Ultrasonic Flowmeter Instruction Manual

Update Record	Revision	3.0.1
	Date	12 . 2018

Notice

Thank you for choosing the Ultrasonic Flowmeter and Analyzer with ARM chip and low-voltage wide-pulse sending technology.

This instruction manual contains important information. Please read it carefully before operation the flowmeter thus avoiding damage to the flowmeter from improper use.

This instruction manual will advise how to use the flowmeter step-by-step manner, including product component description, installation, wiring and quick setup etc. to make it easier to operate.

A working knowledge of the menu settings will assist you in understanding the flowmeters' powerful and output function.

Warning

May cause injury.

Attention

May damage the flow meter.

Some of the instructions may be different from the flowmeter and analyzer you have purchased. That depends on the configuration requirements. It also may be due to changes in product design, modification and upgrade .You will find the flowmeter display interface intuitive and easy to understand and it shall prevail when there is no indication of the instructions. Please refer to the version number and the appendix for more information.

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 loose screw or wires or other damage that may have occurred during transportation. Any questions, please contact your representative as soon as possible.

Transmitter	Transducers
	
Accessories	**Documents**
 Carrying Case  Signal Cable  Software  Pipe Straps  Coupling compound  Charger	 1. Instruction Manual 2. Packing List 3. Certified Factory Calibration

Content

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1.Transmitter Installation and Connection

1.1 Wire Connecting

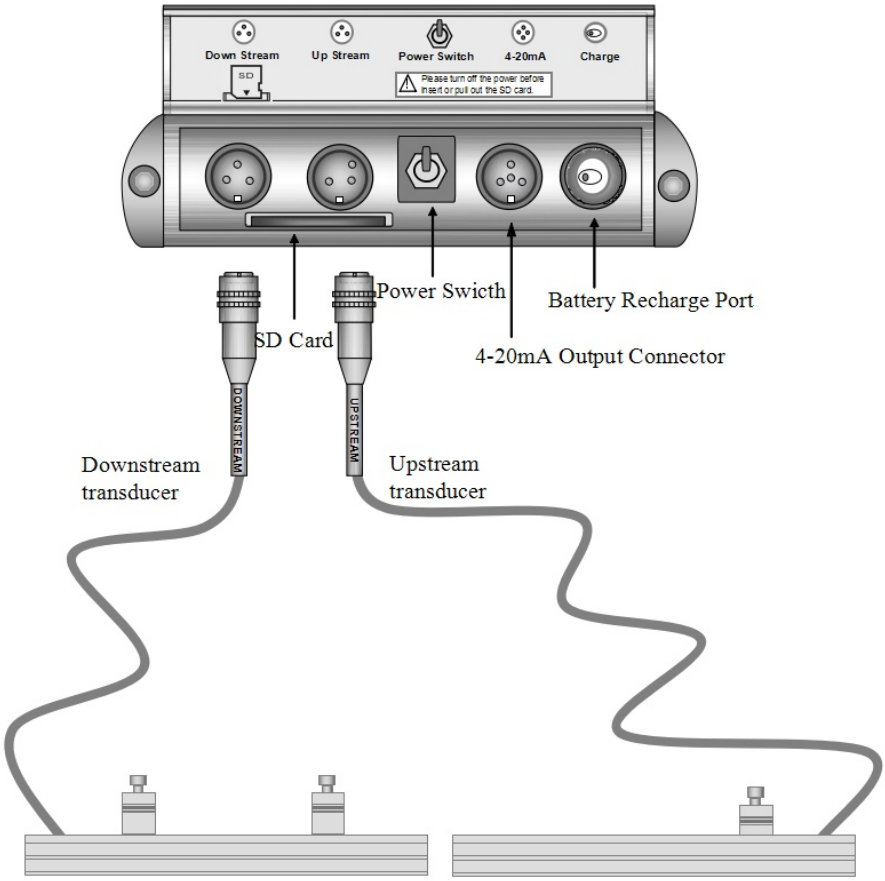
1.1.1Power Supply Option

The factory offers one rechargeable 11.1V Lithium battery and matching battery charger.

1.1.2 Transmitter Wiring

Open the hinged top cover of the electronics. Shown from left to right on the panel of the are the downstream transducer connector, upstream transducer connector, the battery recharge port (charge the transmitter or connect to a standby power supply), and the 4~20mA output connector.

Refer to the below diagram for specific connection information:



Warning

Wire when it is power-off. Reliable grounding must be taken for the instrument before installation and use

1.2 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 displayed on the screen (see Error Diagnostics). After that, the system will run automatically using the programmed parameters.

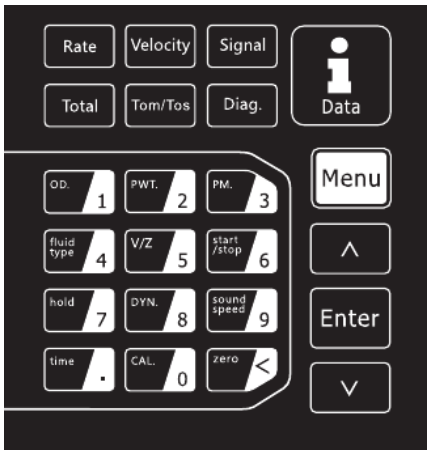
If it is the first time to use or install on a new site, the customer need to input the new installation site parameters. Any parameters which are set by the user will be saved permanently until they are changed by the user.

When the user modifies the parameters or removes the transducers, the meter will recalculate automatically, and

operate normally with the newly set parameters.

1.3 Keypad Functions

Follow these guidelines when using the flowmeter keypad:



CAL. 0 ~ sound speed 9 and time . to input numbers.

zero < Backspace or delete characters to the left.

∧ and ∨ Return to the last menu or open the next menu. Acts as "+" and "-" are used to enter numbers.

Menu Select a menu. Press this key first, input a two-digit menu number and the selected menu data will be displayed. For example, to input a pipe outside diameter, press Menu OD. 1 OD. 1 where "11" is the window ID to display the pipe outside diameter. Enter Enter/Confirm Data Enter/Exit SD card storage interface. Rate、Total、Velocity、Tom/Tos、Signal、Diag.Are shortcuts to the windows for Flow Rate, POS Totalizer, Velocity, Fluid Type, Signal Quality and Diagnosis.

1.4 Keypad Operation

The instrument setup and measurement displays are subdivided into more than 100 independent menus. The operator can input parameters, modify settings or display measurement results by "visiting" a specific menu. These menus are arranged by 2-digit serial numbers from 00~99, then using +0, +1, etc. Each menu ID code has a defined meaning. For example, menu 11 is the pipe outside diameter, while menu 25 is the mounting spacing between the transducers. Each menu is discussed later in this manual.

To visit a specific menu, press the Menu key at any time except the SD Card Storage Interfac**e**, then input the 2-digit menu ID code and that menu will be displayed. For example, to input or check the pipe outside diameter, press the Menu OD. 1 OD. 1 keys for window ID code 11.

Another method to visit a particular menu is to press the ∧ ∨ and Enter keys to scroll through the menus. For example, if the current menu is 30, press ∨ key to enter menu 31, press the ∧ button again to enter menu 30.

The menus are divided into three types:

1) Data Type, such as M11, M12;

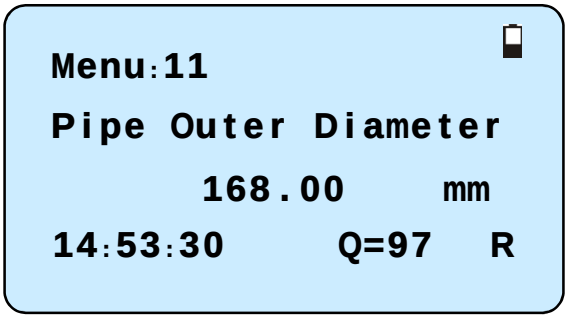
2) Selection Type, such as M14;

3) Display Type, such as M00, M01.

Visit Data Type menus to check specific parameters. If parameter change is needed, just input the values then press Enter; or press Enter first, then input the values and press Enter to confirm.

Example 1: To enter a pipe outer diameter of 200mm, the procedure is as follows:

Press Menu OD. 1 OD. 1 to enter Menu11 (the numerical value displayed currently is the previous

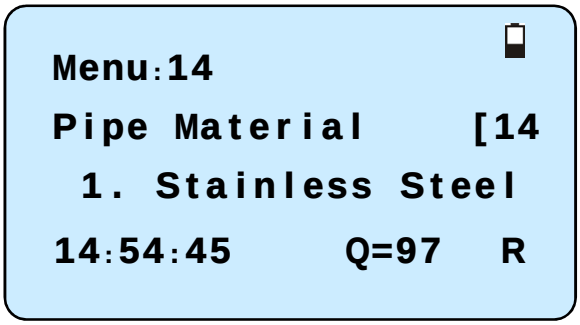


pipe outer diameter). Now press the Enter key. The Visit Selection Type menus to check the related options. If need to modify it, press enter first to enter the revised selection when the symbol “>” and a flashing cursor are displayed at the left end of the third line on the screen; or input numbers directly to select the option when the symbol “>” and a flashing cursor are displayed.

Example 2: If the pipe material is “Stainless Steel”, press Menu OD. 1 fluid type 4 to enter Menu 14, then press Enter to modify the option. Then, select “1. Stainless Steel” from the drop-down menu (you may cycle through the choices by pressing the ∧ and ∨ keys) and then press Enter to confirm the selection. It is also possible to press the OD. 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.

symbol “>” and a flashing cursor is displayed on the left side of the third line on the screen. The new value can now be entered. Or input the value first then press Enter to confirm PWT. 2 CAL. 0 CAL. 0 Enter.



1.5 Flowmeter Menu Descriptions

00~09 Display menus: Used to display flow rate, positive total, negative total, net total, velocity, date & time etc.

10~29 Setup menus: Used to enter pipe outer diameter, pipe wall thickness, fluid type, transducer type, transducer mounting and spacing, etc.

30~38 Flow units selection and totalizer operating menus: Used to select units of measurement. Other menus set/reset the various totalizer modes.

40~45 Zero Set Calibration, Scale Factor.

55~83 Input and output setup menus: current loop mode select, 4mA or 0mA output value, etc.

90~94 Diagnostics: signal strength quality (menu 90), TOM/TOS*100 (menu 91), sound velocity (menu 92), total time and delta time of the measured signal (menu 93), Reynolds number and K factor (menu 94).

+0~+4 Appendix: Power on/off time, total working hours, on/off times etc.

-0 4~20mA correction menu.

Attention

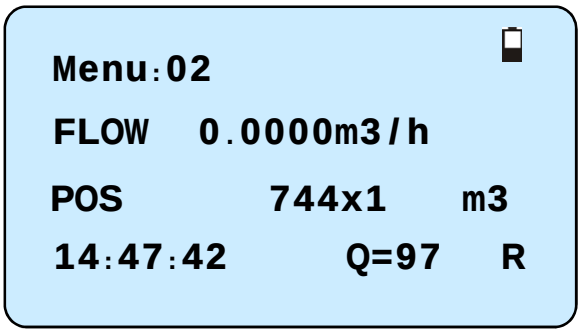
"Hidden" menus are for hardware adjustment (set by the manufacturer).

2. The Quick Setup Instructions

2.1Double function keys menu description

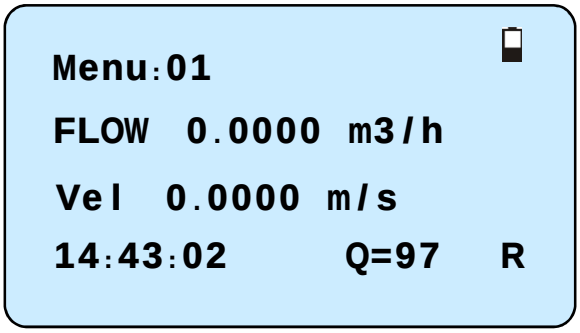
Press Rate

Press the display Flow Rate of M02.



