCB

Flowmeter Address   Function Code   Register Address   Register Number   CRC Verify Code

Flowmeter returned data is:

    0x01   0x06   0x10 0x03   0x00 0x02   0xFC 0xCB

Flowmeter Address   Function Code   Register Address   Register Number   CRC Verify Code

4) Error Check

The flowmeter only returns one error code 0x02 which means data first address in error.

For example, to read address 1 (0x01) of the flowmeter 40002 register data in the RTU mode, the flowmeter considers it to be invalid data, and sends the following command:

    0x01   0x03   0x00 0x01   0x00 0x01   0xD5 0xCA

Flowmeter Address Function Code Register Address Register Number CRC Verify Code

Flowmeter returned error code is:

    0x01   0x83   0x02   0xC0 0xF1

Flowmeter Address Error Code Error Extended Code CRC Verify Code

5) MODBUS Register Address List

The flowmeter MODBUS Register has a read register and a write single register.

Register	No of Register	variable name	Data Type	Description
0001-0002	2	instantaneous flow rate	REAL4	unit：m3/h
0003-0004	2	Instantaneous energy flow rate	REAL4	unit：GJ/h
0005-0006	2	Flow velocity	REAL4	unit：m/s
0007-0008	2	Fluid sound velocity	REAL4	Unit:m/s
0009-0010	2	Positive flow totalizer	LONG	Unit is confirmed in M32(REG1438)
0011-0012	2	The decimal part of positive flow totalizer	REAL4	REAL4 is standard IEEE-754 single-precision floating point number, which is also called FLOAT format.
0013-0014	2	Negative flow totalizer	LONG	LONG is integer with low byte at the beginning position.
0015-0016	2	The decimal part of negative flow totalizer	REAL4	
0017-0018	2	Positive energy flow totalizer	LONG	all the energy totalizer that use long integers,it is confirmed by M84(REG1441)
0019-0020	2	The decimal part of positive flow totalizer	REAL4	
0021-0022	2	Negative flow totalizer	LONG	
0023-0024	2	The decimal part of negative flow totalizer	REAL4	
0025-0026	2	Net flow totalizer	LONG	
0027-0028	2	The decimal part of net flow totalizer	REAL4	
0029-0030	2	Net energy flow totalizer	LONG	
0031-0032	2	The decimal part of net energy totalizer	REAL4	
0033-0034	2	temperature 1/supplying water temperature	REAL4	unit:℃

0035-0036	2	Temperature 2/return water temperature	REAL4	unit：℃
0037-0038	2	Analog input A3 value	REAL4	converted dimensionless data
0039-0040	2	Analog input A4 value	REAL4	converted dimensionless data
0041-0042	2	Analog input A5 value	REAL4	converted dimensionless data
0043-0044	2	Analog input AI3 current value	REAL4	Unit: mA
0045-0046	2	Analog input AI4 current value	REAL4	Unit: mA
0047-0048	2	Analog input AI5 current value	REAL4	Unit:mA
0049-0050	2	System setup password	BCD	Writable,"00H" represents to cancel password setup.
0051	1	Hardware setup password	BCD	Writable, "A55Ah" represents opening.
0053-0055	3	Date and time of instrument	BCD	Writable,6 byte BCD respectively represent second, minute, hour, date, month, year , the low bit is in front
0056	1	Automatically store data,day,hour	BCD	Writable , 2 byte represent scheduled storage data staring time and day, for example, 0312H represents the storage data of the third dat and twelve O'clock each month.0012H represents storage data of twelve O'clock each day.
0059	1	Input key value(analug keyboard)	INTEGER	Writable.refer to manual key value list
0060	1	Screen display X number Menu	INTEGER	writable.
0061	1	Input backlit light time	INTEGER	Writable. Unit: second.
0062	1	Buzzer remaining beeping time	INTEGER	Writable, at most 255 time
0062	1	OCT remaining pulse numbers	INTEGER	Writable, at most 65536
0072	1	Instrument working error code	BIT	Please see remark 4

