# ULTRASONIC ENERGY METER UDM101
# INSTRUCTION MANUAL

# Notice:

This instruction manual is appropriate for UDM101 series ultrasonic Energy Meter.

This ultrasonic Energy Meter adopts ARM.FPGA chip and low-voltage wide-pulse sending technology.

This instruction manual contains important information. Please read carefully before the operation of the Energy Meter,avoiding damaging Energy Meter and improper use.

This instruction manual will introduce how to use the Energy Meter step-by-step, including product component, installation, wiring, quick setup etc. to make it easier to operate.

Understanding more about the menu settings can fulfill your higher requirements with the Energy Meters' powerful function option and output function.

Warning

May cause injury.

Attention

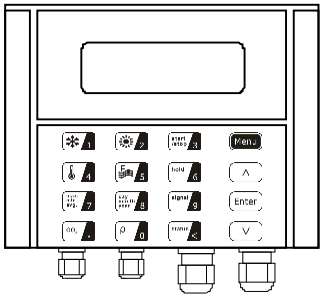
May damage the Energy Meter.

Some of the instructions may be different to the Energy Meters you purchased, depending on configuration requirements, otherwise, there is no indication about the product design and upgrade requirement in the instructions, please refer to the version number, as well as the appendix.

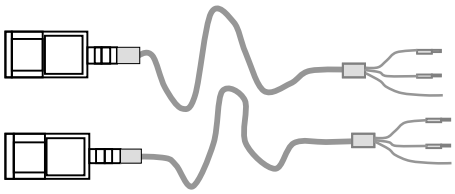
# Product Components

Inspection should be made before installing the Energy Meter. 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.

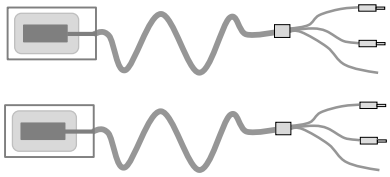
## Transmitter



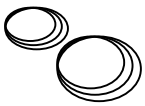

## Transducers



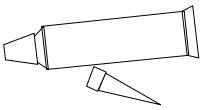
## Temperature Sensor



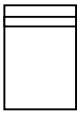
## Accessories



Pipe Straps

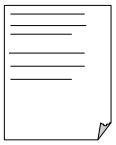


Coupling compound



Install accessory

## Documents



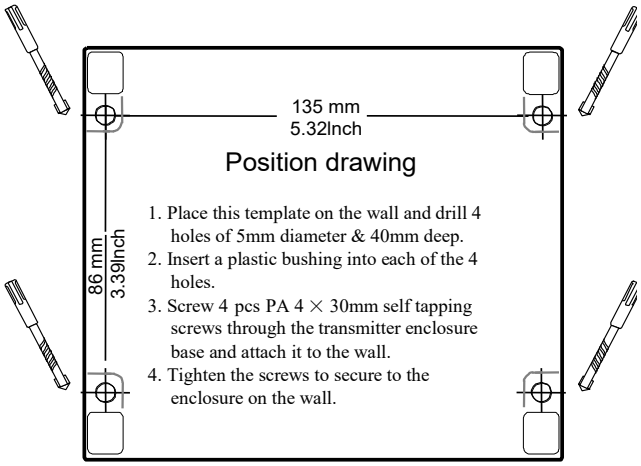
1. Instruction Manual
2. Packing List
3. Position drawing

# Content

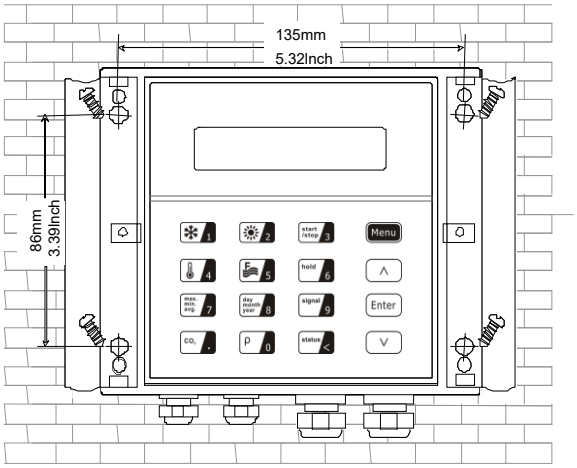
# 1 Transmitter Installation and Connection

## 1.1 Prior to Transmitter Installation

You will find a "Position Drawing" in the packing. Please use it as a template in the place that you are going to install the Energy Meter. Then drill 4 installing holes at the screws position shown on the drawing with the 5.0mm drill.




Take out the enclosed screws and plastic bushings. Insert the plastic bushings into the installing holes. Put the Energy Meter to the position and screw it in.




Attention

When installing please ensure the front cover is secure and will not fall open.

## 1.2 Wire Connecting

### 1.2.1 Power supply option

Customers should pay special attention to specify the desired power supply when wiring.

Factory standard power supply is 10~36VDC/1A max.

To ensure the transmitter can work normally, please pay attention to the followings when wiring:

Ensure that power connections are made in accordance with the specifications shown on the transmitter.

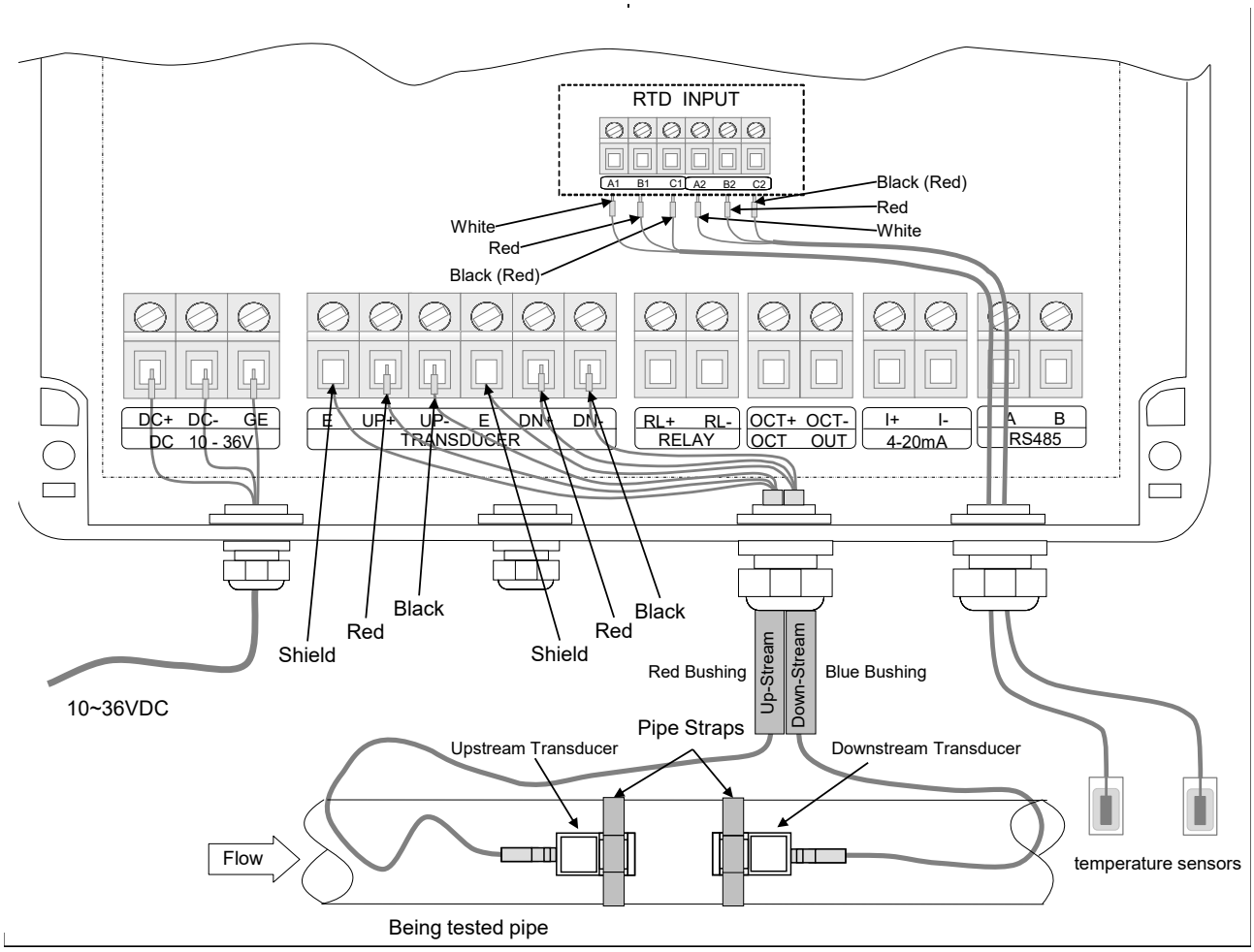
### 1.2.2 Transmitter Wiring

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

Open the case, you will find the transmitter interfaces labels, from up to down, from left to right as follows:

Connect to the RTD module, Power supply, Upstream transducer, Downstream transducer, Relay output, OCT Output, 4-20mA, RS485 interface.

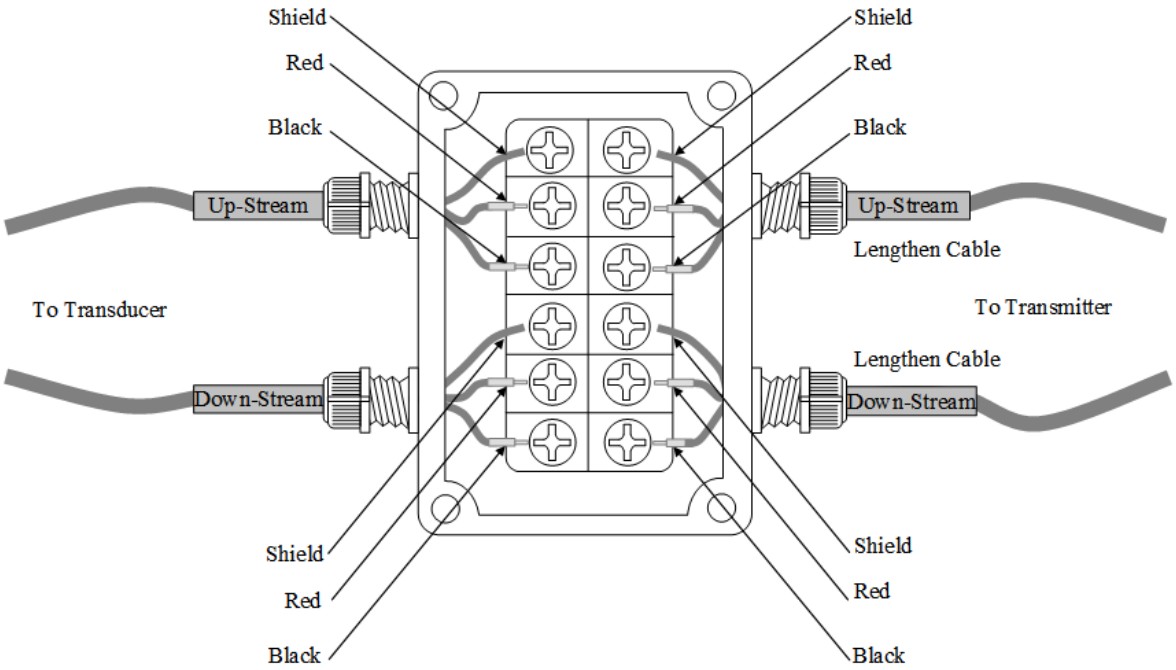
Refer to the below diagram for specific connection:




### 1.2.3 Lengthened Cable Method

Standard cable length of sensor is 9 meters; it can be lengthened to be 300 meters according to the actual need for fluid measurement.