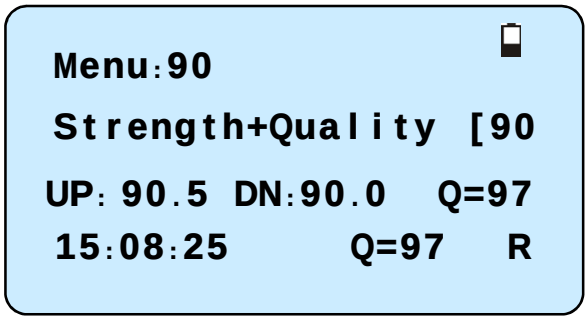
Press Velocity

Press the display Velocity of M01.



Press Signal

Press the display Signal Strength of M90.



Press Total

Press the Total of M00.

```
Menu:00
FLOW   0.0000m3/h
NET      744x1   m3
14:42:42      Q=97   R
```

Press Tom/Tos

Press the TOM/TOS of M91.

```
Menu:91
Tom/Tos*100      [91
         0.00%
15:08:45      Q=97  R
```

Press Diag.

Press the display System of M08.

```
Menu:08
* R----------------
Instrument Working
Properly
14:51:24      Q=97   R
```

Press OD. 1

Enter input Pipe Outer Diameter of M11.

```
Menu:11
Pipe Outer Diameter
      168.00     mm
14:53:30      Q=97   R
```

Press PWT. 2

Enter input Pipe Wall Thickness of M12.

```
Menu:12
Pipe Wall Thickness
         6.00   mm
14:54:00      Q=97   R
```

Press 

Enter the select Pipe Material type of M14.

```
Menu:14
Pipe Material      [14
 0. Carbon Steel
14:54:45      Q=97   R
```

Press 

Enter the select Fluid Type of M20.

```
Menu:20
Fluid     Type    [20
  0. Water
14:55:58      Q=97   R
```

Press 

Enter the select Transducer Mounting of M24.

```
Menu:24
Transducer Mounting
  0. V
14:56:20      Q=97   R
```

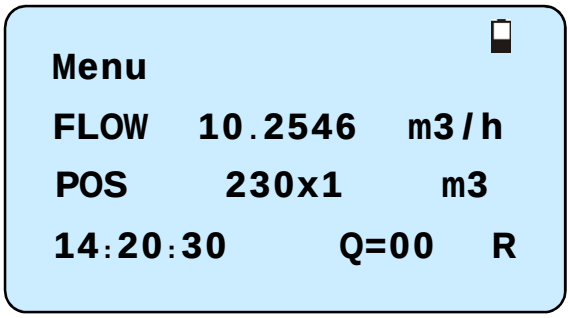
Press 

Start/stop manual totalizer in turn.

```
Menu
            202    sec
OFF       2.125   m3
14:20:30      Q=00   R
```

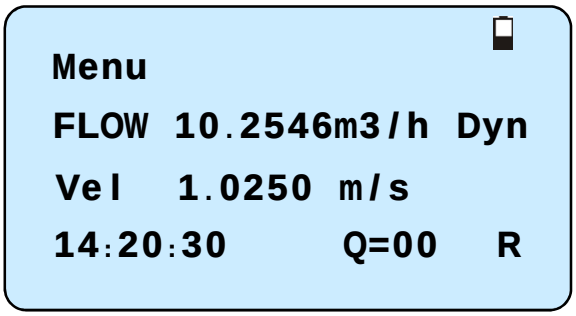
Press 

Show/keep totalizer in turn.



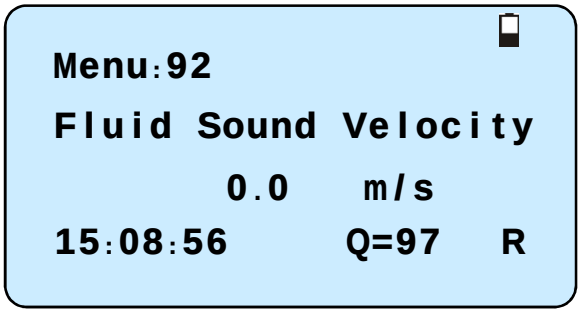
Press 

Display dynamic/normal mode instantaneous flow and flow velocity in turn.



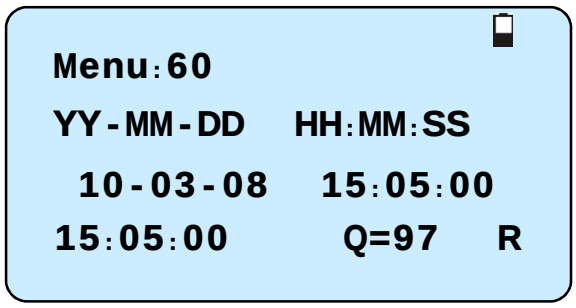
Press 

Enter the Fluid Sound Velocity of M92.



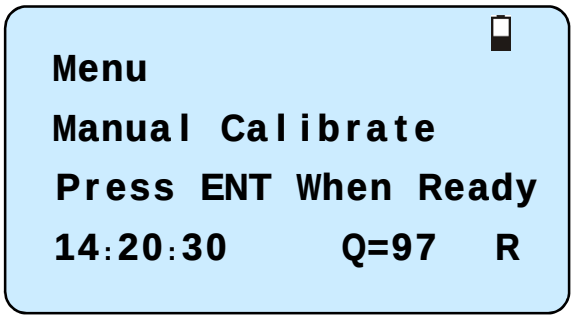
Press 

Enter setup time of M60.



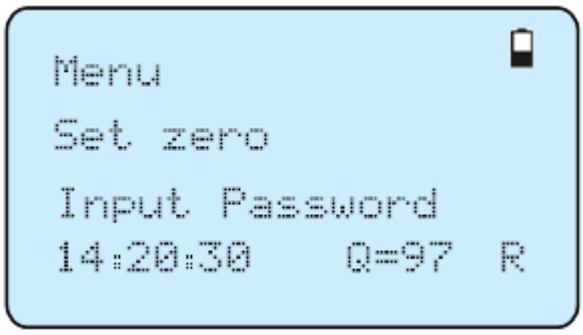
Press [CAL. 0]

Press enter the manual calibration of flow velocity, press [Enter] to manual accumulation, then press [Enter] accumulated over, press [Enter] input criteria cumulants, confirm reasonable press [Enter] store to complete the calibration coefficient K.



Press [zero <]

Enter the password to Set zero to remove 1234.

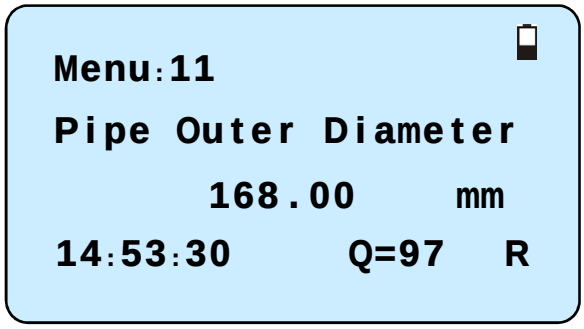


2.2 For example

Example: Let us assume you have a DN150 (6”) pipe, measuring water, Material is carbon steel with no liner. These parameters should be entered as follows:

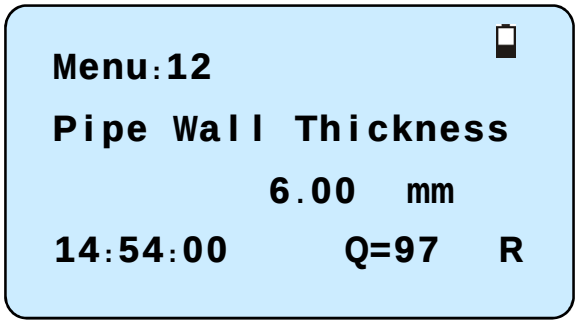
Step 1. Pipe outside diameter

Press [Menu] [OD. 1] [OD. 1] keys to enter menu 11, enter the pipe outside diameter, then press the [Enter] key.



Step 2. Pipe wall thickness

Press the [Menu] [OD. 1] [PWT. 2] key to enter menu 12, enter the pipe wall thickness (wall thickness for various pipe schedules can be found in the appendix), then press the [Enter] key.



Step 3. Pipe material

Press the Menu OD. 1 fluid type 4 key to enter menu 14, press the Enter key, use the ∧ or ∨ key to select the pipe material from the drop-down menu, then press the Enter key.

```
Menu:14
Pipe Material      [14
 0. Carbon Steel
14:54:45     Q=97   R
```

Step 4. Liner material parameters
(including thickness and sound velocity, if needed)

Press the Menu OD. 1 start /stop 6 key to enter menu 16, press the Enter key, use the ∧ or ∨ key to select liner material from the drop-down menu, and then press the Enter key.

```
Menu:16
Liner Material [16
 0.None,Liner
14:55:10     Q=97   R
```

Step 5. Fluid type

Press the Menu PWT. 2 CAL. 0 key to enter menu 20, press the Enter key, use the ∧ or ∨ key to select fluid type from the drop-down menu, then press the Enter key.

```
Menu:20
Fluid     Type     [20
  0. Water
14:55:58     Q=97   R
```

Step 6. Transducer mounting methods

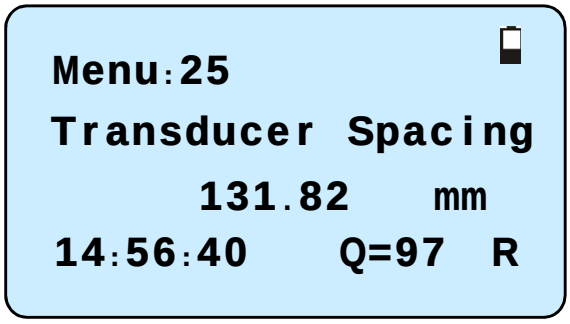
Press the Menu PWT. 2 fluid type 4 key to enter menu 24, press the Enter key, use the ∧ or ∨ key to select transducer-mounting from the drop-down menu, then press the Enter key.
(Details on Chapter 4.1)

```
Menu:24
Transducer Mounting
  0. V
14:56:20     Q=97   R
```

Step 7. Transducer spacing

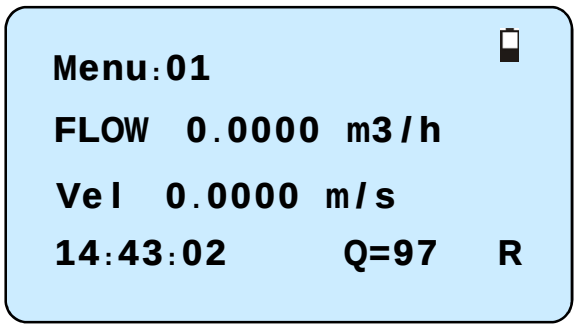
Press the Menu PWT. 2 V/Z 5 key to enter menu 25, accurately install the transducer according to the displayed transducer mounting spacing and the selected mounting method.

(Details on Chapter 4).



Step 8. Display Measurement Results

Press Menu CAL. 0 OD. 1 to enter Menu 01 to display flow rate. (Subject to the real measurement.)