0077-0078	2	supply water resistor value	REAL4	Unit:ohm
0079-0080	2	Return water resistor value	REAL4	Unit:ohm
0081-0082	2	Total ultrasound transmission time	REAL4	Unit:ms
0083-0084	2	Delta time	REAL4	Unit:ns
0085-0086	2	Upstream ultrasound transmission time	REAL4	Unit:ms
0087-0088	2	Downstream ultrasound transmission time	REAL4	Unit: ms
0089-0090	2	Current loop output current value	REAL4	Unit:mA
0092	1	Work procedure and signal quality	INTEGER	High byte represents signal adjustment step.low byte represents signal quality.value range from 0-9, higher value represents better signal.
0093	1	Upstream signal strength	INTEGER	Value range: 0-4095
0094	1	Downstream signal strength	INTEGER	Value range: 0-4095
0097-0098	2	Ultrasound transmission time between actual measured and calculated	REAL4	Normal range: 100+-3%
0099-0100	2	Current reynolds value	REAL4	
0101-0102	2	Current reynolds correction factor	REAL4	
0103-0104	2	Work timer time	LONG	Unit: s
0105-0106	2	Total working time	LONG	Unit :s
0105-0106	2	Total power on times	LONG	
0113-0114	2	Net flow totalizer(floating point format)	REAL4	Unit:m^3，7 significant digits
0115-0116	2	Positive flow totalizer(floating point format)	REAL4	Unit:m^3，7 significant digits
0117-0118	2	Negtive flow totalizer((floating point format)	REAL4	Unit:m^3，7 significant digits

0119-0120	2	Net energy flow totalizer(floating point format)	REAL4	Unit:GJ，7 significant digits
0121-0122	2	Positive energy flow totalizer(floating point format)	REAL4	Unit:GJ，7 significant digits
0123-0124	2	Negtive energy flow totalizer(floating point format)	REAL4	Unit:GJ，7 significant digits
0125-0126	2	today total flow(floating point format)	REAL4	unit:m^3，7 significant digits
0127-0128	2	this month total flow(floating point format)	REAL4	unit:m^3，7 significance digits
0129-0130	2	manual total flow	LONG	
0131-0132	2	manual totalizer decimal part	REAL4	
0133-0134	2	batch controller total flow	LONG	
0135-0136	2	batch controller decimal part	REAL4	
0137-0138	2	today total flow	LONG	
0139-0140	2	today total flow decimal part	REAL4	
0141-0142	2	this month total flow	LONG	
0143-0144	2	this month total flow decimal part	REAL4	
0145-0146	2	this year total flow	LONG	
0147-0148	2	this year total flow decimal part	REAL4	
0158	1	Current displaying menu	INTEGER	
0165-0166	2	running time with trouble	LONG	Unit:s
0173-0174	2	present frequency output value	REAL4	unit：Hz
0175-0176	2	present current loop output value	REAL4	unit：mA

0181-0182	2	Present temperature difference	REAL4	unit：℃
0183-0184	2	replenished flow by this power on	REAL4	Unit:m^3
0185-0186	2	frequency coefficient	REAL4	Lower than 0.1
0187-0188	2	total automatically saving time	LONG	saving time is determined by register 0056
0189-0190	2	automatically saving Positive flow totalizer	REAL4	storing time is determined by register 0056
0191-0192	2	automatically store positive flow totalizer	REAL4	storing time is determined by register 0056
0221-0222	2	Inner pipe diameter	REAL4	Unit:mm
0229-0230	2	upstream transmission time delayed	REAL4	Unit:μs
0231-0232	2	downstream transmission time delayed	REAL4	Unit: μ s
0233-0234	2	estimated total transmission time	REAL4	Unit: μ s
0257-0288	32	monitor buffer area	BCD	readable
0289	1	monitor buffer area storage pointer	INTEGER	
0311	2	Today working time	LONG	Unit:s
0313	2	This month working time	LONG	Unit:s
0315	2	today max instantaneous flow	INTEGER	unit： m^3/h
0317	2	This month max instantaneous flow	INTEGER	unit： m^3/h
1437	1	present instant flow measuring unit	INTEGER	value range:0-31(remark 5)
1438	1	present flow totalizer measuring unit	INTEGER	value range:0-7(remark 1)
1439	1	present flow totalizer multiplier factor	INTEGER	n range:0-7,(remark 1)

1440	1	present energy flow totalizer multiplier factor	INTEGER	n range:0-7,(remark 1)
1441	1	present energy measuring unit	INTEGER	Range :0～3,0=GJ，1=Kcal 2=KWh， 3=BTU
1442	1	Instrument communication address number	INTEGER	
1491	1	instrument types	INTEGER	BIT0=0 represent flow meter BIT0=1 represent energy meter BIT3=1 represent energy meter installed on supply water pipe BIT3=0 represent energy meter installed on return water pipe
1451	2	user scaling factor	REAL4	
1521	2	factory scaling factor	REAL4	unmodified
1529	2	equipment electronic serial number	BCD	this equipment electronic serial number high bit is at the beginning