### 1.2.3.1 Sketch of lengthened Cable




### 1.2.3.2 Junction Box Requirements

The Energy Meter use sealed waterproof junction box, installing 6×2 press-connections, the recommended minimum specifications of the junction box is 115×90×55mm.

### 1.2.3.3 Cable Specifications

Name: Shielded Twisted Pair

Administer Standard: JB8734.5

Diameter: Φ5 mm

Twist Line Space: 50 mm

Multi Core Line: 0.4 $mm^2$/radix

Wire Guage: AWG 20#

Core Line Color: Red and Black

Shield Floor: 128 Intwine

Warning

Wire with power off. The energy meter must be reliable grounding before installation.

## 1.3 Powering on

As soon as the Energy Meter 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 self-diagnosis, 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. Generally, after the upper right corner of the display shows two steps of *I and *G, the system will activate the normal measurement condition automatically. And the upper right corner will show "*R". If the signal is not ideal, the above process may cycle several times.

If it is the first time to use or install on a new site, the customer need to input the new installation site parameters. The system will default to the last window settings and automatically display them at next power on.

## 1.4 Keypad Functions

This keypad is dual function keypad:

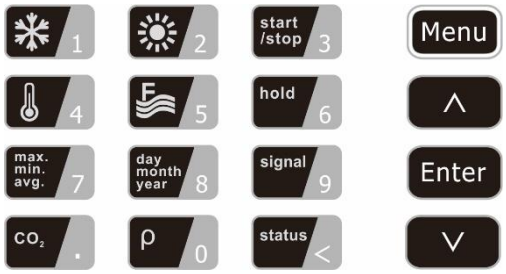
1. When separately pressed, is shortcut function, referring to "2. Quickly set menu instructions ";
2. Press [Menu] and Number key, is Menu key, referring to"7.Menu Window Description".
3. Follow these guidelines when using the Energy Meter keypad (Refer to Keypad Figure):

[0] ~ [9] And [•] To input numbers.

[<] Backspace or delete characters to the left.

[^] And [v] 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, input two menu numbers and then enter 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.




## 1.5 Keypad Operation

The energy meter adopts the window software design to consolidate or subdivide all of the parameters entered, the instrument setup and measurement result displays 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 [v] keys to scroll the screen. For example, if the current window ID code is M02, press [^] key to enter Window M01, press the [^] button again to enter Window M00; then, press the [v] key to back Window M01, and press the [v] key again to enter Window M02.

Windows are separated into three types: (1) Data Type, such as M11, M12; (2) Option Type, such as M14; (3) Pure Display Type, such as M01, M00.

You can check the corresponding parameters by visiting the Data Type Windows. If you want to modify the parameters, after press [Enter], and the digits, and then press [Enter] again to confirm.

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. Then input the value parameters [2] [1] [9] [•] [2] [3] [4] [5] [Enter].

You can check the selected option by visiting Option Type Windows. If you want to modify it, you must press [Enter] first, the symbol ">" and the flashing cursor are displayed at the left of the Screen. Operator can use the [^] and [v] to scroll the screen and get the required value then press [Enter] to confirm.


For example, if the pipe material is "Stainless Steel", Press [Menu] [1] [4] to enter Window M14, press [Enter] to modify the options. Select the "1. Stainless Steel" option by pressing [^] and [v], then press [Enter] to confirm the selection.

Attention

Generally, press [Enter] key first if operator wants to enter "modify" status. 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.

## 1.6 Energy Meter Window Descriptions

These windows are assigned as follows:

| | |
|---|---|
| 01~08 | The window is the display window. It can display instantaneous flow, positive cumulative flow, negative cumulative flow, instantaneous flow rate, date and time, instantaneous heating (cooling) cumulative energy, cumulative heating (cooling) energy, inlet and outlet water temperature, temperature difference, and daily flow. |
| 10~29 | Initial Parameter Setup: to enter pipe outside diameter, pipe wall thickness, fluid type, transducer type, transducer mounting method and spacing, etc. |
| 30~38 | Flow Units Options: to select the flow unit such as cubic meter, liter or other units, can turn totalizers on/off and reset totalizers, etc. |
| 40~49 | Setup options: Scaling factor, system lock (Window M47), etc. |
| 55~89 | Input and output setup: date and time, ESN, communication baud rate setting, etc. |
| 90~98 | 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), etc. |
| +0~+5 | Appendix: power on/off time, total working hours, on/off times and a single-accuracy function calculator. |

Attention

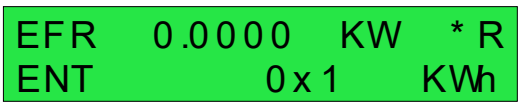
The other windows for hardware adjustment are reserved by the manufacturer.

# 2 Pipe Parameter Entry Shortcuts

## 2.1 Dual function keys menu description

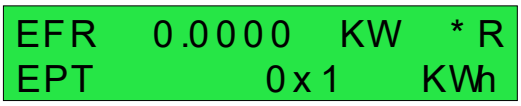
Press 1 is equivalent to the function of Menu 0 6

Display instantaneous cooling energy/cumulative cooling energy




Press 2 is equivalent to the function of Menu 0 5

Display instantaneous heating energy/cumulative heating energy



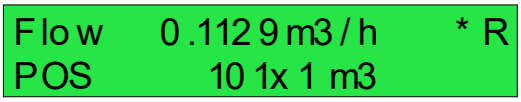

Press start /stop 3, show energy cumulative energy's on/off in order


Pressing 4 is equivalent to the function of Menu 0 7

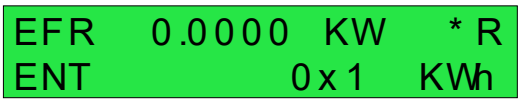
Display water inlet temperature, outlet water temperature and temperature difference


Pressing 5 is equivalent to the function of Menu 0 2

Display instantaneous flow and positive totalizer

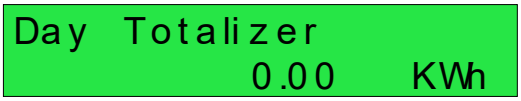



Press hold 6 and display or keep instantaneous heating(cooling) energy and cumulative heating(cooling) energy in order



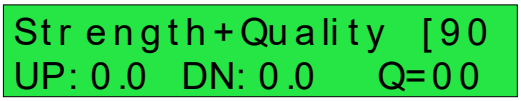

Press max. min. avg. 7 and display the max/min/average value of instantaneous in order


Press day month year 8 and display cumulative energy of The DAY/MONTH/YEAR in order

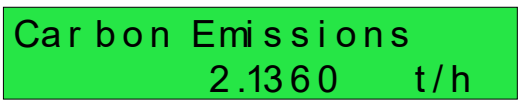



Pressing signal 9 is equivalent to the function of Menu 9 0

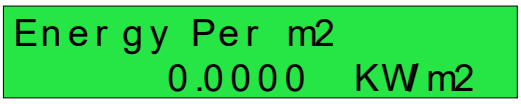
Display signal strength and signal quality



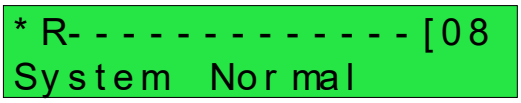

Press $CO_2$ . and display carbon emission




Press ρ 0 and display energy consumption per square



Pressing status is equivalent to the function of Menu 0 8



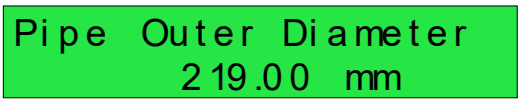

Display system error code

## 2.2 Examples

For example, measuring the diameter of 219mm and pipe wall thickness of 6mm, measuring medium is water, Pipe 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 to confirm.

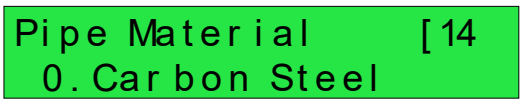



Step2. Pipe wall thickness

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


Step3. Pipe Material

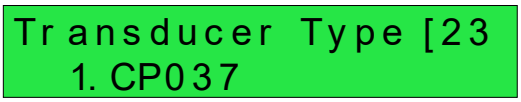
Press the Menu 1 4 keys to enter Window M14, press the Enter key, press the ^ or v key to select Pipe Material, and press the Enter key to confirm.




Step4. Transducer type

(The transmitter is available for various transducer types.)

Press the Menu 2 3 key to enter M23, and then press Enter, next press ^ or v to select flow transducer type1. CP037, finally press Enter to confirm.




Step5. Transducer mounting methods

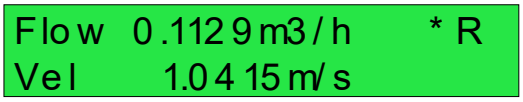
Press the Menu 2 4 key to enter Window M24, press the Enter key, press the ^ or v key to select transducer-mounting method, and press the Enter key to confirm.


Step6. 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).

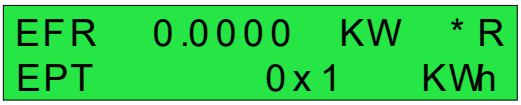

Step7. Display measurement result

Press the Menu 0 1 keys to enter Window M01 to display measurement result. (Base on the



actual measurement)

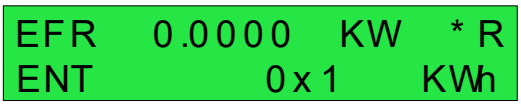
Step 8. Display heating energy measurement results




Press Menu 0 5 to eneter into M05 and display heating measurement result. (Subject to actual measurement). The default unit is KW.

Enter M84 to change the instantaneous heating (cooling) energy unit, M85 to change the cumulative heating (cooling) energy unit, M87 to change heating (cooling) energy accumulation switch, M88 to change the heating (cooling) energy multiplication factor, and M89 to clear the accumulator of heating (cooling) energy.

Step 9. Display cooling energy measurement results




Press Menu 0 6 to enter into M06 and display cooling energy measurement result. (Subject to actual measurement). The default unit is KW.