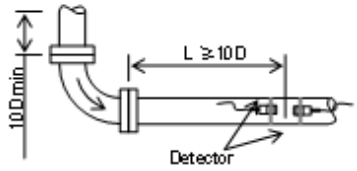
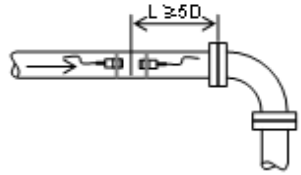
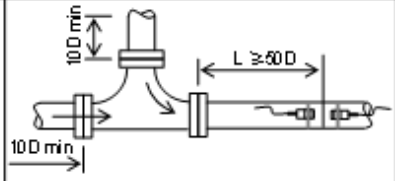
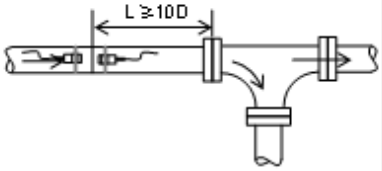
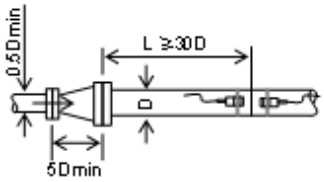
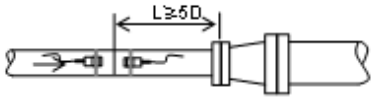
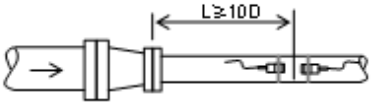
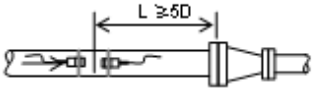
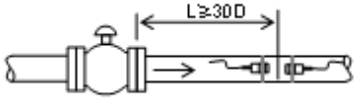
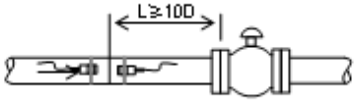
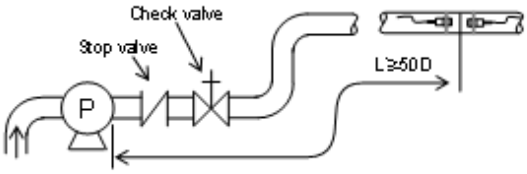


2.3 Measurement Site Selection

Comparing with other kinds of flowmeters, Ultrasonic Flowmeter is the simplest one to install. Choose a proper measurement site, enter the pipe's parameters into the flowmeter, install and fix the transducers on the pipe, then it can start the measurement.

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.
- On the horizontal pipe, the transducer should be mounted on the 3 o'clock and 9 o'clock position of the pipe section, avoid the 6 o'clock and 12 o'clock position, in order to avoid the signal attenuation caused by the sediment at the bottom, or air bubbles or cavitation.
- 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.
- Choose a section of sound conducting pipe.

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

3.Transducer Installation

3.1 Installing the Transducer

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, ensure there are no air bubbles between the transducers and the pipe wall, and then attach the transducers to the pipe with the straps provided and tighten them securely.

Note:

1. The two transducers should be mounted at the pipe's centerline on horizontal pipes. Make sure that the transducer mounting direction is parallel with the flow.

2. 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.

3. Refer to 2.15 for the Transducer Mounting Spacing.

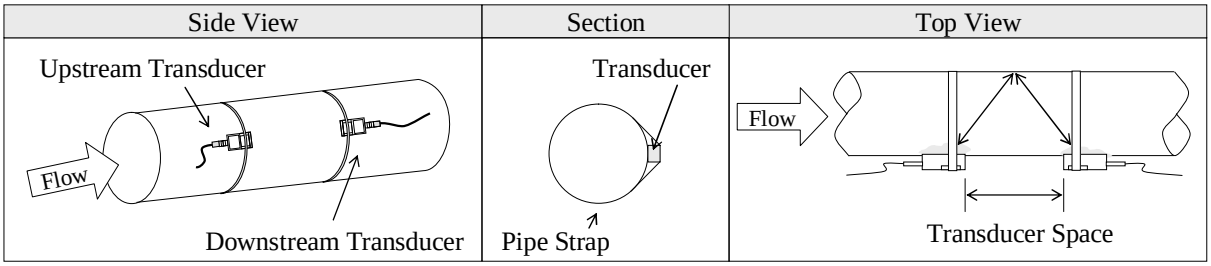
4. If the transducers cannot be mounted horizontally symmetrically due to limitation of the local installation conditions, it may be necessary to mount the transducers at a location where there is a guaranteed full pipe condition (the pipe is always full of liquid).

3.1.1 Transducer Mounting Methods

Three 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 (DN100~300mm, 4"~12"). 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").

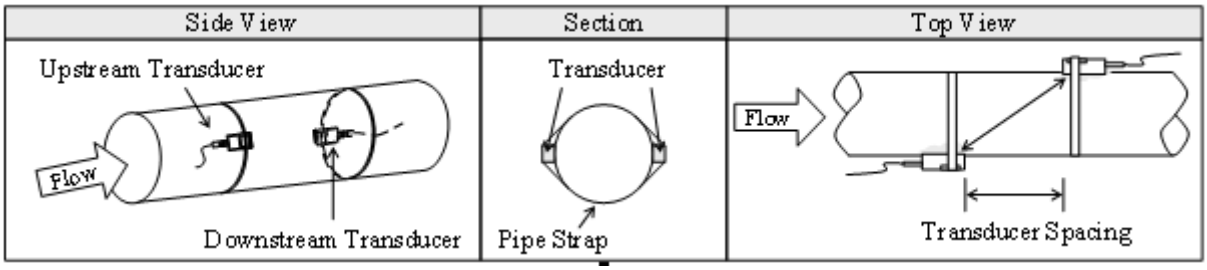
3.1.2 V Method

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 transducers, contact on the pipe at the pipe's centerline and equal spacing on either side of the centerline.



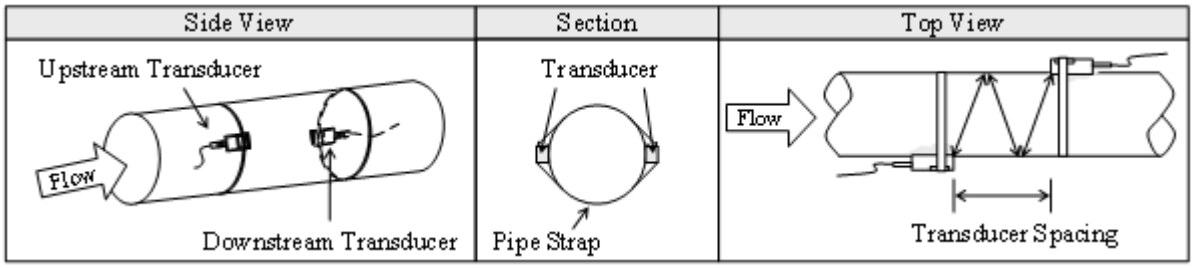
3.1.3 Z Method

The signal transmitted in a Z method installation has less attenuation than a signal transmitted with the V method when the pipes are too large, there are some suspended solid in the fluid, or the scaling and liner are too thick .
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 5000mm (4" to 200") approximately. Therefore, we recommend the Z method for pipe diameters over 300mm (12").



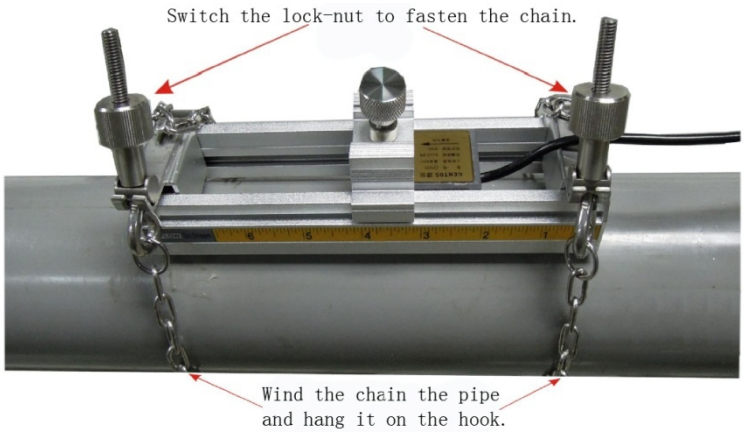
3.1.4 N Method (not commonly used)

With the N method, the sound waves traverse the fluid three times and bounce twice 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).



3.2Transducer Installation and Fixing

Transducers can stick onto the pipe with its magnetic steel racks. If need to fasten them, then can use the chains to make it firm. See below picture.



3.3 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-term operation reliability. In most instances, only apply a wide band 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 a high reliability of the measurement and long-term operation of the instrument.

3.3.1 Signal Strength

Signal strength (displayed in Signal) 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 represents 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 ensure enough sonic coupling compound has been applied adequately during the installation in order to obtain the maximum signal strength.

System normal operation requires signal strength over 65.0, 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 method to be Z method.

3.3.2 Signal Quality (Q value)

Q value is short for Signal Quality (displayed in Signal). 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 to ensure the signal quality can be detected as strong as possible.

3.3.3Total Time and Delta Time

"Total Time and Delta Time", which displays in Window M6.04, 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 resulted 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.

3.3.4 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 M6.02.

Attention

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

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

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

If the transducer is mounted at the pipe's centerline on the same diameter,

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

3.3.5Warnings

(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 transducers onto the pipe wall. While checking the signal strength and Q value, move the transducers slowly around the mounting site until the strongest signal and maximum Q value can be obtained. .
(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 on the same diameter.
(4) 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 too 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) Keep the flowmeter away from the electromagnetic interference area to ensure its proper operation..
(6) After completing the installation, power on the instrument and check the parameters and the result accordingly.

4. Operating Instructions

4.1 System Normal Identification

Press the Menu CAL. 0 DYN. 8 keys. If the letter "*R" displays on the screen, it indicates system normal.
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 to see if the transducer wiring connections are correct, the transducers are securely installed, etc.
For further information, please refer to "Error Diagnosis".

4.2 Low Flow Cutoff Value

The data in M41 is Low Flow Cutoff Value. If the flow rate falls below the low flow cutoff value, the flow indication is deemed to be ZERO. This can prevent the flow meter accumulate the flow when the actual flow is"0"after a pump was shut down. 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 is higher than the low flow cutoff value.

4.3 Zero Settings

When zero flow occurs, any measuring instrument will has a zero point which shows the measuring value is not equal to "0", this value indicates "Zero". To any measuring instrument, the smaller the "Zero" is, the better the quality is.

If the zero set point is not at true zero flow, a measurement difference may occur. The smaller the measurement flow is, the larger the measurement difference caused by the zero point will exist. Only when zero point reduced to a definite degree the measuring difference caused by the zero point can be ignored.
For an ultrasonic flowmeter, the measurement difference caused by the zero point cannot be ignored under low flow conditions. It is necessary to perform a static zero set calibration to improve the low flow measurement accuracy.

Set Zero in Menu42 press [Enter], and then wait for the processing indication or displayed Complete..If setting Zero in flowing conditions, it may cause the flow to be displayed as "0". If so, it can be recovered via Menu 43.

4.4 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 productions. The difference is called "consistency".
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 flow calibration. The scale factor can be input in Window M45.

4.5 4 ~ 20mA Current Loop Output

With a current loop output exceeding an accuracy of 0.1%, the flowmeter is programmable and configurable with outputs such as 4 ~ 20mA selected in Menu 55. Please refer to Menu 55 in "Window Display Explanations" for more information.
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 ~ 1000m^3/h, enter 0 in Window M56and 1000 in Window M57.

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

Press [Menu] [V/Z 5] [DYN. 8] [Enter] ,move [∧] or [∨] 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 not within tolerance. Refer to Section 5.6 for Current Loop Verification.