Remark:

(1) inside total flow used combined method by long integers and decimal.when using,read long integers is ok without decimal part.total flow size and total unit and multiplier factor have relations,assumed that long integers part of total flow is N(for positive total flow,it is the digit of register 0009,0010,32 bit with character long integers),decimal part of totaliser flow is Nf(for positive total flow,it is the digit of register 0011,0012,4 byte floating point),multiplier factor of total flow is n(register 1439),then positive total flow=$(N+Nf) \times 10^{n-3}$(unit is comfirmed in register 1438 of total flow unit) in register 1438,the meaning of data 0-7 is as follows:

1. cubic meter (m3)
2. litre (L)
3. US gallon (GAL)
4. imperial gallon (igl)
5. US Mega gallon (mgl)
6. cubic feet (cf)
7. US oil barrel [42](ob)
8. imperial oil barrel (ib)

Totaliser flow=$(N+Nf) \times 10^{n-4}$

include：for net heat quantity,N is in the register of 0029，0030

    for neat heat quantity,Nf is in the register of 0031，0032

    n is confirmed in the register of 1440.

    totaliser heat quantity unit is confirmed in the register of 1441.

（2）not supply other variables,if you need,pls consult our factory.

（3）Pls note that lots of datas in above table are not valid for non heat meter,using flow meter solely,you can ignore the irrelevant term,these irrelevant terms are to unify our products' communication protocol ,convenient for users to use.

（4）error code is 16 bit,the meaning is as follows:

Bit0 error of no receipt of signal

Bit1 error of lower signal

Bit2 error of poor signal

Bit3 error of empty pipe

Bit4 error of circuit hardware

Bit5 adjusting current gain

Bit6 over range error of frequency output

Bit7 error of the current that current loop output is over range(normaly need to setup max range)

Bit8 verification error of inside data register

Bit9 master frequency or clock frequency exists error

Bit10 parameter block exists checksum error

Bit11 program memory data checksum error

Bit12 temperature measuring circuit possibly exists error

Bit13 reserved

Bit14 error of inside timer overflow

Bit15 analogue input circuit exists error

Attention:if used in flow meter, pls shield the bit related with heat quantity measurement before using these codes,because the status of the bit are not assured.

（5）instant flow unit code as follows:

0	m^3/s	1	m^3/minute	2	m^3/h	3	m^3/day
4	l/s	5	l/minute	6	l/h	7	l /day
8	gal /s	9	gal /minute	10	gal /h	11	gal /day
12	igl/s	13	igl /minute	14	igl /h	15	igl /day
16	mgl /s	17	mgl /minute	18	mgl /h	19	mgl /day
20	cf /s	21	cf /minute	22	cf /h	23	cf /day
24	ob /s	25	ob /minute	26	ob /h	27	ob /day
28	ib/s	29	ib /minute	30	ib /h	31	ib /day

12. Appendix4 - Flow Application Data

12.1. Sound Velocity and Viscosity for Fluids Commonly Used

Fluid	Sound Velocity (m/s)	Viscosity
water 20℃	1482	1.0
water 50℃	1543	0.55
water 75℃	1554	0.39
water100℃	1543	0.29
water125℃	1511	0.25
water150℃	1466	0.21
water175℃	1401	0.18
water200℃	1333	0.15
water225℃	1249	0.14
water250℃	1156	0.12
Acetone	1190	
Carbine	1121	

Ethanol	1168	
Alcohol	1440	1.5
Glycol	1620	
Glycerin	1923	1180
Gasoline	1250	0.80
Benzene	1330	
Toluene	1170	0.69
Kerosene	1420	2.3
Petroleum	1290	
Retinal	1280	
Aviation kerosene	1298	
Peanut oil	1472	
Castor oil	1502	

12.2. Sound Velocity for Various Materials Commonly Used

Pipe Material	Sound Velocity (m/s)
Steel	3206
ABS	2286
Aluminum	3048
Brass	2270
Cast iron	2460
Bronze	2270
Fiber glass-epoxy	3430
Glass	3276
Polyethylene	1950
PVC	2540
Titanium	3150

Cement	4190
Bitumen	2540
Porcelain enamel	2540
Glass	5970
Plastic	2280
Polyethylene	1600
PTFE	1450
Rubber	1600

12.3. Sound Velocity in Water (1 atm) at different temperatures

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

Refer to the sound velocity of other fluids and materials, please contact the factory.