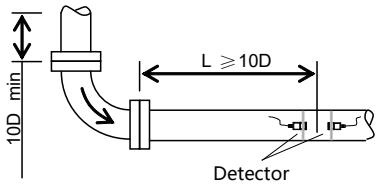
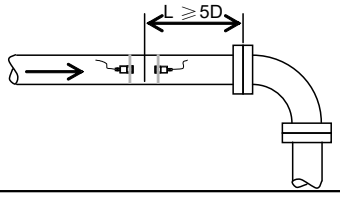
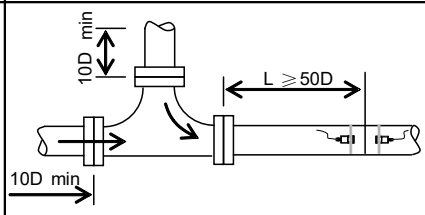
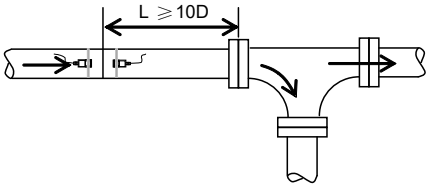
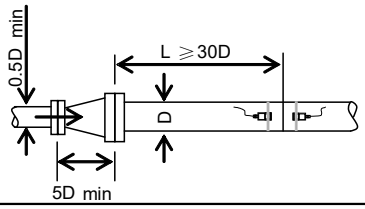
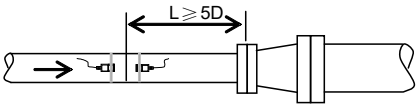
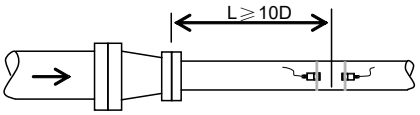
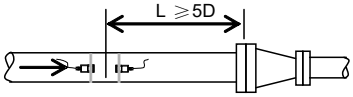
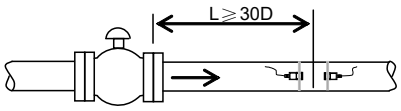
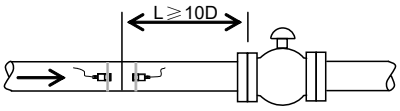
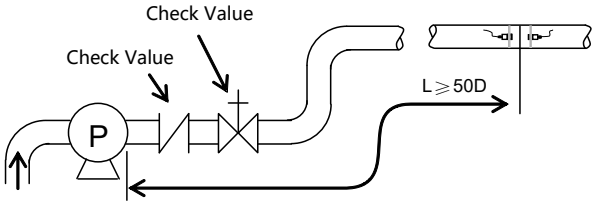
Enter M84 to change the instantaneous heating (cooling) energy unit, M85 to change the cumulative heating (cooling) energy unit, M87 to change heating (cooling) energy accumulation switch, M88 to change the heating (cooling) energy multiplication factor, and M89 to clear the accumulator of heating (cooling) energy.

# 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 |  |  |
| Reducer |  |  |
| Value |  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, 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:

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.

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 guaranteed 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.

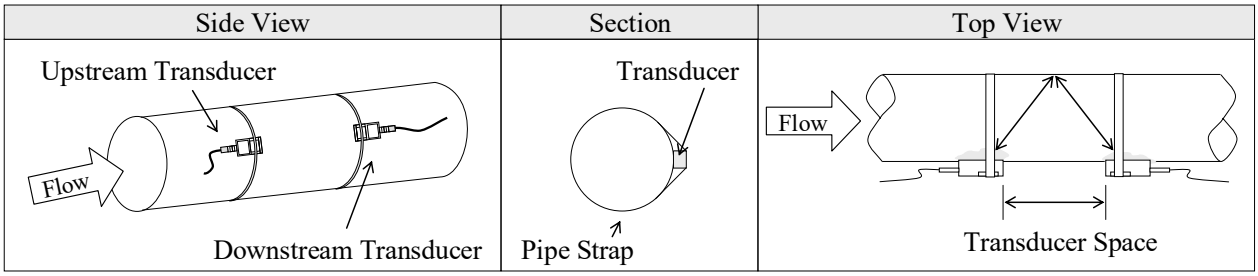
### 4.1.2 Transducer Mounting Methods

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″ ).

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

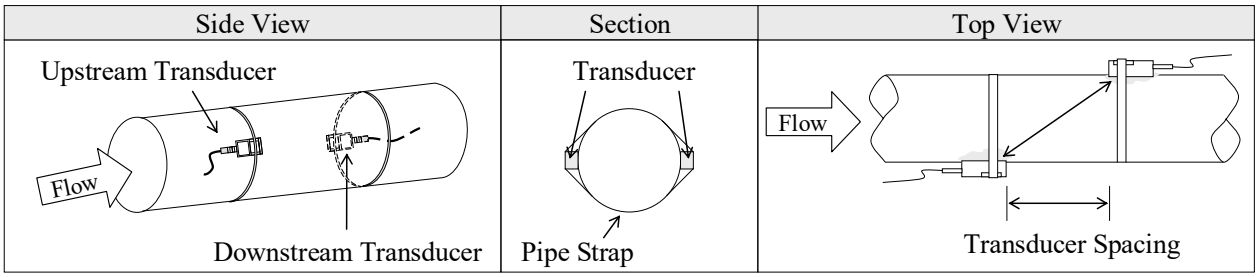


### 4.1.4 Z Method

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.

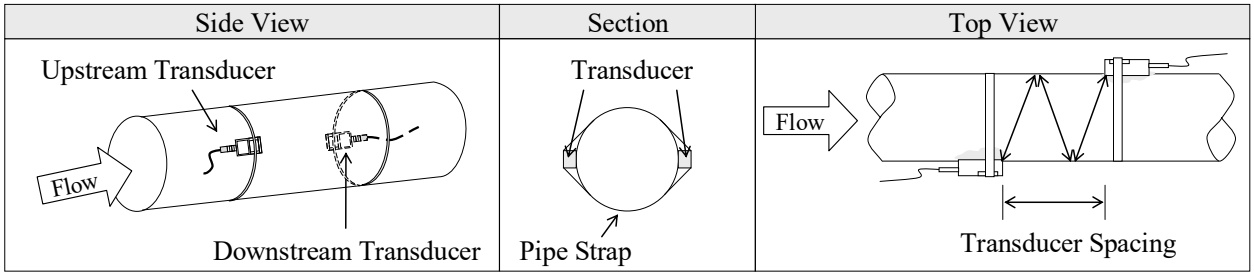
The Z method is able to measure on pipe diameters ranging from 100mm to 800mm (4″ ~32″ ) approximately. Therefore, we recommend the Z method for pipe diameters over 300mm (12″ ).




### 4.1.5 N Method (not commonly used)

With the N method, the sound waves traverse the fluid three times and bounce twice 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 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 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 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 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 method to be 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 Energy Meter 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.

### 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 centerline on the same diameter,

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 Energy Meter 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. Make sure that the larger the pipe diameter, the more the transducers 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 on the same diameter.

(4) Pay special attention to those pipes that 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 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) Make sure that the Energy Meter is able to run properly with high reliability. The stronger the signal strength displayed, the higher the Q value reached. The longer the Energy Meter 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) After the installation is complete, power on the instrument and check the result accordingly.

# 5 Temperature Sensor Installation

Standard configuration PT1000 temperature sensor.

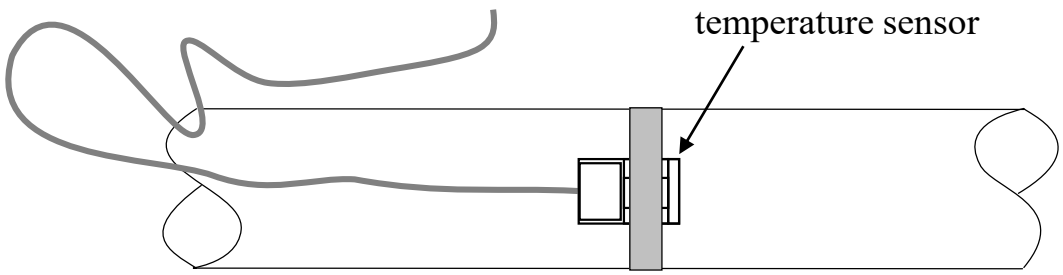
Before the temperature sensor transducer is installed, it is necessary to select the appropriate measuring point to ensure the accuracy of measurement.

## 5.1 Selection of measuring point

The installation position of the temperature sensor shall be selected according to the following principles:

1. The installation position of the temperature sensor shall be selected at the place with sensitive and representative medium temperature change, not near the resistance parts such as valves, welds and the dead angle of medium flow rate.
2. Installed in a place convenient for operation and maintenance.
3. The temperature of the measured fluid does not exceed the rated working temperature, and the working temperature range of the temperature sensor is 0-100 ℃.
4. The installation of the temperature sensor shall not affect the installation of the ultrasonic sensor because it will become a resistance part for the fluid in the pipeline after the temperature sensor is installed , which will cause turbulence of the fluid flow). It shall be installed downstream of the ultrasonic sensor.

## 5.2 Installation of temperature sensor




Before installing the clamp on temperature sensor, the area to be installed on the surface of the pipeline shall be cleaned and the rust and paint shall be removed, and then the clamp on temperature sensor shall be tightly bound on the pipe wall. Note that the water inlet temperature sensor is installed on the water inlet pipe wall, and the water outlet temperature sensor is installed on the water outlet pipe wall.

# 6 Operating Instructions

## 6.1 System Normal Identification

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

If the letter "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(＞2min) 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.

## 6.2 Zero Set Calibration

Once zero flow occurs, a zero point may indicate on each measuring instrument, but the displayed 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. Conversely, if the Zero is too big, that indicates the quality of the instrument is poor.

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 Energy Meter, the measurement difference from zero point cannot be ignored at low flow. It is necessary to perform a static zero set calibration to improve low flow measurement accuracy.

Press Window M42 to set the Zero, press Enter first, and then wait the readings display is finished. If this is carried out with flow, the flow will be displayed as "0", M43 can help to restore settings.

## 6.3 Scale Factor

Scale factor refers to the ratio between "actual value" and "reading value". For example, when the measurement and 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 calibration. The scale factor can be input in Window M45.

## 6.4 System Lock

System lock is readable but not modifiable to prevent operation error due to unauthorized tampering by unauthorized personnel.

Press the Menu 4 7 keys, if displays "Unlock" on the screen, then press the Enter key, enter 6 numerically long password, and then press the Enter key to confirm.

Unlock it by using the selected password only. Press Menu 4 7 , if "lock" is displayed on the screen, then press the Enter key and enter the correct password, then press Enter to confirm.