Check the present current loop output in Window M59, the value will change along with the change of the flow.

4.6 4-20mA Analog Output Calibration

Attention

Each flowmeter has been strictly calibrated 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.

Calibrate the analog input required to expand the hardware debugging menu as below procedures:

Press [Menu] [∨] [CAL. 0] [Enter], enter the password “115800” then press [Enter]. This action will be inoperative after powering off.

Then press [Enter] to enter the Current Loop Verification Mode, press [Enter] to enter the 4mA verification status, use an accurate ammeter to measure the output current of the current loop, and move [∧] or [∨] to adjust the displayed values, wait for the ammeter current value to reach “4mA”, then the 4mA verification is finished.

Press [Enter] to do the 20mA verification using the same procedure as for the 4mA verification.

The calibration results will be automatically saved in EEPROM and won’t get lost even if power off.

4.7TF Card Operation

4.7.1Specifications

Capacity: 1 GB standard(To prevail in kind)

Note: TF card is a kind of fashion consumer products, quickly up grade .The specific configuration is subject to the product you received.

Data collection update rate: user selectable: 1 seconds to 60 seconds. If the rate is set longer than 60 seconds the default will be 60 seconds; when is set to be less than 1 seconds, it will default to 1 seconds.

Data content: date and time, flow rate, flow velocity, total flow, positive totalizer, negative totalizer.

Data collection time: user selectable from 1~9999mins. If it is set is longer than 9999mins, it will default to 10mins.

Data storage format: 1=15-09-10, 14:16:33

2=+3.845778E+01m3/h

3=+1.451074E+00m/s

4=-0000010E+0m3

5=+0000002E+0m3

6=-0000012E+0m3

File system format: FAT32

File type: plain text file (.txt)

File capacity: maximum 512pcs

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

Turn to chapter 5.7.4 for details if want to change a filename.

When the capacity of the SD card is full, the new data will override the earliest files automatically (it will rollover).

4.7.2 Install or Remove the SD card while the meter is powered on

If the operator desires to insert or remove the SD card with power on, the following operation is to be used:

1. Insert or remove the SD card without data storage.
2. To save data, press 

button for 4 seconds, exit the acquisition, and then insert or remove the SD card.

Attention

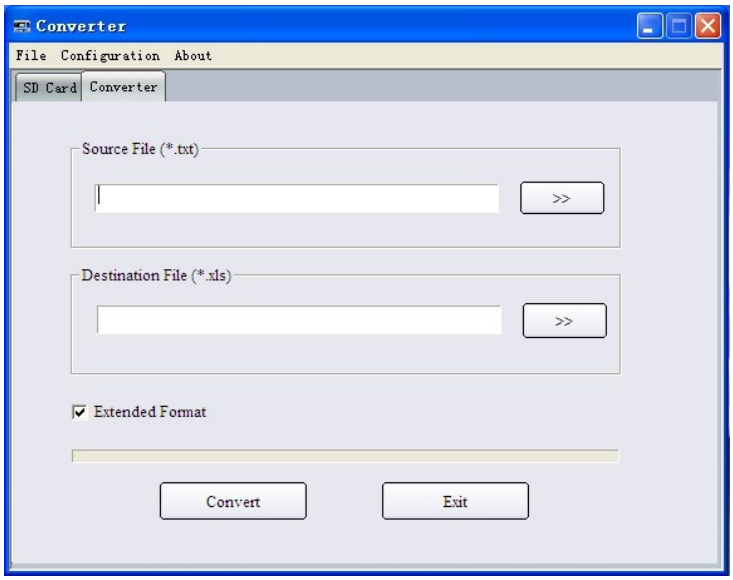
Do not remove the SD card from the reader while actively collecting data. Processing the data directly from the SD card file location on the PC could result in lost or corrupt data if the SD card is removed while data is still being processed.

4.7.3 Reading the TF Data Offline

Remove the TF card from the flowmeter and insert into the TF card reader. Copy the data to the PC. Use "Converter.exe" software to convert the format when needed.

1. File converter (Click the "Offline" button and enter the Document Conversion Interface).

Press "Converter" button, convert the T card data format from ".TXT "to ".XLS", the interface is as follows:

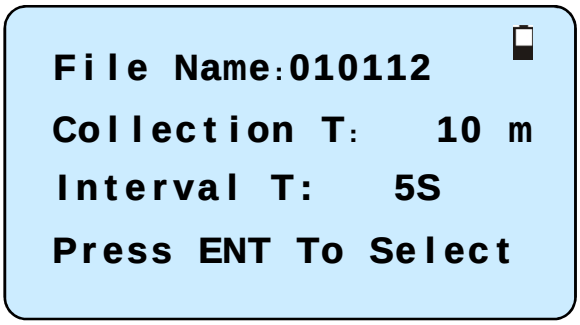


Select the file to be converted in "Source File (*.txt), enter the directory path and the file name in "Destination File (*.xls), then press "Convert". If "OK!" is displayed, the conversion is completed.

4.7.4 SD Card Storage Operation

1.Insert the SD card，then press 

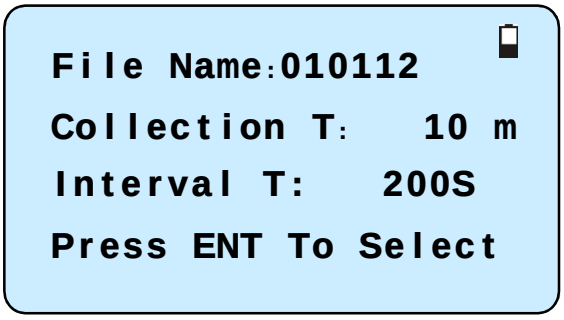
button to enter the SD card storage setting interface.



2.If you need to modify the filename, acquisition time or acquisition interval, enter the number to modify it directly, press 

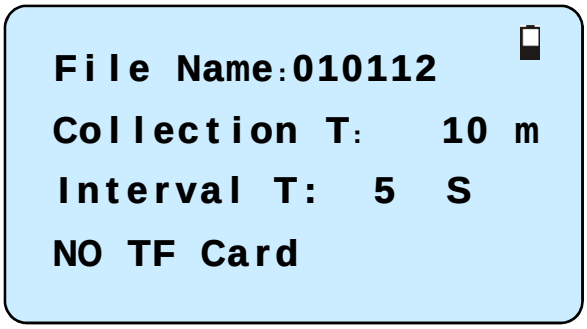
or 

button for line feed.



3.After modification or to use the default value, press 

to store the data. The above picture shows the normal operation interface. (If it does not work normally, will be shown as the picture below.)



4. If you do not want to save the data .Press 

into the end choose to stop or store data.

4.8 ESN

We provide the Flowmeter and Analyzer with a unique electronic serial number to identify each Flowmeter for the convenience of the manufacturer and customers. The ESN is able to be viewed in Window M61.

Attention

Please refer to "6.2 Windows Display Explanations" for more information.

5. Window Display Explanations

5.1 Window 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
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
24	Transducer Mounting
25	Transducer Spacing
26	Parameter Setups
27	Cross-sectional Area
28	Holding with Poor Sig

29	Empty Pipe Setup
Flow Units Options	
30	Measurement Units In
31	Flow Rate Units
32	Totalizer Units
33	Totalizer Multiplier
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
47	System LOCK
49	Segment Factor
Input and output setup	
55	CL Mode Select
56	CL 4mA Output Value
57	CL 20mA Output Value
58	CL Checkup
59	CL Current Output

60	Date and Time
61	ESN
70	LCD Backlit Option
72	Working Timer
77	Beeper Setup
82	Date Totalizer
83	Automatic Correction
Diagnoses	
90	Signal Strength and Quality
91	TOM/TOS*100
92	Fluid Sound Velocity
93	Total Time and Delta
94	Reynolds Number and Factor
97	Spacing Correction
Appendix	
+0	Power ON/OFF time
+1	Total Working Hours
+2	Last Power Off Time
+3	Last Flow Rate
+4	ON/OFF Times
-0	Hardware Parameter Modification

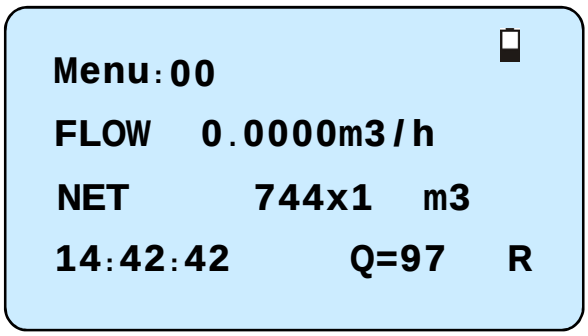
NOTE：The factory maintains the final explanation for other menu features.

5.2 Display Explanation

Flow Rate / Net Totalizer

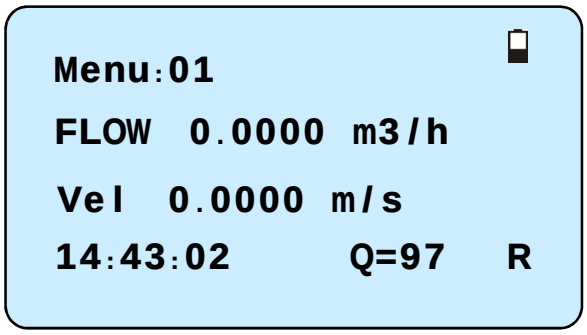
Display flow rate and net Totalizer.

If the net Totalizer has been turned off (refer to M34), the net Totalizer value displayed is the total that existed prior to turning it off.



Flow Rate / Velocity

Display flow rate and velocity.

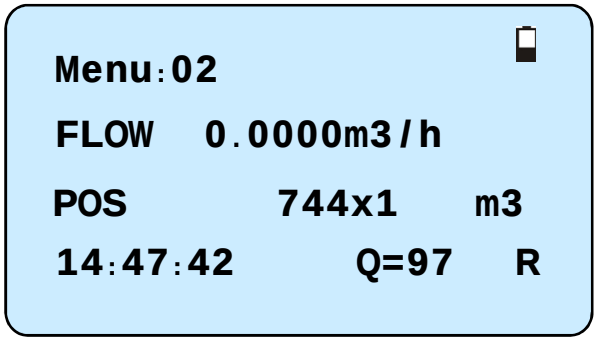


Flow Rate / Positive Totalizer

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 the total that existed prior to turning it off.

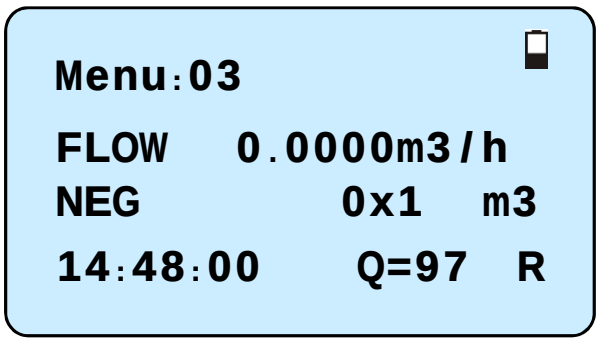


Flow Rate / Negative Totalizer

Display flow rate and negative Totalizer.

Select the negative Totalizer value in Window M32.

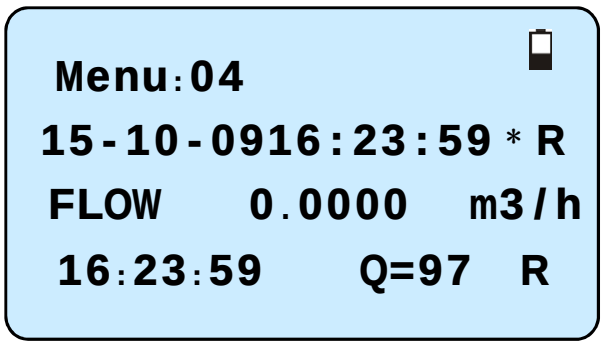
If the negative Totalizer has been turned off (refer to M36), the value displayed is total the total that existed prior to turning it off.



Date Time / Flow Rate

Display the current date time and flow rate.

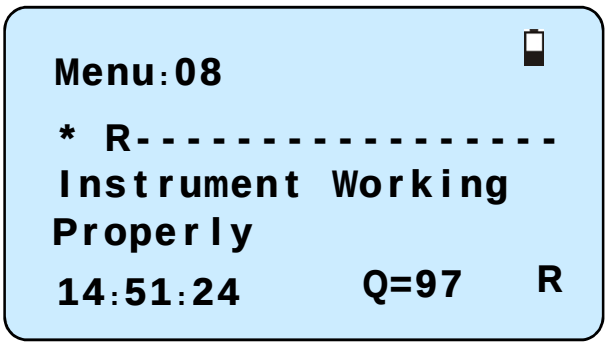
The time setting method is found in window M60.



System Error Codes

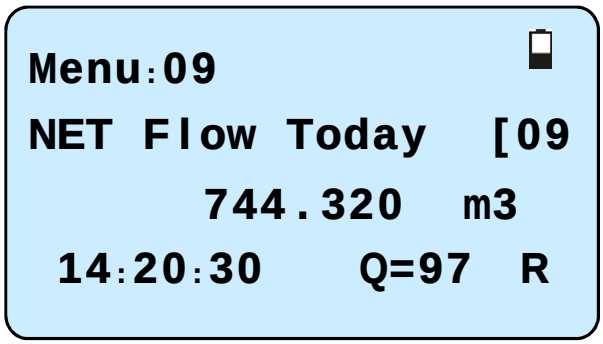
Display the operating condition and the system error codes. More than one error code can occur at the same time.

The explanations of error codes and detailed resolution methods can be found in “Error Diagnosis”.



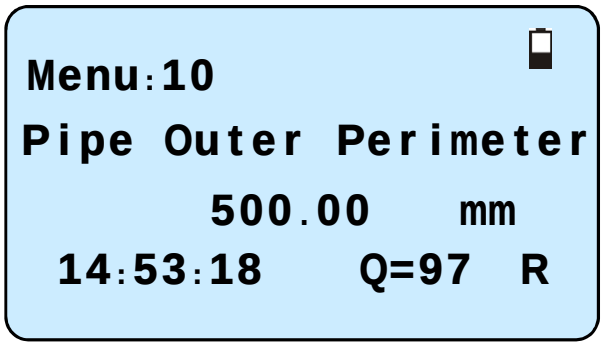
Net Flow Today

Display net total flow today.



Pipe Outer Perimeter

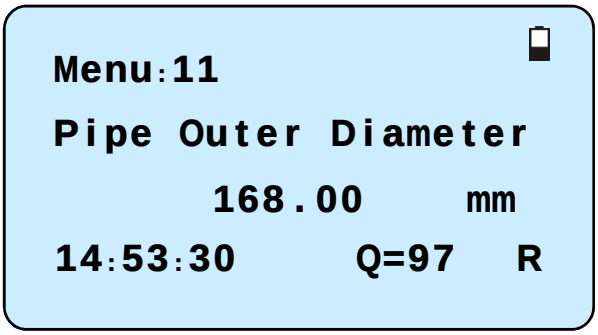
Enter the pipe outer perimeter (circumference). If the diameter is known know, enter it in window M11.



Pipe Outside Diameter

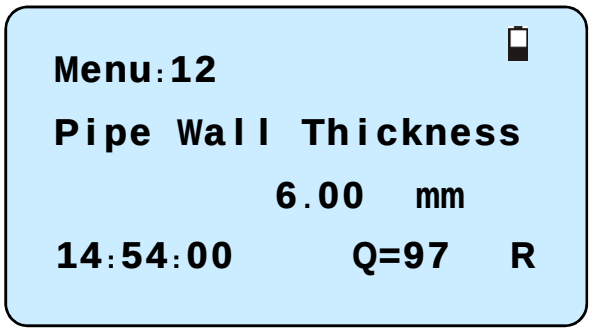
Enter the pipe outside diameter; the pipe outside diameter must range from 10mm to 600mm.

Note: Enter either the pipe outside diameter or pipe outer perimeter.



Pipe Wall Thickness

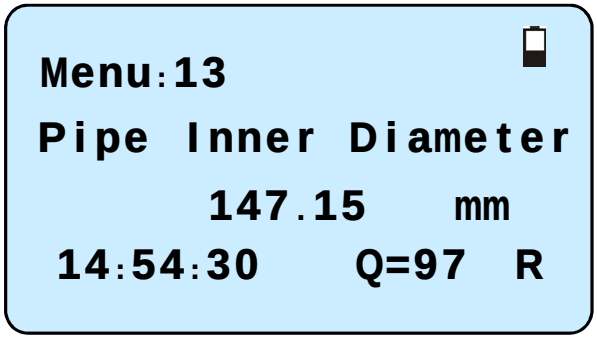
Enter the pipe wall thickness. If the pipe inside diameter is already known, skip this window and enter it in window M13.



Pipe Inner Diameter

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

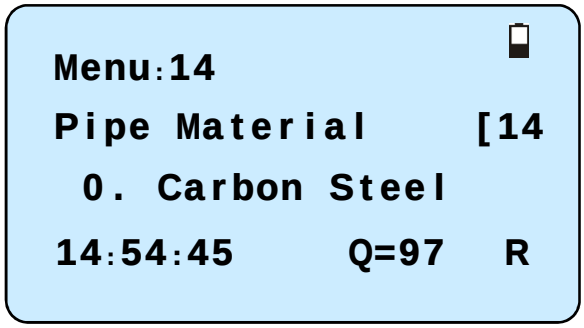
Note: Enter either pipe wall thickness or pipe inside diameter.



Pipe Material

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

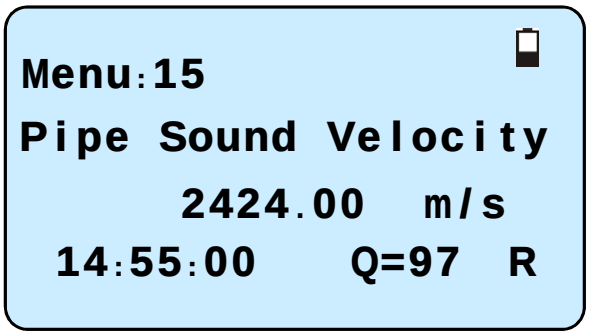


6. Aluminum
7. Asbestos
8. Fiber Glass-Epoxy
9. Other

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. If sound velocity is not known, there are other ways to determine it onsite.

Pipe Sound Velocity

Enter pipe sound velocity. This function is only used when item 9 “Other” is selected in Window M14. At the same time, this window cannot be visited. It will be calculated automatically according to the existing parameters.

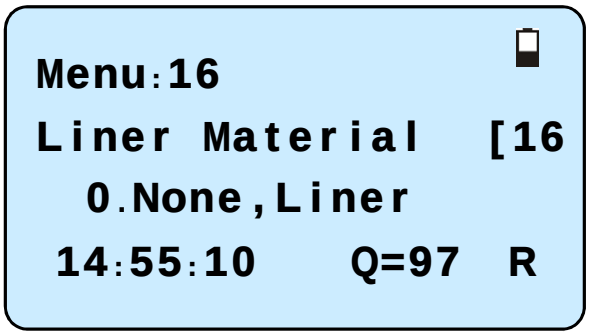


Select the Liner Material

The following options are available:

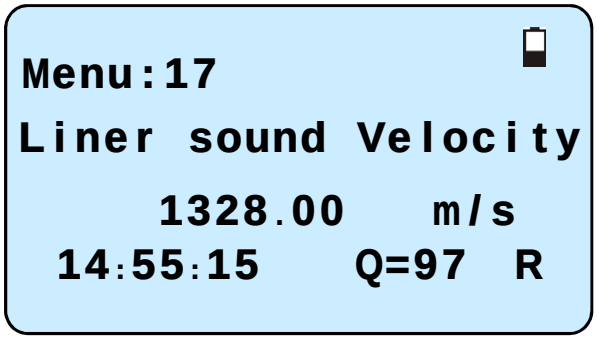
0. None, No Liner
1. Tar Epoxy
2. Rubber
3. Mortar
4. Polypropylene
5. Polystryol
6. Ploystyrene
7. Polyester
8. Polyethylene
9. Ebonite
10. Teflon
11. Other

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.



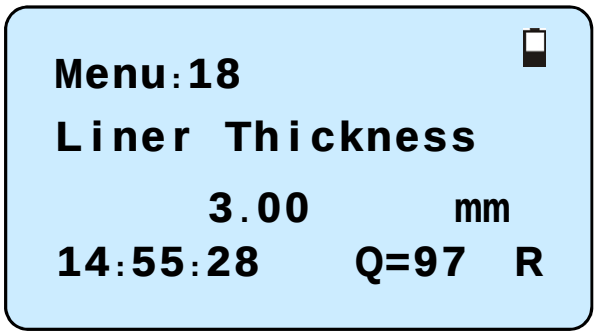
Liner Sound Velocity

Enter liner sound velocity. It only can be visited when item “ Other” in Window M16 is selected.



Liner Thickness

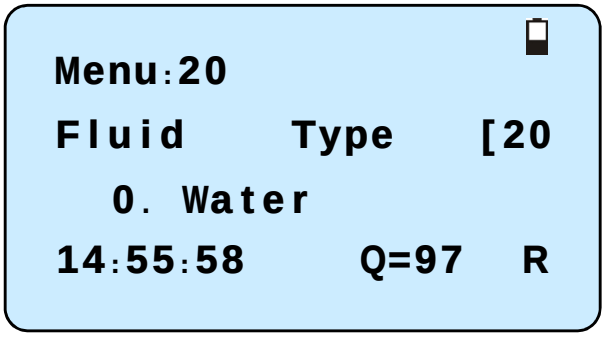
Enter liner thickness. It only can be visited when a definite liner is selected in Window M16.



Select Fluid Type

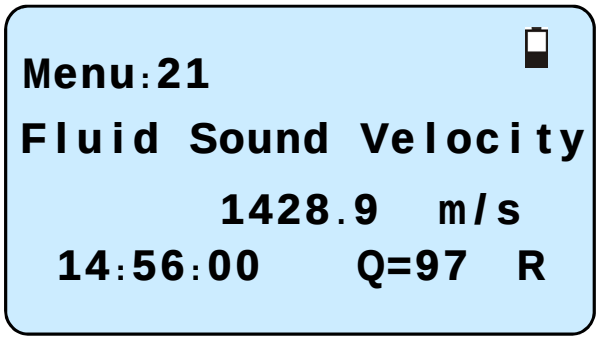
The following options are available:

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



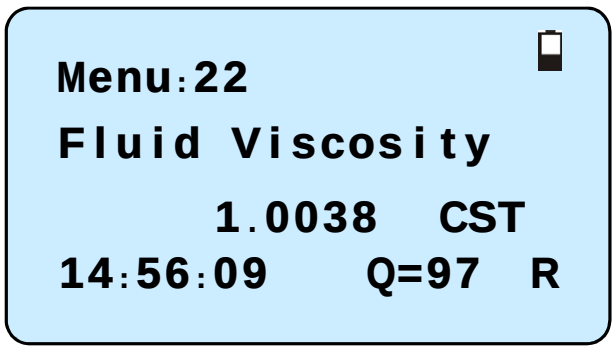
Fluid Sound Velocity

Enter the fluid sound velocity. It only can 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 Viscosity

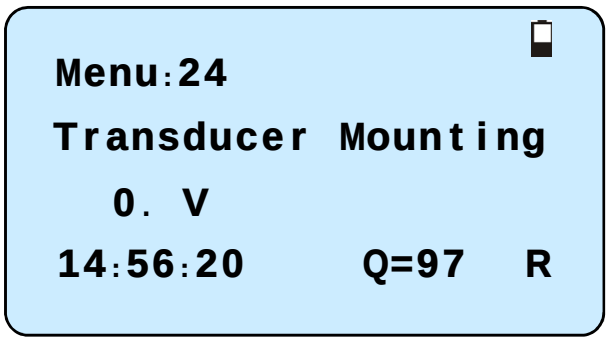
Enter fluid's kinematics viscosity. It only can be used when item "Other" is selected in Window M20, i.e. it is unnecessary to enter all the fluids that listed in Window M20.