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

## 6.5 Frequency Output

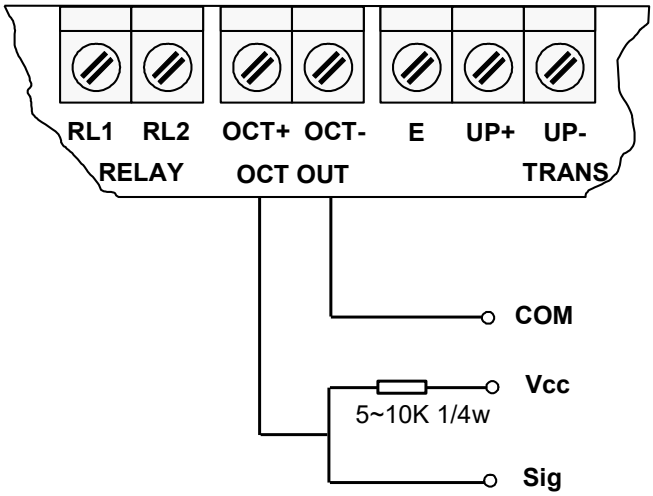
The Energy Meter is provided with a frequency output transmitter function. The high or low frequency output displayed indicates the high or low flow rate reading. The user can reset the frequency output as well as flow rate as his requirements.

For example: if a pipe flow range is 0~3000m³/h, the relative frequency output required is 0~5000Hz, 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;

Typical OCT Output wiring diagram as below:




OCT Output Wiring Diagram

## 6.6 Totalizer Pulse Output

The heating (cooling) meter can generate a cumulative pulse output to the external counting device for every unit flow through the heating (cooling) meter.。

The accumulated pulse can only be output through hardware OCT or relay. Therefore, the hardware OCT or relay must be set accordingly (see M78, M79). For example: if you want to use OCT to output positive cumulative pulses, each pulse represents a flow of 0.1m3, kindly set the following:

In Window M32, select the totalizer flow unit "Cubic Meters (m³)";

In Window M33, select the scale factor "x0.1";

In Window M78, select "1. NET int pulse";

Attention

The pulse period is at least 200ms, that is, the maximum of 5 pulses are output per second. Therefore, the value needs to be adjusted according to the actual situation. For example, if the set value is 1.20, then the instantaneous value must not exceed 5*1.2=6, that is, it must not exceed 6 units per minute.

## 6.7 4~20mA Current Loop Output Verification (Optional)

Processing a current loop output exceeding an accuracy of 1%, the Energy Meter is programmable and configurable with multiple output modes such as flow rate or fluid velocity. Select in Window M55. For details, please refer to "Windows Display Explanations".

In Window M56, enter a 4mA flow rate or fluid velocity value. Enter the 20mA flow rate or fluid velocity 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.

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", "12mA","16mA", "20mA" readings, connect an ammeter to test the current loop output and calculate the difference. Calibrate it if the difference is within tolerance. If the difference is without tolerance, refer to the "Analog Output Calibration" to calibrate the current loop.

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

## 6.8 Recover the Factory Default

Press [Menu] [3] [7] [Enter] keys to Window m37, press [^] or [v] key to choose"Reset"keys to recover the factory default.

## 6.9 4~20mA Analog Output Calibration

Note

Each Energy Meter has been calibrated strictly before leaving factory. It is unnecessary to carry through 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 Analog Output. The procedure is as follows:

Press [Menu] [v] [0] [Enter] enter password "115800", 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 [v] to calibrate the current loop 4mA output. Use an ammeter to measure the current loop output current. At the same time, press [^] or [v] 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 the same as 4mA calibration.

The results are automatically saved in EEPROM and won't lose when power off.

## 6.10 ESN

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

Attention

Other Operation refers to "7.2 Windows Display Explanations".

# 7 Windows Display Explanations

## 7.1 Windows Display Codes

| | |
|---|---|
| Flow Totalizer Display | |
| 01 | Flow Rate/Velocity |
| 02 | Flow Rate/POS Totalizer |
| 04 | Date Time/Flow Rate |
| 05 | Instantaneous Heat Capacity / Totalizer Heat Capacity |
| 06 | Instantaneous Cool Capacity/ Totalizer Cool Capacity |
| 07 | Inlet Water Temp/ Outlet Water Temp / Delta Temp. |
| 08 | System Error Codes |
| 09 | POS Flow Today |
| Initial Parameter setup | |
| 11 | Pipe Outer Diameter |
| 12 | Pipe Wall Thickness |
| 14 | Pipe Material |
| 23 | Transducer Type |
| 24 | Transducer Mounting Method |
| 25 | Transducer Spacing |
| 26 | Parameters Setups |
| 27 | Cross-sectional Area |
| 28 | Holding with Poor Sig |
| 29 | Empty Pipe Setup |
| Flow Units Options | |
| 30 | Measurement Units |
| 31 | Flow Rate Units |
| 32 | Totalizer Flow Units |
| 33 | Totalizer Multiplier |
| 35 | POS Totalizer |

| | |
|---|---|
| 37 | Totalizer Reset |
| 38 | Manual Totalizer |
| Setup Options | |
| 40 | Damping |
| 41 | Low Flow Cutoff Value |
| 42 | Set Static Zero |
| 43 | Reset Zero |
| 44 | Manual Zero Point |
| 45 | Scale Factor |
| 46 | Network identifying address code |
| 47 | System Lock |
| 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 | ESN |
| 62 | Serial Port Parameter |
| 67 | FO Frequency Range |
| 68 | Low FO Flow Rate |
| 69 | High FO Flow Rate |
| 70 | LCD Backlit Option |
| 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 |
| 82 | Date Totalizer |
| 83 | Automatic Correction |
| Energy Calculation Methods | |
| 84 | Energy Units Options |
| 85 | Specific Heat Select Options |
| 86 | Delta Temperature Sensitivity Settings |
| 87 | Energy Totalizer ON/OFF |
| 88 | Energy Totalizer Multiplier |
| 89 | Reset Energy Totalizer |
| Diagnoses | |
| 90 | Signal Strength and Quality |
| 91 | TOM/TOS*100 |
| 92 | Fluid Sound Velocity |
| 93 | Total Time and Delta Time |
| 94 | Reynolds Number and Factor |
| 96 | Protocol Select |
| 97 | Transducer Spacing correction selection |
| 98 | Transducer Mounting Position Options |
| 99 | Temperature Unit Selection |
| Appendix | |
| +0 | Last Power Off Time and Flow Rate |

| | |
|---|---|
| +1 | Total Working Hours |
| +2 | Last Power Off Time |
| +3 | Last Flow Rate |

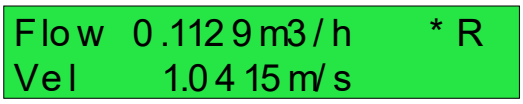
| | |
|---|---|
| +4 | Total Power Off Times |
| -0 | Hardware Adjusting Entry |
| -1 | Temperature Calibration |

NOTE:The other menu features are retained by manufacturers and the windows in gray background are optional functions.

## 7.2 Display Explanation

Menu 0 1

Display Flow Rate and Velocity.




Menu 0 2

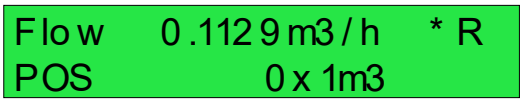
Flow Rate / POS Totalizer

Display Flow Rate and POS Totalizer.

Select the POS Totalizer units in Window M31.

If the POS Totalizer has been turned off, the POS

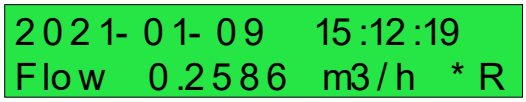
Totalizer value displayed is the total prior to its turn off.




Menu 0 4

Date Time / Flow Rate

The time setting method can be found in Window M60.




Menu 0 5

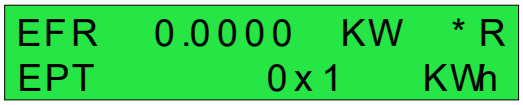
Heat Capacity / Totalizer Heat Capacity

Display Instantaneous Heat Capacity and Totalizer Heat Capacity.

Net Energy Totalizer: E□T; Instantaneous Energy: EFR.

Note1 : when the instrument is named energy meter:

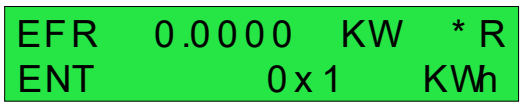
Heat Capacity: "[P", Cool Capacity: "[N".




Menu 0 6

Cool Capacity / Totalizer Cool Capacity

Display Instantaneous Cool Capacity and Totalizer Cool Capacity.




Menu 0 7

Inlet Water Temp / Outlet Water Temp / Delta Temp

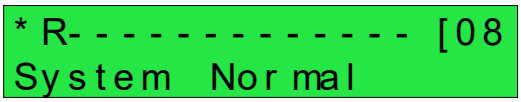
Display Inlet Water Temperature, Outlet Water Temperature and Delta Temperature.


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.

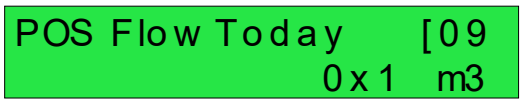
The explanations of error codes and detailed resolution methods can be found in "Error Diagnoses"




Menu 0 9

POS Flow Today

Display POS Flow Today.

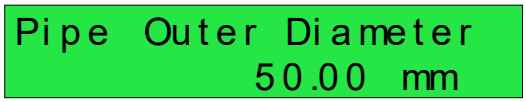



Menu 1 1

Pipe Outer Diameter

Enter the pipe outside diameter

The pipe outside diameter must range from 15mm to 1250mm.




Menu 1 2

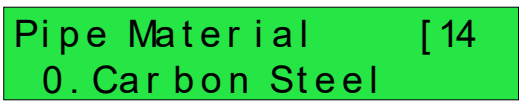
Pipe wall thickness


Menu 1 4

Pipe Material

Enter pipe material. The following options are available (by ^、v buttons):

0. Carbon Steel
1. Stainless Steel
2. PVC
3. Copper




Menu 2 3

Transducer Type

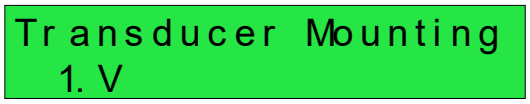
0. CP037(clamp-on type transducer)
1. CP035(CP series clamp-on type transducer)
2. Plug-in-W211(W211 type insertion transducer)


Menu 2 4

Transducer Mounting

Four mounting methods are available:

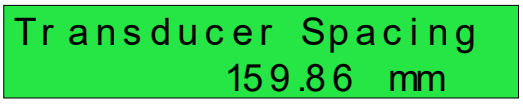
0. Z
1. V
2. N (small pipe)



Menu 2 5

Transducer Spacing

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



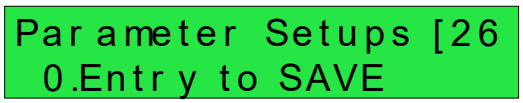

Menu 2 6

Initial Parameter Setups and Save

Load and save the parameters. 10 different sets of setup conditions/groups are available to load and save by three methods

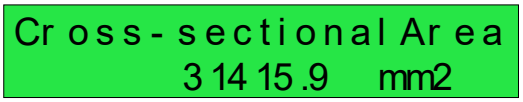
0. Entry to Save
1. Entry to Load
2. To Browse

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 spacing in Window M25.