Transducer Mounting

Four mounting methods are available:

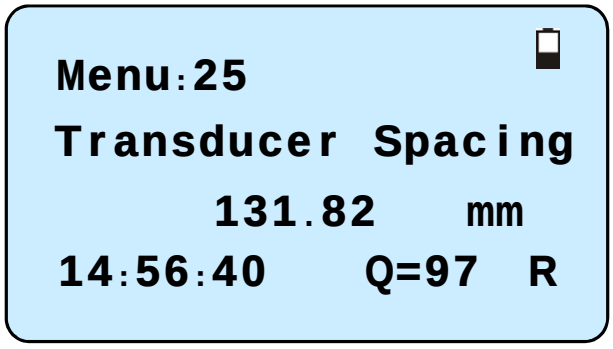
0. V (sound wave bounces 2 times)
1. Z (sound wave bounces once. The most commonly use method)
2. N (small pipe, sound wave bounces 3 times.)



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 has been entered.



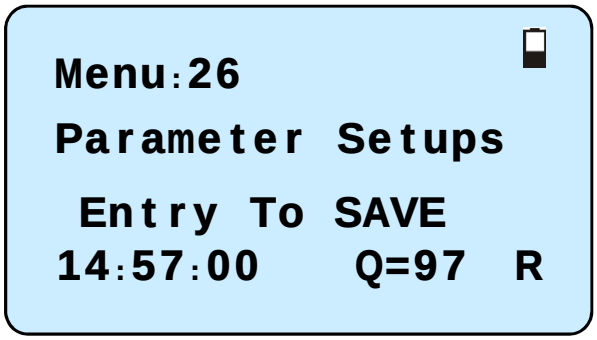
Initial Parameter Setups and Save

Load and save the parameters. 18 different sets of setup conditions/groups are available to load and save by three methods (i.e.-you can load and save 18 different applications):

0. Entry to Save
1. Entry to Load
2. To Browse

Select "Entry to Save", press 

. An ID code and the original parameters are displayed in the window. Press UP or DOWN ARROW to move the ID code,

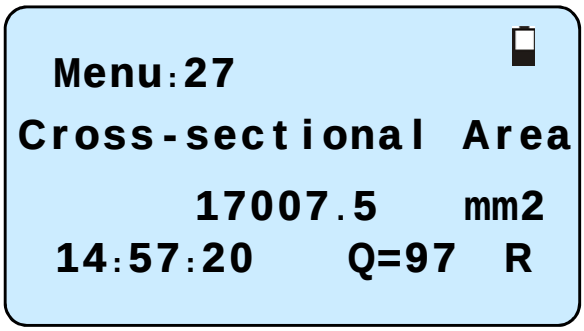


then press the Enter key again to save the current parameter in the current ID file.
When selecting “Entry to Load”, press ENT, and the system will read and calculate the parameters automatically and display the transducer mounting spacing in Window M25.

Menu PWT. 2 hold 7

Cross-Sectional Area

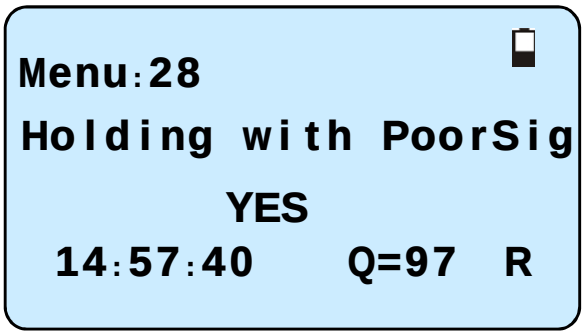
Display the cross-sectional area inside the pipe.



Menu PWT. 2 DYN. 8

Holding With Poor Sig

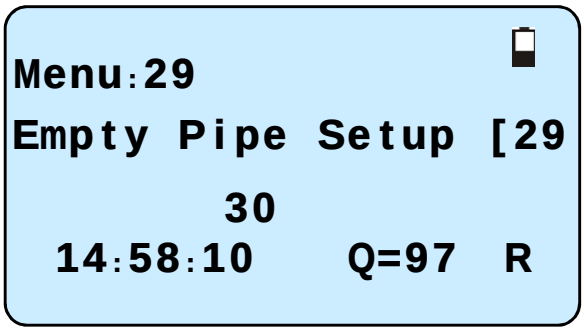
Select “Yes” to hold last good flow signal displayed if the flowmeter experiences a poor temporary signal condition. This function will allow continued data calculation without interruption.



Menu PWT. 2 sound speed 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.

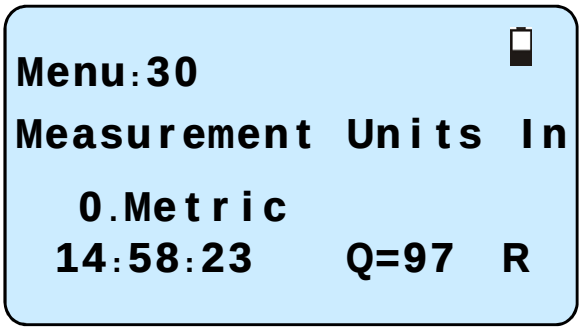


Measurement Units

Select the measurement unit as follows:

0. Metric
1. English

Factory default is metric.



Flow Rate Units Options

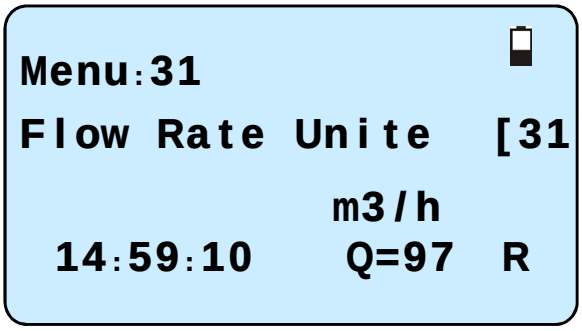
The following flow rate units are available:

0. Cubic Meters (m3)
1. Liters (L)
2. USA Gallons (GAL)
3. Imperial Gallons (Imp gal)
4. Million Gallons (mg)
5. Cubic Feet (cf)
6. USA Barrels (US bbl)
7. Imperial Barrels (Imp bbl)
8. Oil Barrels (Oil bbl)

The following time units are available:

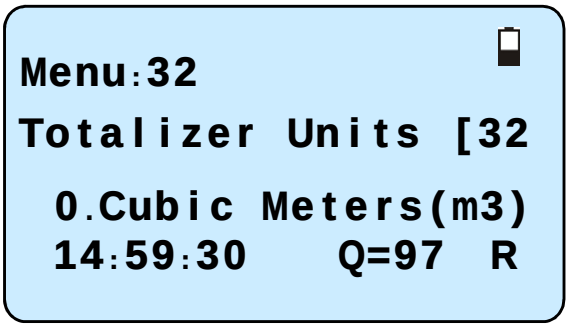
/Day /Hour /Min /Sec

Factory default is Cubic Meters/hour.



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.

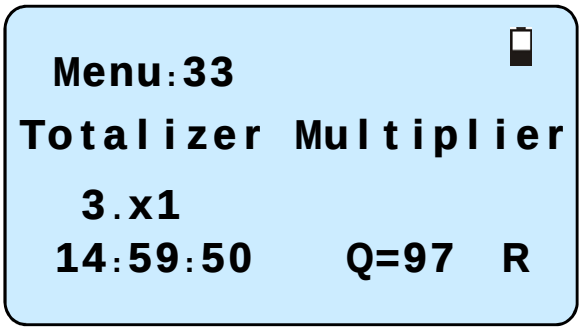


Totalizer Multiplier Options

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. x 0.001 (1E-3)
1. x 0.01
2. x 0.1
3. x 1
4. x 10
5. x 100
6. x 1000
7. x 10000(1E+4)

Factory default factor is x1



Menu PM. 3 V/Z 5

ON/OFF POS Totalizer

On/off positive totalizer. “ON” indicates the flowmeter starts to totalize. When it is turned off, the positive totalizer is displayed in Window M02. Factory default is “ON”.

```
Menu:35
POS Totalizer [35
        ON
15:01:00    Q=97  R
```

Menu PM. 3 start /stop 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”.

```
Menu:36
NEG Totalizer   [36
        ON
15:01:20    Q=97  R
```

Menu PM. 3 hold 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 time . zero < keys after the above-mentioned characters are displayed on the screen.

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

```
Menu:37
Totalizer Reset? [37
      Selection
15:01:40    Q=97  R
```

ATTENTION:

This operation will cancel all the data and revert back to factory default. Be careful with this operation.

Menu PM. 3 DYN. 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.

```
Menu:38
Manual Totalizer [38
Press ENT When Ready
 15:01:58    Q=97  R
```

Menu fluid type 4 CAL. 0

Damping

The damping factor ranges from 0～999 seconds. 0 indicates no damping; 999 indicate the maximum damping. The damping function will stabilize the flow display. Usually a damping factor of 3 to 10 is recommend in most applications.

```
Menu:40
Damping
    10          sec
15:02:10    Q=97  R
```

Menu fluid type 4 OD. 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 pump 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.

```
Menu:41
Low Flow Cutoff Val
       0.030  m/s
 15:02:20    Q=97  R
```

Menu fluid type 4 PWT. 2

Set Zero

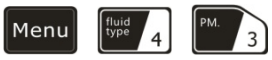
When fluid is in the static state (no movement), the displayed value is called “Zero Point”. When “Zero Point’ is not at true zero in the flowmeter, the difference is going to be added into the actual flow values and measurement differences will occur in the flowmeter.

Set zero 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 location and parameters can be eliminated. The measuring accuracy at low flow is enhanced by doing this function and flow offset is eliminated.

```
Menu:42
Set zero
Press ENT To Go
15:02:30    Q=97  R
```

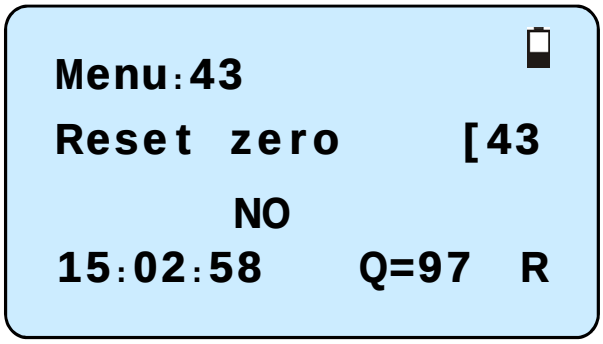
Press ENT , wait for the processing instructions at the bottom right corner of the display to reach 0.

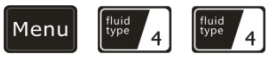
Performing Set zero with existing flow may cause the flow to be displayed as “0”. If so, it can be recovered via Window M43.



Reset Zero

Select “YES”; reset “Zero Point” which was set by the user.





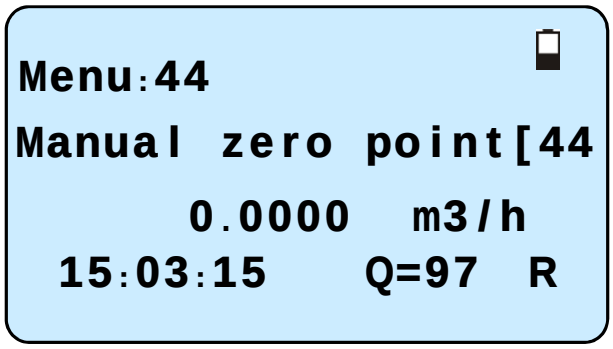
Manual Zero Point

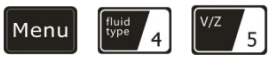
This method is not commonly used. It is only suitable for experienced operators to set zero under conditions when it is not preferable to use other methods.

Enter the value manually to add to the measured value to obtain the actual value. For example:

Actual measured value	＝250 m3/H
Value Deviation	＝10 m3/H
Flowmeter Display	＝240 m3/H

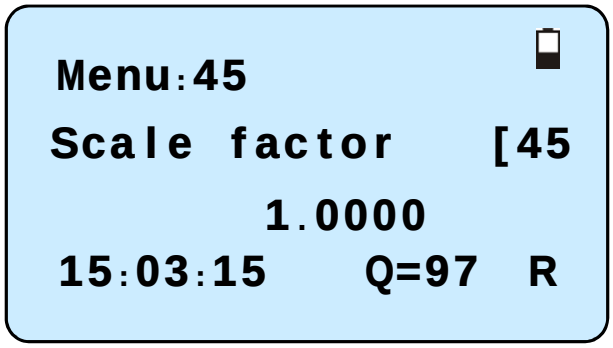
Normally, set the value as “0”.





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.



Menu fluid type 4 hold 7

System Lock

Lock the instrument. Once the system is locked, any modification to the system is prohibited, but the parameter is readable. Entering your designated password correctly can be the only way to "Unlock" the instrument. The password is composed of 6 numbers. (Please contact the representative or manufacturer as soon as possible when the password is lost.) Press “Unlock” to set the “new password”, press Enter to permanently save the password.

Warm reminder: Please keep the new password in mind, and the factory code is 115800.

```
Menu:47
System LOCK        [47
*******UNLOCK*********
14:20:30     Q=97   R
```

Menu fluid type 4 sound speed 9

Segment Factor

16 groups correction coefficient can be set for the sectional correction measurement results. The user can input the actual scale factor according to the calibration results. After the completion of input, move the cursor to 16 .And press Enter to save the revised value.

```
Menu:49
Segment Factor     [49
        Entry
14:20:30     Q=97   R
```

Menu V/Z 5 V/Z 5

Current Loop Mode Select

0.4-20mA output mode

1.4-20mA Corresponding Velocity

```
Menu:55
CL mode Select     [55
  0.4-20mA
15:03:30     Q=97   R
```

Menu V/Z 5 start /stop 6

CL 4mA Output Value

Set the CL output value according to the flow value at 4mA. The flow unit’s options are as same as those in Window M31. Once “velocity 4-20mA”is selected in Window M55, the unit should be set as m/s if it is the velocity unit selected

```
Menu:56
CL 4 mA Output Value
      0.0000   m3/h
15:03:30     Q=97   R
```

Menu V/Z 5 hold 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. Once “velocity 4-20mA”is selected in Window M55, the unit should be set as m/s, if m/s is the velocity selection.

```
Menu:57
CL 20mA Output Value
   14400.00   m3/h
15:03:50    Q=97  R
```

Menu V/Z 5 DYN. 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 it is over the permitted tolerance. For more information, refer to “Analog Output Calibration”.

```
Menu:58
CL Checkup        [58
Press ENT When Ready
15:04:20    Q=97  R
```

Menu V/Z 5 sound speed 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.

```
Menu:59
CL Current Output[59
      4.0000
15:04:40    Q=97  R
```

Menu start /stop 6 CAL. 0

Date and Time Settings

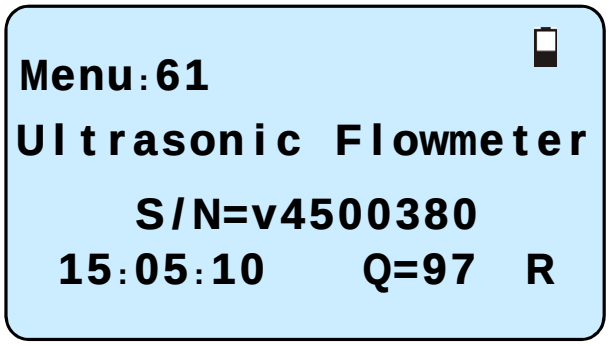
Generally, it is unnecessary to modify date time as the system is provided with a highly reliable perpetual calendar chip.

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

```
Menu:60
YY-MM-DD   HH-MM-SS
13-01-01 16:34:51
15:05:00    Q=97  R
```

ESN

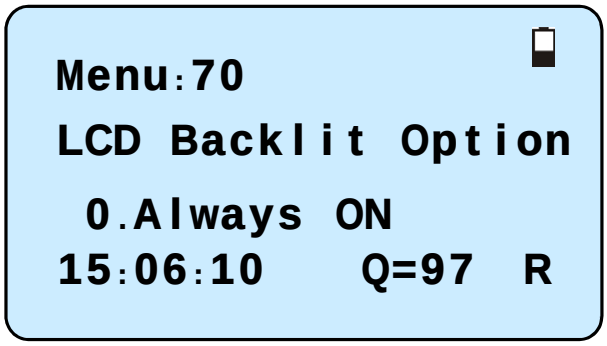
Display electronic serial number (ESN) of the instrument. This ESN is the only one assigned to each flowmeter ready to leave the factory. The factory uses it for file setup and for management by the user.



Display Backlight Control

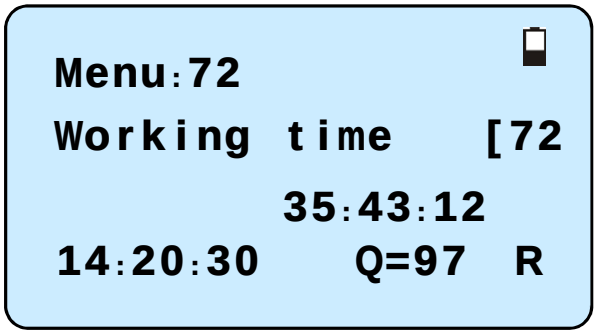
"1. Always On";

"0. Always off".



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".

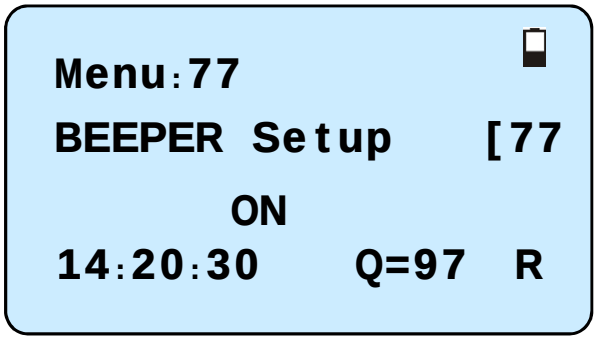


Beeper Setup

Set the beeper's on-off status.

"ON" the beeper function open.

"Off:"the beeper function shut down.



Menu DYN. 8 PWT. 2

Date Totalizer

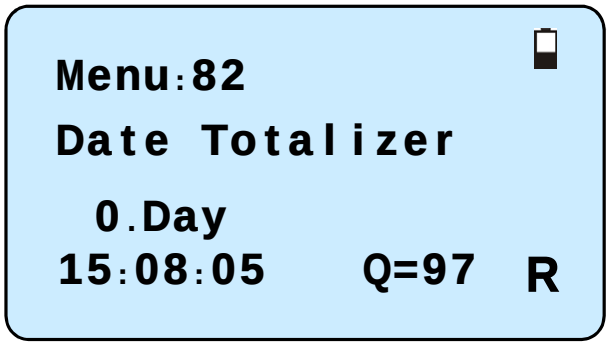
The following options are available:

0. Day
1. Month
2. Year

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 file numbers;

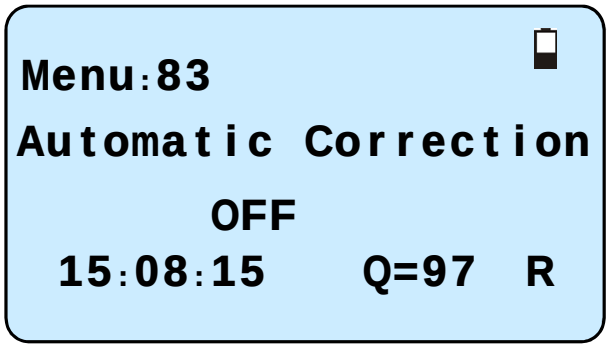
For example, to display the flow total for July 18, 2000, the display "----------" at the upper right corner of the screen indicates that it was working properly the whole day. On the contrary, if "G" is displayed, it indicates that the instrument gain was adjusted at least. Probably it was offline once 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.



Menu DYN. 8 PM. 3

Automatic Flow Correction

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

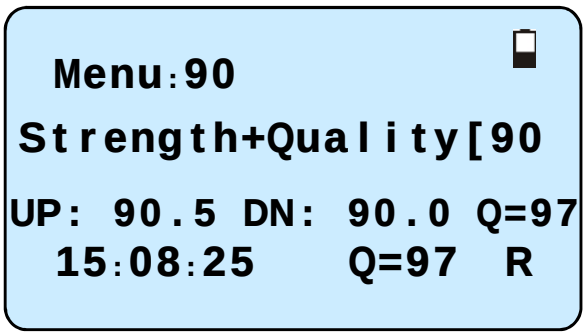


Menu sound speed 9 CAL. 0

Signal Strength and Signal Quality

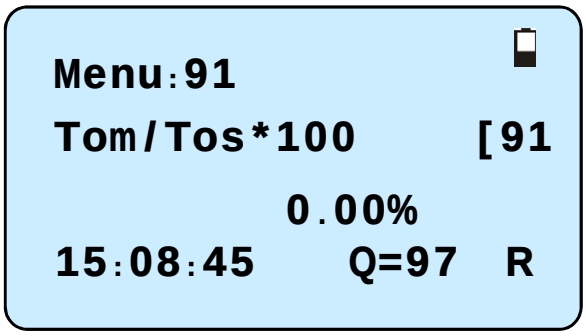
Display the measured signal strength and signal quality Q value upstream and downstream.

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



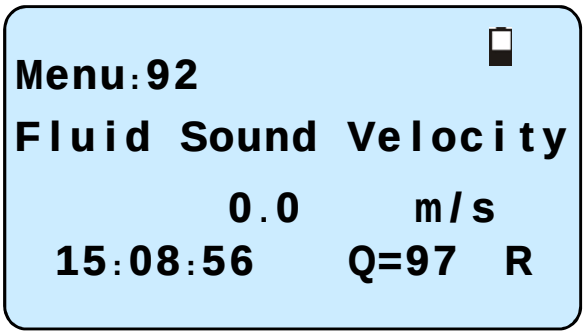
TOM/TOS*100

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.