Menu 2 7

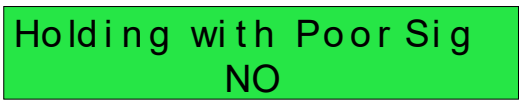
Cross-sectional Area




Menu 2 8

Holding with Poor Sig

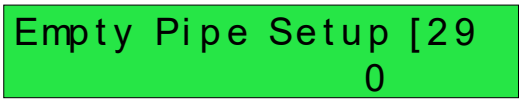
Select "Yes" to hold last good flow signal displayed if the Energy Meter experiences a poor signal condition. This function will allow to calculate flow totalizer data without interruption. Select "NO", instead.




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 condition 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.



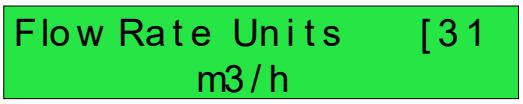
Menu 3 0


Measurement Units Options

Select the measurement unit as follows:

0. Metric
1. English

Menu 3 1




Flow Rate Units Options

The following flow rate units are available:

| | | |
|---|---|---|
| 0. | m3 | Cubic Meters |
| 1. | 1 | Liters |
| 2. | gal | USA Gallons |
| 3. | ig | Imperial Gallons |
| 4. | mg | Million Gallons |
| 5. | cf | Cubic Feet |
| 6. | bal | USA Barrels |
| 7. | ib | Imperial Barrels |
| 8. | ob | Oil Barrels |

The following time units are available:

/ Day / Hour
/ Min / Sec

Factory default is Cubic Meters/hour

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 requirement. Factory default is Cubic Meters.

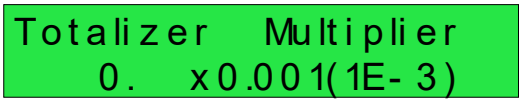
Menu 3 3

Totalizer Multiplier Options

The totalizer multiplier will affect the display mode of flow cumulant (positive, negative, net) and the output cumulant mode of RS485 MODBUS. 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)
8. None

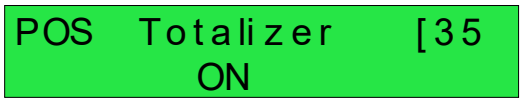
Factory default factor is x1



Menu 3 5

ON/OFF POS Totalizer

ON/OFF POS Totalizer. " ON " indicates the Energy Meter starts to totalize the value. When it is turned off, the positive totalizer displays in Window M02 will not change. Factory default is " ON ".




Menu 3 7

Totalizer Reset

Totalizer reset; all parameters are reset. Press Enter; press ^ or v arrow to select corresponding options. And then press Enter to clear ZERO. The following options are available:

None:No reset;

All:Reset all totalizers;

NET Totalizer Reset;

POS Totalizer Reset;

NEG Totalizer Reset;

Reset:back to the factory default

If the user wants to delete all the already set parameters and set back to the factory default, select reset in this window and then the Energy Meter will reset to be the factory default automatically.


Attention

This operation will delete the entire user's data(In addition to the cumulatant, power off record, installation point parameters) and reset as the factory default. Please consider carefully before taking this operation.

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.


Menu 4 0

Damping Factor

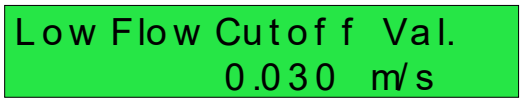
The damping factor ranges from 0～999 seconds. 0 indicates no damping; 999 indicates the maximum damping.

The damping function will stabilize the flow display. Its principle is the same as that in a single-section RC filter. The damping factor value corresponds to the circuit time constant. Usually a damping factor of 3 to 10 is recommended in applications.


Menu 4 1

Low Flow Cut off Value

Low Flow Cut off is used to make the system display as "0" value at lower and smaller flows to avoid any invalid totalizing. For example, if the cutoff value is set as 0.03, system will take all the measured flow values below ±0.03 as "0". Usually 0.03 is recommended in most applications.




Menu 4 2

Set Static State 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 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.

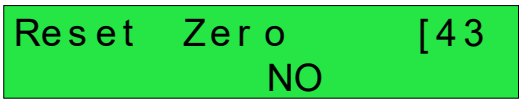
Press Enter, wait for the process to complete.

When the zero point is greater than 0.3m/s, the static zero point function setting will not be possible.


Menu 4 3

Reset Zero

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




Menu 4 4

Manual Zero Point

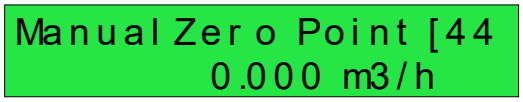
This method is not commonly used. It is only suitable for experienced operators to set zero under conditions when it is not preferable to use other methods. Enter the value manually to add to the measured value to obtain the actual value. For example:

Actual measured value＝250 m3/H

Actual measured value＝10 m3/H

Energy Meter Display＝240 m3/H

Normally, set the value as "0".



Menu 4 5

Scale Factor [45
1.000

Scale Factor

The scale factor named as instrument K factor is used to modify the measurement results. The user can enter a numerical value according to the actual calibration results.

Menu 4 6

Network I DN [46
88

Network IDN

Input system identifying code, these numbers can be selected from 1~247 except that 13 (0DH ENTER), 10 (0AH Newline), 42 (2AH * ) and 38 (26H&) are reser ved.

System IDN is used to identify the flowmeter to a ne twork.

Menu 4 7

System Lock [47
****** Unlock ******

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 6 numbers.

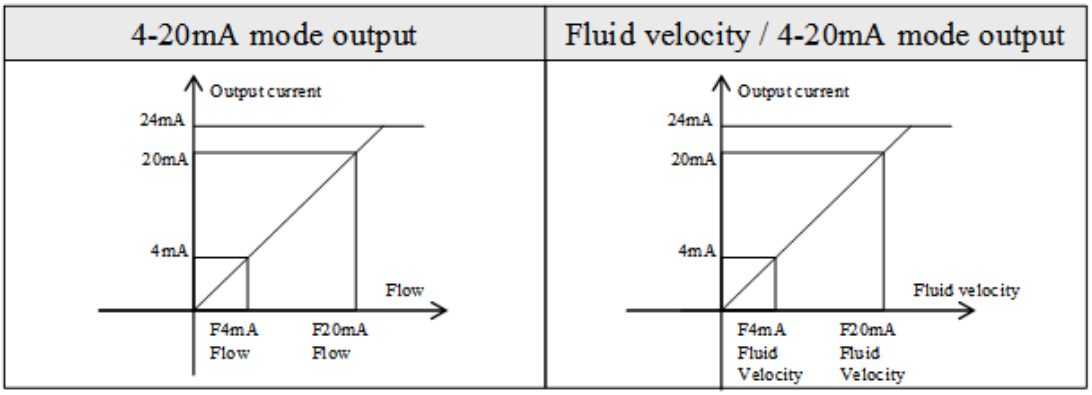
Menu 5 5

CL Mode Select [55
0:4 - 20 mA vs. Flow

Current Loop Mode Select

0. 4-20mA vs.Flow set up the 4-20mA output to. be flow rate mode
1. 4-20mA vs.Vel. set up the 4-20mA output to. be velocity mode
2. 4-20mA vs.Energy set up current loop output 4-20mAcorresponding energy

Other different current output characteristics are displayed in below figures. The user can select one of them according to his actual requirements.

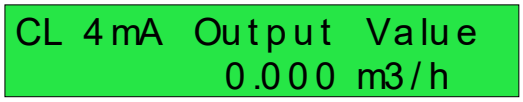


In two graphs shown above, flow $F_{4mA}$ indicates the value that the user entered in Window M57; and flow $F_{20mA}$ indicates the value that the user entered in Window M58.

Menu 5 6

CL 4mA Output Value

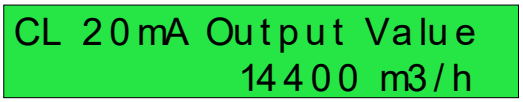
Set the CL output value according to the flow value at 4mA. The unit of this value varies with the configuration of M55.




Menu 5 7

20mA Output Value

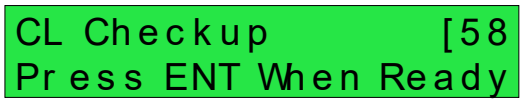
Set the CL output value according to the flow value at 20mA. The unit of this value varies with the configuration of M55.




Menu 5 8

CL Check Verification

Check if the current loop has been calibrated before leaving the factory. Press Enter to start, press ^ or v to display 0mA, 4mA, 8mA, 12mA, 16mA, 20mA, and at the same time, check with an ammeter to measure the current loop output current and calculate the differences to see if it is under the permitted tolerance. If not, refer to the "Analog Output Calibration" to calibrate.

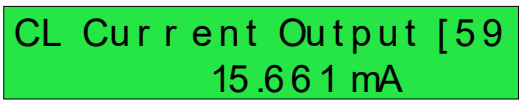



Menu 5 9

CL Current Output

Display theoretical CL current output. The display of 10.0000mA indicates that CL current output value is 10.0000mA.

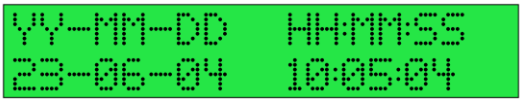
If the difference between displaying value and actual CL output value is too large, the current loop then needs to be re-calibrated accordingly.




Menu 6 0

Date and Time Settings

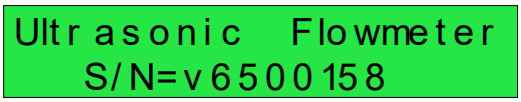
Date and time modifications are made in this window. The format for setting time setting is 24 hours. Press Enter, wait until ">" appears, the modification can be made.




Menu 6 1

ESN

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




Menu 6 2

Serial Port Settings (Title: RS485 Setup)

This window is used for serial port setting. Serial port is used to communicate with other instruments. The serial port parameters setting of the instrument that applies the serial port connection must be consistence. The first selected data indicates baud rate, 2400、4800、9600、19200、38400、56000 are available.

The second option indicates parity bit, None (No verification).

Data length fixed to 8;

Stop bit length for a fixed length.

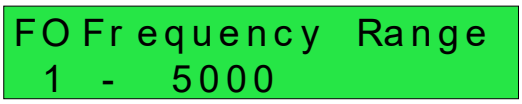
The factory default serial port parameter is "9600, None".


Menu 6 7

FO Frequency Range

Set the highest limit of the output signal frequency. highest limit frequency values must be greater than the lower frequency range： 0~9999Hz， Factory default：1~1001Hz.

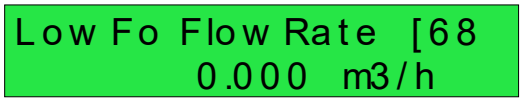
Note: output frequency signal output from OCT mouth, so to output frequency signal, must also Be set OCT into frequency signal output mode （M78 choose 0. FO).




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 1000 Hz, low FO flow rate is 100m3/h then when the frequency output is 1000 Hz, the low flow at this moment measured by the Energy Meter is 100m3/h.

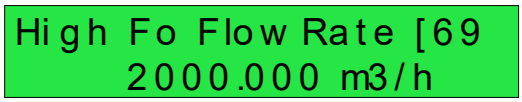



Menu 6 9

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. For example, when the low FO frequency is 5000Hz, low FO flow rate is 1000m3/h,then when the

frequency output is 5000Hz, the low flow at this moment measured by the Energy Meter is 1000m3/h.




Menu 7 0

LCD Back lit Option


Select LCD back lit controls.

0. Always ON
1. Always OFF
2. Lighting For nn sec

Keep the backlight off can save about 30mA power.

Menu 7 2

Working Timer


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

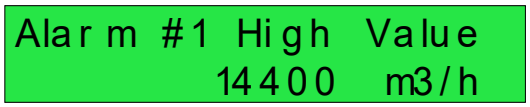
Menu 7 3

Alarm #1 Low Value


Enter the low alarm value. Relevant alarm is 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.

Menu 7 4

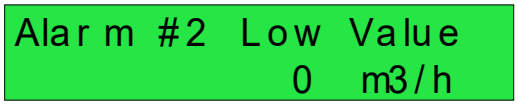
Alarm #1 High Value




Enter the high alarm value. Relevant alarm is 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.

Menu 7 5

Alarm #2 Low Value




Enter the low alarm value. Relevant alarm is 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.

Menu 7 6

Alarm #2 High Value

Enter the high alarm value. Relevant alarm is turned on in Windows M78 and M79; any of the measured flow, which is higher than the high value, will activatethe alarm in the OCT hardware or Relay output signal.


Menu 7 7

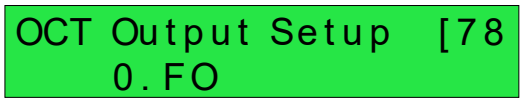
Beeper Setup


Set up the beeper on-off state.

0. ON Beeper ON
1. OFF Beeper OFF

Menu 7 8

OCT Output Setup

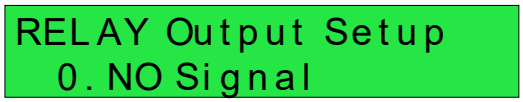



Set OCT output hardware unit output trigger sources, selection of triggering events:

| | | | |
|---|---|---|---|
| 0. | FO | 1. | NET Int Pulse |
| 2. | Energy Pulse | 3. | No Signal |
| 4. | Alarm #1 | 5. | Alarm #2 |

Menu 7 9

Relay Output Setup

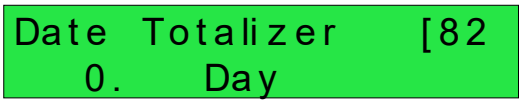



The relay is single-pole and constant-on for external instrument controls. The following options are available:

| | | | |
|---|---|---|---|
| 0. | No Signal | 1. | NET Int Pulse |
| 2. | Energy Pulse | 3. | Alarm #1 |
| 4. | Alarm #2 | | |

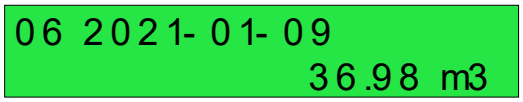
Menu 8 2

Date Totalizer




In this window, it is possible to review the historical flow data totalizer for any day of the last 64 days, any month of the last 64 months and any year of the last 5 years.

Press Enter , use the ^ or v to review totalizer in days, months and years. "0" for day, "1" for month, "2" for year. Use the ^ or v to review the totalizer in some day, some month, some year.




For more information please refer to "Error Code and Resolutions"

Menu 8 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 "ON" to use this function and "OFF" to cancel this function. The default value is “Cancel” this function.


Menu 8 4

Energy Units Options

Select Energy Units. The factory default unit is GJ/h. The following options are available:

| | | | |
|---|---|---|---|
| 0. | Giga Joule (GJ) | 1. | Kilocalorie (Kcal) |
| 2. | MBtu | 3. | Kilojoule (KJ) |
| 4. | Btu | 5. | KWh |
| 6. | MWh | | |

The following units of time are available:

/day ( per day ); /hour ( per hour ); /min ( per minute ); /sec ( per second ). The factory default unit is /hour.


Menu 8 5

Specific Heat Select

Select the following 2 kinds of specific heat value:

Press Enter, choose 0.RTD 1.AI

Then, press Enter, choose 0.CJ128 SHC 1.USER SHC


Menu 8 6

Temperature sensitivity and user SHC

When the delta temperature is less than the sensitivity set,, energy will not be accumulated. Set the adjustable temperature range of 0℃ to 10℃.

The factory default setting is 0.2℃

When the user specific heat is setting, energy is accumulated according to the user specific heat value. The setting range is from 1 to 99999 KJ/m3 C.

The factory default is 4186.8KJ/m3C.


Menu 8 7

Energy Totalizer Switch

Select "ON" represent to open Energy Totalizer;

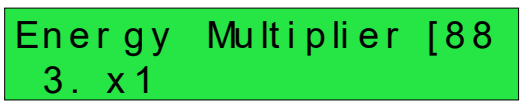
Select "OFF" represent to close Energy Totalizer.


Menu 8 8

Energy Multiplier

Select Energy Multiplier range:

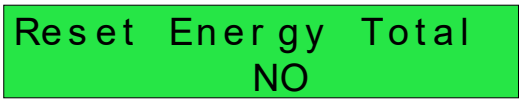
$10^{-3}$ ~ $10^{4}$ (1E-3 ~ 1E+4)



Menu 8 9

Reset Energy Totalizer

Select "YES" to reset Energy Totalizer value.




Menu 9 0

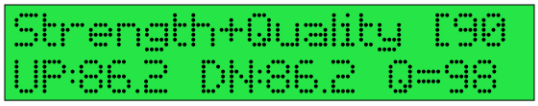
Signal Strength and Signal Quality

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

Signal strength is indicated from 0.0~99.9. A reading of 0.0 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 60.

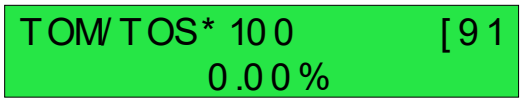
During the installation, pay attention to the signal strength and signal quality, the higher, the better. The strong signal strength and high quality value can ensure the long-term stability and the high accuracy of the measurement results.




Menu 9 1

TOM/TOS*100

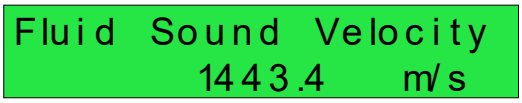
Display the ratio between the actual measured transmit time and the calculated transmit time according to customer's requirement. Normally the ratio should be 100±3%. If the difference is too large, the user should check whether the parameters are entered correctly, especially the sound velocity of the fluid and the installation of the transducers.




Menu 9 2

Fluid Sound Velocity

Display the measured fluid sound velocity.




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 Energy Meter 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 Energy Meter and the factor that is set currently by the Energy Meter. Normally this scaling factor is the average of the line and surface velocity factor inside the pipe.


Menu 9 6

Protocol Select

0. FUJI
1. MODBUS
2. CAL


Menu 9 7

Installation spacing correction selection

selection includes the followings:

OFF Turn off Installation spacing correction
ON Turn on Installation spacing correction
The default value is OFF.


Menu 9 8

Flow sensor set up ( Transducer Mounting Position Selection )

The following options are available:

0. Infall （water intake）
1. Outfall （water outlet）


Menu 9 9

Temperature Unit Selection

0. Celsius °C
1. Fahrenheit °F

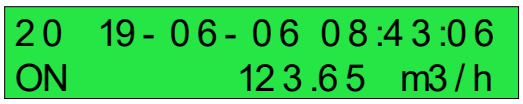
When Fahrenheit °F is selected for temperature, M07 displays the temperature unit as Fahrenheit °F, M86 temperature difference sensitivity input value unit is Fahrenheit °F, user specific heat capacity input unit is KJ/m3* °F, SD card stores temperature values in °F, Modbus reads RTD temperature values in °F.


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.

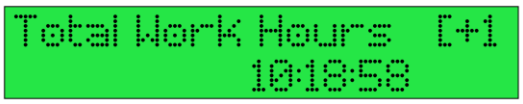

Enter the window, press Enter and ^ to display alternately the last time, the before last time and so on. The total is 64 times for on/off time and instantaneous flow values. The display style is shown on the right, "ON" indicates that the power is on; "20" on the upper left corner indicates "order". "19-06-06 08:43:06" indicates the date time; instantaneous flow is displayed in the lower right corner.




Menu ^ 1

Total Working Hours

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

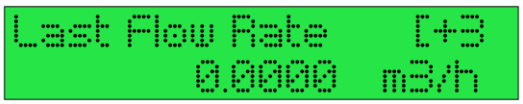



Menu ^ 2

Display the last power off time.


Menu ^ 3

Displays the last flow rate.




Menu ^ 4

Total ON/OFF Times

Display total on/off times since the Energy Meter left the factory.

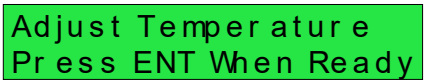

Menu v 0

Adjust 4-20mA

Please refer to the 6.9 "4~20mA Analog Output Verification"

Menu v 1

Temperature Calibration




Please refer to Chapter 12.4 "Temperature Calibration Methods" for more details.

# 8 Error Diagnoses

The ultrasonic Energy Meter has advanced self-diagnostics functions and displays any errors on 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.
Table 1 applies when errors caused by incorrect settings and signals are detected and are announced by error codes displayed in Window M08.

## 8.1 Table1. Error codes and solutions

| Code | MENU 08 Display | Cause | Solutions |
|---|---|---|---|
| *R | System Normal | * System normal | |
| *I | NO Signal Detected | * Signal not detected.<br>* Spacing is not correct between the transducers or not enough coupling compound applied to face of transducers.<br>* Transducers installed improperly<br>* Scale is too thick.<br>* New pipe liner. | * Attach transducer to the pipe and tighten it securely. Apply a plenty of coupling compound on transducer and pipe wall.<br>* Remove any rust, scale, or loose paint from the pipe surface. Clean it with a file.<br>* Check the initial parameter settings.<br>* 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.<br>* Wait until liners solidified and saturated. |
| *G | Adjusting Gain | The machine is adjusting for gain,preparing for normal calibration. | |

## 8.2 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 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.

# 9 Product Overview

## 9.1 Introduction

The Ultrasonic Energy Meter is a state-of-the-art universal transit-time Energy Meter designed using FPGA chip and low voltage broadband pulse transmission.,available for measuring water.