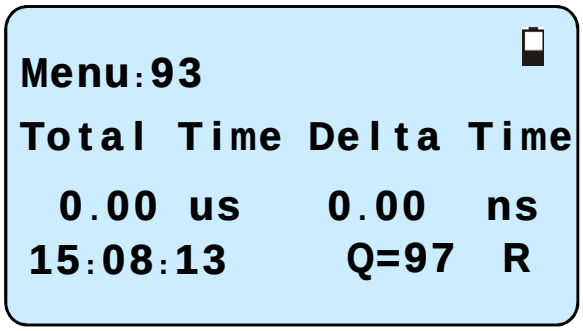
Fluid Sound Velocity

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 entered in Window M21 or improper installation of the transducers.



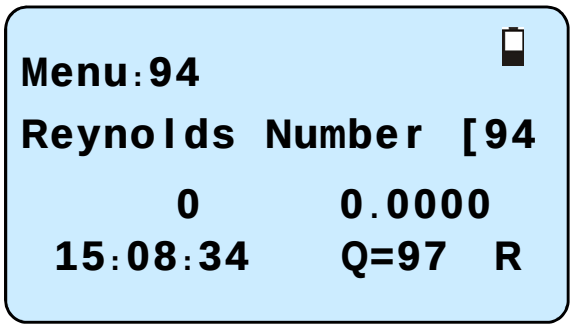
Total Time and Delta Time

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.



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.

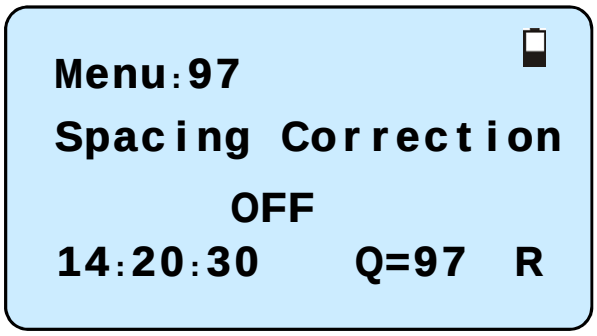


Spacing Correction

The following options are available:

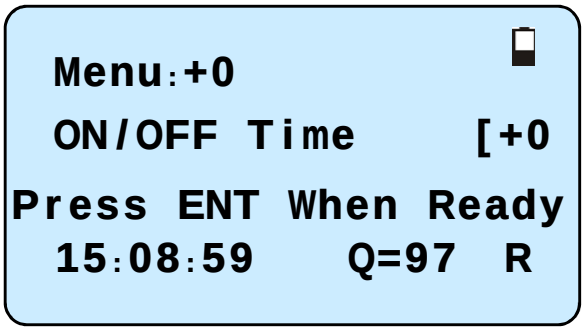
0.OFF Shut down spacing correction.

1.ON Open spacing correction.



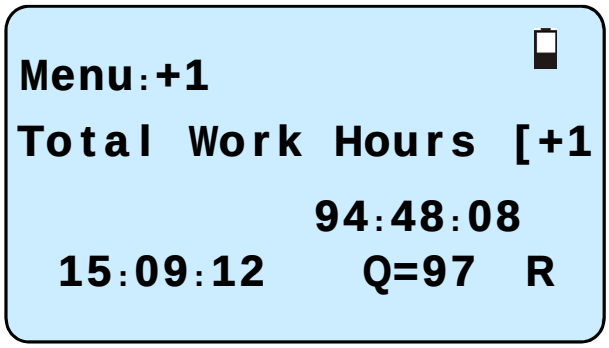
Power ON/OFF Time

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.



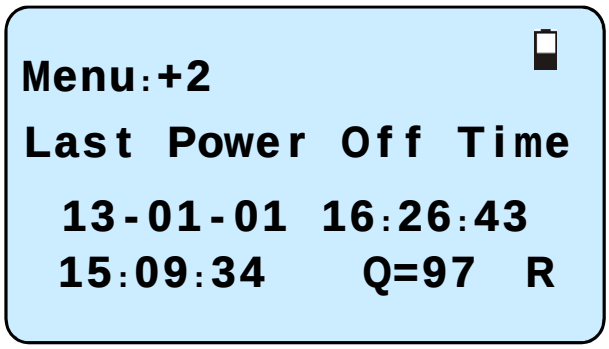
Total Working Hours

With this function, it is possible to view the total working hours since the flowmeter left the factory.



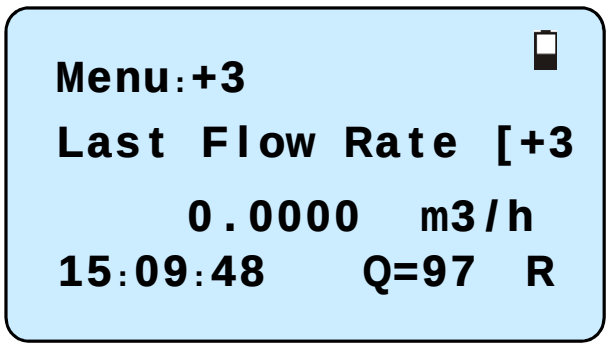
Last Power Off Time

Display the last power off time.



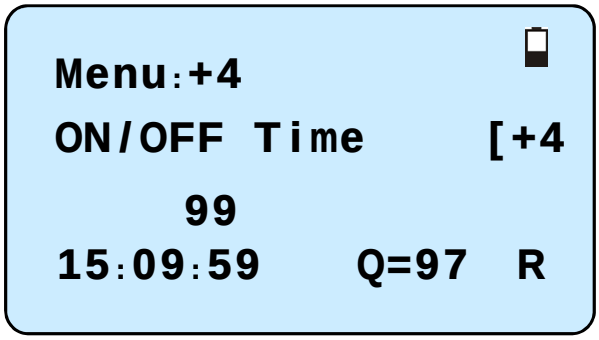
Last Flow Rate

Display the last flow rate.



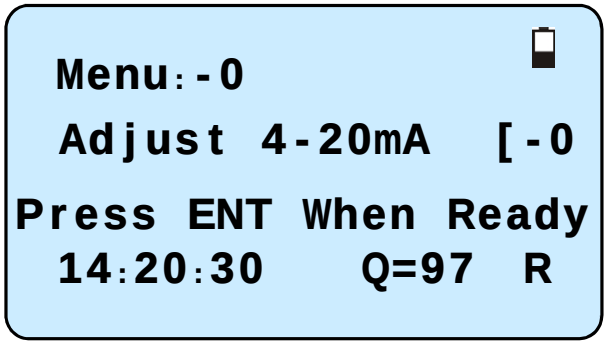
Total ON/OFF Times

Display total on/off times since the flowmeter left the factory.



Adjust 40-20mA

See section 4.6 for detailed "4-20mA analog output calibration ".



6. 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.

Flow meter shows the error code can be made of M08 window shows a more detailed questions about the reception and improper setup.

Problems and countermeasures are given in the table below：

6.1 Table 1. Self-diagnosis and Error Solutions

Code	M08 Display	Cause	Solution
*R	System Normal	* System normal	* No errors
*I	Signal Not Detected	* Signal not detected * Spacing is not correct between the transducers or not enough coupling compound applied to face of transducers. *Transducers installed improperly. * Scale is too thick. * New pipe liner.	*Attach transducer to the pipe and tighten it securely. Apply a plenty of coupling compound on transducer and pipe wall. * Remove any rust, scale, or loose paint from the pipe surface. Clean it with a file. * Check the initial parameter settings. * 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. * Wait until liners solidified and saturated.
*G	Adjusting Gain	* Adjusting gain for normal measurement.	

6.2 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 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

7. Product Overview

7.1 Introduction

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

7.2 Features

Comparing With other traditional flowmeter or ultrasonic flowmeter, it has distinctive features such as high precision, high reliability, high capability and low cost, the Flowmeter features other advantages:

1. With ARM COMA chip, low power consumption, high reliability, anti-jamming and outstanding benefits.

2. User-friendly menu designed. Parameters of pipe range, pipe material, pipe wall thickness, output signals, etc can be conveniently entered via the windows. British and Metric measurement units are available.

3. 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.

4. With the SD Card, 512 files can be stored; the time interval can be within 5 seconds.

5. Parallel operation of positive, negative and net flow totalizes with scale factor and 7 digit display.

The flow meter ensures the higher resolution and wider measuring range by the 0.04nS high resolution, high linearity and high stability time measuring circuit and 32 bits digits processing program.

7.3 Theory of Operation

This Ultrasonic Flowmeter and Analyzer adopts the time-difference measurement principle. The ultrasonic waves emitted by the sensor in a fluid, the flowing in the propagation direction of acoustic wave propagation velocity downstream increases, decreases the upstream direction, have different propagation distance in the same transmission time, measure the flow rate according to the difference of the transmission time and the fluid flow velocity.

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

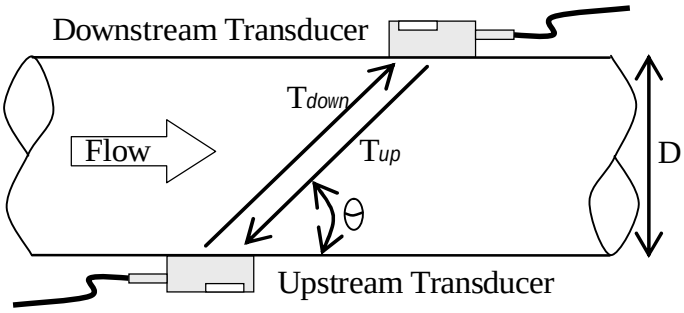
D Pipe Diameter

θ The angle between the ultrasonic signal and the flow

Tup Transit time in the forward direction

Tdown Transit time in the reverse direction

ΔT=Tup –Tdown



7.4 Applications

Water, sewage (with low particle content) and seawater; Acid alkali liquor, edible oil, diesel oil, crude oil, alcohol, beer, etc.

Water plant and sewage treatment plants;

Plant irrigation；

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

Petroleum and chemicals;

Food and medicine;

Energy-saving monitoring, water-saving management and flow inspection flow tracking and collection, computerized management and monitoring network system.

7.5 Specifications

Performance	
Flow range	±(0.03 ~ 40) ft/s ±(0.01 ~ 12) m/s
Accuracy	±1% of measured value
Repeatability	0.3%
Linearity	±1%
Pipe Size	1" ~ 48" (25m ~ 1200mm)
Functional	
Output	Analog output: 4～20mA，Max 750Ω
SD card	Storage: 1GB (To prevail in kind) Max：512 files Interval：5～60 seconds
Power Supply	11.1V rechargeable Lithum Battery Power (continuous operation of main battery 16 hours)
Keypad	Tactile Keys
Display	64×128 alphanumeric，backlit LCD
Temperature	Transmitter: -10℃～50℃ Measuring medium: - 40℃～80℃（Standard）
Humidity	0~99%RH, non-condensing
Physical	
Transmitter	NEMA13 (IP54)
Transducer	Encapsulated design, IP68 Standard cable length: 5m
Weight	Transmitter: 1kg

8. Appendix1 - Flow Application Data

8.1 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
water 100℃	1543	0.29
water 125℃	1511	0.25
water 150℃	1466	0.21
water 175℃	1401	0.18
water 200℃	1333	0.15
water 225℃	1249	0.14
water 250℃	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	

8.2 Sound Velocity for Various Materials Commonly Use

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
Liner Material	Sound Velocity (m/s)
PTFE	1225
Titanium	3150
Cement	4190

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

8.3 Sound Velocity In Water (1 atm) At Different Temperatures

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

Please contact the manufacturer for the sound velocity of other fluids and materials.