## 9.2 Features of UDM101

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

1. SLSI technology designed. Less hardware components, low voltage broadband pulse transmission, low consumption power, high reliability, anti-jamming and outstanding applicability.
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 Energy Meter has manual or automatic amendment during offline sessions.
4. 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 open collector.

## 9.3 Operating principle

A energy meter is installed in the heat exchange system. When the water flows through the system, the heat released or absorbed by the system can be calculated and displayed by the heat meter according to the flow given by the flow sensor, the temperature of the water supply and backwater given by the matched temperature sensor, and the time of the water flow. Its basic formula is:

$$Q = \int_{\tau_0}^{\tau_1} q^m \Delta h d\tau = \int_{\tau_0}^{\tau_1} \rho q_v \Delta h d\tau$$

Formula: Q——The heat released or absorbed(J or wh);

$q^m$——Mass flow of water through the hot (cold) meter (kg/h);

$q_v$——Volume flow of water through the hot (cold) meter ($m^3$/h);

ρ——Density of water flowing through the hot (cold) meter（kg/ $m^3$）;

Δh——Enthalpy difference of water at inlet and outlet temperature of heat exchange system(J/kg);

$\tau$ ——Time(h).

## 9.4 Specifications

| Performance specifications | |
|---|---|
| Flow range | 0.03 ~ 16 ft/s ( 0.01 ~ 5.0 m/s ). |
| Accuracy | Flow accuracy: ±1% (0.5~5m/s standard condition)<br>Energy accuracy: ±2% |
| Pipe size | Clamp-on: 1" ~ 48" (25mm ~ 1200mm) |
| Fluid | Water. |
| Pipe material | Carbon steel, stainless steel, PVC, Copper. |
| Function specifications | |
| Outputs | Analog output : 4 ~ 20mA, (max load 750Ω);<br>Pulse output: 0 ~ 9999 Hz, OCT ( min. and max. frequency is adjustable );<br>Relay output: max. frequency 1Hz ( 1A@125VAC or 2A@30VDC ). |
| Input Interface | 2*PT1000 interface, Three-wire system;<br>0~100℃（32～212℉） |
| Communication interface | RS485　MODBUS. |
| Power supply | 10 ~ 36VDC/1A. |
| Keypad | 16 ( 4×4 ) key with tactile action. |
| Display | 20×2 lattice alphanumeric, back lit LCD. |
| Temperature | Transmitter: 14 °F to 122 °F ( –10℃ ~ 50℃ );<br>Transducer: 32 °F to 176 °F ( 0℃ ~ 80℃ ). |
| Humidity | Up to 99% RH, non-condensing. |
| Physical specifications | |
| Transmitter | PC/ABS, IP65. |
| Transducer | Encapsulated design, IP68. |
| transducer cable | Standard cable length: 30 ft (9m). |
| Weight | Transmitter: approximately 0.6kg;<br>Transducer: approximately 0.8kg. |

# 10 Appendix1-Serial Interface Network Use and Communications Protocol

## 10.1 Overview

The transmitter has perfect communication protocol. It can also be connected to a RS-485.

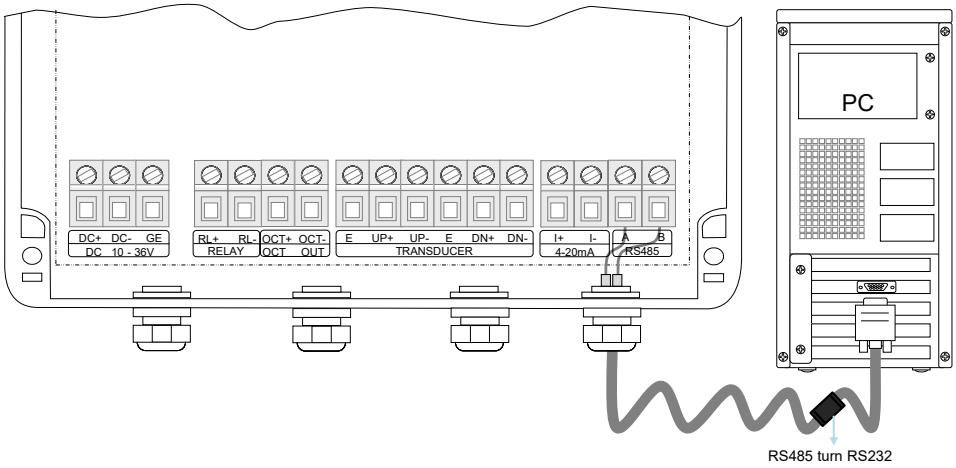
Two basic schemes can be chosen for networking, i.e. the analog current output method only using the Energy Meter or the RS485 communication method via serial port directly using the Energy Meter. The former is suitable to replace dated instruments in old monitoring networks. The later is used in new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

When the serial port communication method is directly used to implement a monitoring network system, the address identification code (in window M46) of the Energy Meter is used as network address code. Expanded command set with [W] is used as communication protocol. Thus analog current loop and OCT output of Energy Meter can be used to control the opening 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(0~1000m) can be directly used for data transmission link for a short distance.

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

## 10.2 Direct connection via RS-485 to the host device




Drawing of Upper Computer RS-485 network data acquisition system

Notices:

When the Energy Meter is in Energy Meter network, the following network IDN:13 (0DH ENTER), 10(0AH NEWLINE), 42(2AH*) and 38(26H&). The Network IDN is set in M46.

## 10.3 Communication protocol and the use

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

### 10.3.1 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 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 | ±ddddddE±d(cr) *2 |
| 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) |
| DC(cr) (lf) | Return current error code | *3 |
| DT(cr) (lf) | Current date and time | yy-mm-dd,hh:mm:ss(cr) |
| LCD(cr) (lf) | Return currently displayed content on LCD display | |
| ESN(cr) (lf) | Return electronic serial number | ddddddd(cr)(lf) *4 |
| W | Networking command prefix of numeric string address | *5 |
| P | Prefix of return command with check | |
| & | Function sign of command "add" | |

*Note:

1. (cr)expresses carriage return. Its ASCII value is 0DH. (lf) expresses line feed. Its ASCII value is 0AH.
2. "d" expresses 0-9 number. 0 value is expressed as +0.000000E+00.

   "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. Eight "ddddddddd" expresses the electronic serial number of the machine. "t" expresses the type of machine.
5. If there are multiple flowmeters in a data network then the basic commands cannot be used alone. The prefix W must be added. Otherwise, multiple flowmeters will answer simultaneously, which will cause chaos in the system.

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, 35H, 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] AI1 analogous input current value, the following command is issued:

W04321PDQD&PDV&PDI+&PDI-&PDIN(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+0m3! DA(CR)

+0.000000E+0 m3! DA(CR)

### 10.3.2 MODBUS Communication Protocol

This MODBUS 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.

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-I RTU mode uses hexadecimals to transmit data.

#### 10.3.2.1 MODBUS 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 |

### 10.3.2.2 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 bytes |
| 0x01~0xF7 | 0x03 | 2xN* | N*x2 | CRC(Verify) |

N*＝data register number

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 Register Address Register Number 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) CRCVerify 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 06 51 3F 9E .

### 10.3.2.3 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:

0x01 0x83 0x02 0xC0 0xF1

Flowmeter Address Error Code Error Extended Code CRC Verify Code

### 10.3.2.4 MODBUS Register Address List

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

Read Register Address List (use 0x03 performance code to read)

| PDU | Register | Data | Type | No. | Remark |
|---|---|---|---|---|---|

| Address | | description | | registers* | |
|---|---|---|---|---|---|
| $0000 | 40001 | Flow/s - low word | 32 bits real | 2 | |
| $0001 | 40002 | Flow/s - high word | | | |
| $0002 | 40003 | Flow/m - low word | 32 bits real | 2 | |
| $0003 | 40004 | Flow/m- high word | | | |
| $0004 | 40005 | Flow/h - low word | 32 bits real | 2 | |
| $0005 | 40006 | Flow/h - high word | | | |
| $0006 | 40007 | Velocity – low word | 32 bits real | 2 | |
| $0007 | 40008 | Velocity – high word | | | |
| $0008 | 40009 | Positive total – low word | 32 bits int. | 2 | |
| $0009 | 40010 | Positive total – high word | | | |
| $000A | 40011 | Positive total – exponent | 16 bits int. | 1 | |
| $0011 | 40018 | Energy total – low word | 32 bits int. | 2 | |
| $0012 | 40019 | Energy total – high word | | | |
| $0013 | 40020 | Energy total – exponent | 16 bits int. | 1 | |
| $0014 | 40021 | Energy flow – low word | 32 bits real | 2 | |
| $0015 | 40022 | Energy flow – high word | | | |
| $0016 | 40023 | Up signal int – low word | 32 bits real | 2 | 0～99.9 |
| $0017 | 40024 | Up signal int – high word | | | |
| $0018 | 40025 | Down signal int – low word | 32 bits real | 2 | 0～99.9 |
| $0019 | 40026 | Down signal int – high word | | | |
| $001A | 40027 | Quality | 16 bits int. | 1 | 0～99 |
| $001B | 40028 | 4~20mA Analog output—low word | 32 bits real | 2 | Unit: mA |
| $001C | 40029 | 4~20mA Analog output—high word | | | |
| $001D | 40030 | Error code – char 1,2 | String | 3 | Refer to "Error Analysis" for detailed codes meanings. |
| $001E | 40031 | Error code – char 3,4 | | | |
| $001F | 40032 | Error code – char 5,6 | | | |
| $003B | 40060 | Velocity unit – char 1,2 | String | 2 | Currently support m/s only |
| $003C | 40061 | Velocity unit – char 3,4 | | | |
| $003D | 40062 | Flow unit – char 1,2 | String | 2 | |
| $003E | 40063 | Flow unit – char 3,4 | | | |
| $003F | 40064 | Total unit – char 1,2 | String | 1 | |
| $0040 | 40065 | Energy unit – char 1,2 | String | 2 | |

| | | | | | |
|---|---|---|---|---|---|
| $0041 | 40066 | Energy unit – char 3,4 | | | |
| $0049 | 40074 | Inlet water temperature value - Low byte | 32 bits real | 2 | |
| $004a | 40075 | Inlet water temperature value - High byte | | | |
| $004b | 40076 | Outlet water temperature value - Low byte | 32 bits real | 2 | |
| $004c | 40077 | Outlet water temperature value - High byte | | | |
| $004d | 40078 | Accumulated heat energy - Low byte | 32 bits uint. | 2 | |
| $004e | 40079 | Accumulated heat energy - High byte | | | |
| $004f | 40080 | Accumulated heat energy - Exponent | 16 bits int. | 1 | |
| $0050 | 40081 | Accumulated cooling energy - Low byte | 32 bits uint. | 2 | |
| $0051 | 40082 | Accumulated cooling energy - High byte | | | |
| $0052 | 40083 | Accumulated cooling energy - Exponent | 16 bits int. | 1 | |

Notes:

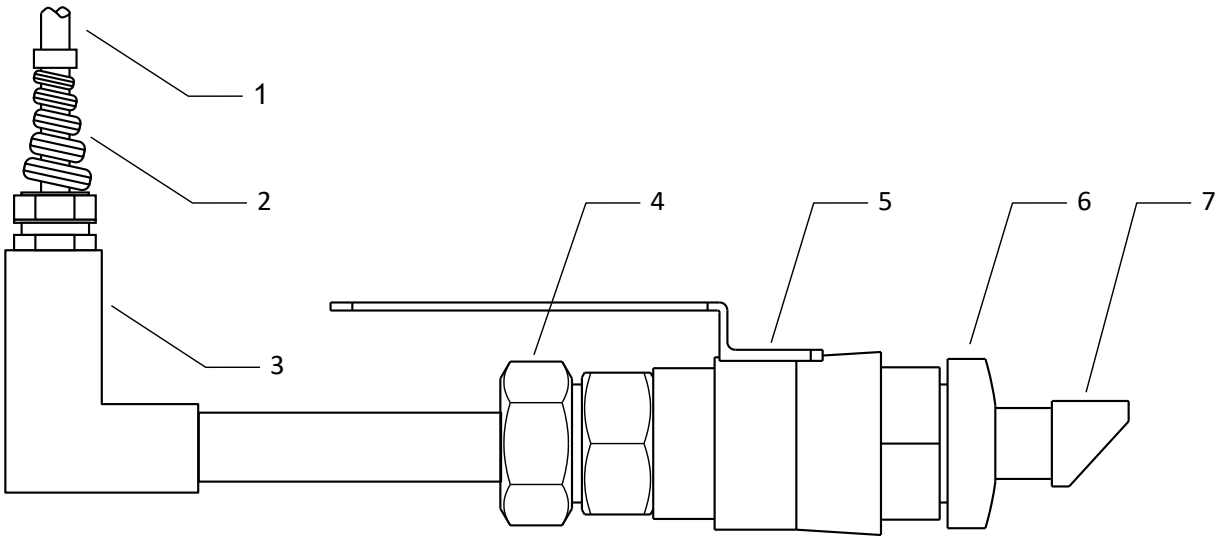
1. The following flow rate units are available:
   0. "m3" —Cubic Meter
   1. "l" —Liters
   2. "ga" —Gallons
   3. "ig" —Imperial Gallons
   4. "mg" —Million Gallons
   5. "cf" —Cubic Feet
   6. "ba" —US Barrels
   7. "ib" —Imperial Barrels
   8. "ob" —Oil Barrels
2. When the flowmeter address or communication baud rate change, the meter will work under the new address or communication baud rate after the communication baud rate responded with returned primary address and communication baud rate.
3. 16 bits int—short integer, 32 bits int—long integer, 32 bits real—floating point number, String—alphabetic string.

# 11 Appendix2 – W211 Insertion Transducer

## 11.1 Overview

W211 type insertion transducers can be installed into metal pipelines via an isolation ball valve ( installation into pipelines of plastic or other materials may require an optional mounting seat ). The maximum pipe diameter in which insertion transducers can be installed is DN1200. Fluid temperature range: -10℃ ~ +80℃. Sensor cable length ( 9m standard ) normally can be extended to as long as 100m.

Figure 1 shows a diagram of the W211 Insertion Transducer. The insertion transducer is attached to its mounting base ( which is welded to the pipe section at the measurement point ) via a ball valve. When the transducer is removed, pipe fluids can be contained by shutting off the ball valve. Therefore, installation and extraction of the transducer can be performed without relieving pipeline pressure. An O-ring seal and joint nut guarantee user safety while installing or operating the transducer.




Construction Drawing of W211 Insertion Transducer

1. Cable
2. Cable Connector
3. Connector
4. Lock - nut
5. Ball valve
6. Mounting base
7. Transducer probe

## 11.2 Measurement Point Selection

To obtain the strongest signal strength and the highly accurate measurement results, it is necessary to select an appropriate measurement point before installing the transducer. For examples of measuring point selection, see the related section in the manual.

## 11.3 Determining Transducer Spacing & Transducer Installation

The mounting space of insertion transducer is the center-to-center hole distance between the two transducers ( please refer to Menu 25 ). After entering the right parameter, please check the mounting space in Menu 25. ( unit: mm )

Mounting method:

1. Drilling at the measuring point, the diameter of the drilling hole is 24mm. Before drilling, please make the hole center of transducer mounting base aim at the drilling hole center, and then weld it on the pipe vertically. ( When the Energy Meter need to be hot-tapped into the pipe under pressure without flow interruption ,please refer to the Sitelab' operation construction of DDK electric Hot-tapping or corresponding equipment. )
2. Close the ball valve and screw it tightly on the mounting base.
3. Twist off the locknut and loose the lock ring, pull the transducer into the joint nut, and then screw up the joint nut on the ball valve.
4. Open the ball valve and insert the transducer, measure the dimension from the outer surface of the pipe to the front end surface of handspike position to meet the following formula:

   H = 175 - d

In this formula:

H is Mounting height (mm);

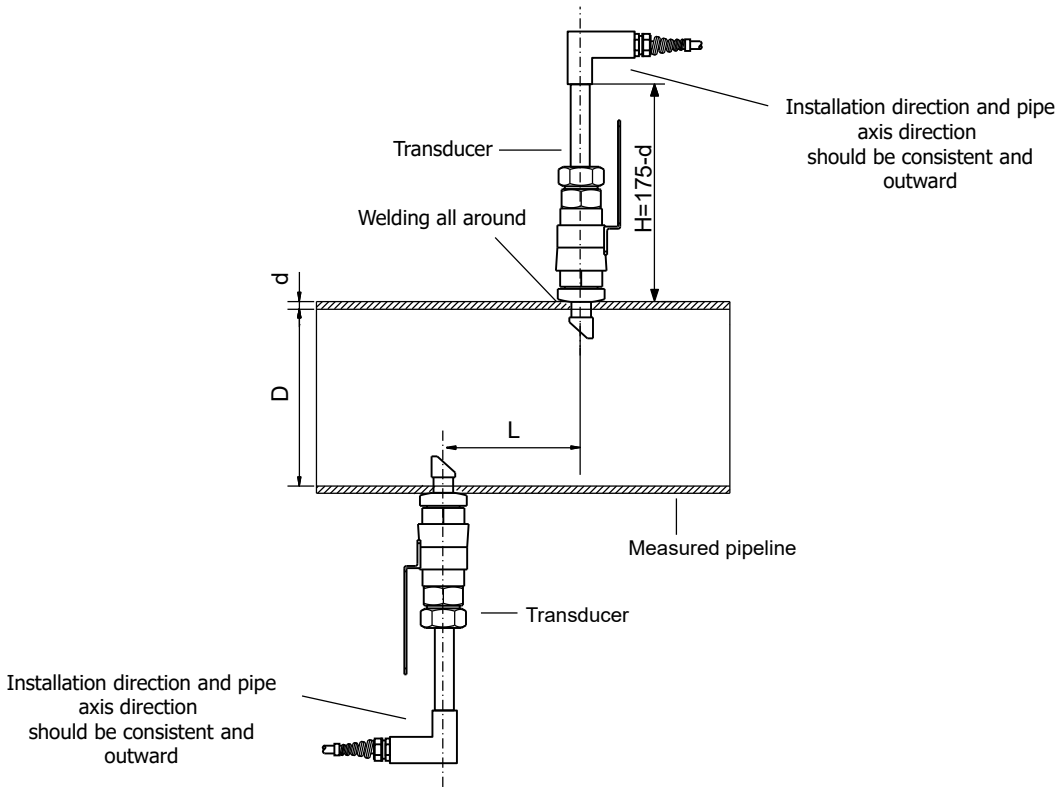
175 is Transducer length (mm);

d is Pipe wall thickness (mm).

5. Tighten the nut slightly, make the locking ring press the transducer, rotate the connector, make the installation direction of the connector consistent with the pipe axis and outward, and finally tighten the nut.

6. Connect the transducer cables to the corresponding upstream / downstream ( upstream = red, downstream = blue ) terminal ends.

7. Please refer to the following installation diagram(vertical view):




**Important**

The direction of the connector shall be consistent with the center line of the pipeline under test and outward, otherwise the sensor will not receive the signal.

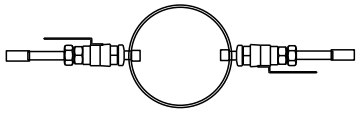
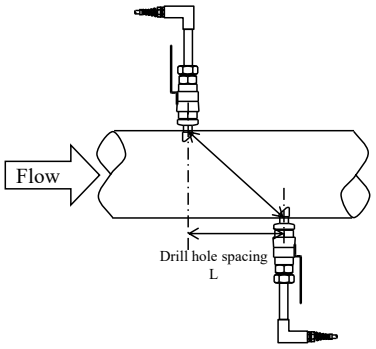
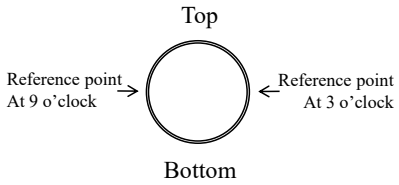
On the horizontal measuring pipeline, the sensor must be installed in the positive side position (i.e. 3 o'clock, 9 o'clock position), because there are often bubbles or air pockets in the upper part of the pipeline, and sediment at the bottom, which causes signal attenuation.

## 11.4 Transducer Mounting Methods

W211 insertion transducer mounting method: Z method through M24, it should be installed according to the specific application condition.

### 11.4.1 Z Mounting Method

Z method is the most commonly used mounting method for insertion-type ultrasonic Energy Meters, suitable for pipe diameters ranging from 50mm to 1200mm. Due to strong signal strength and high measurement accuracy, the Z method is preferable for pipe sections severely rusted or with too much scale formation on the inside wall. When installing the transducer using the Z method, be sure that the two transducers and the pipeline center axis are in the same plane, but never in the 6 or 12 o'clock positions. see below:

| Profile Chart | Top View | Section |
|---|---|---|
|  |  |  |

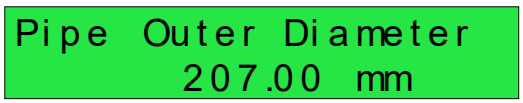
## 11.5 Pipe Parameter Entry Shortcuts

For example, measuring the diameter of DN200, pipe outside diameter is 219mm, pipe wall thickness is 6mm, pipe inner diameter is 207mm, measuring medium is water, and material is carbon steel, no liner, can be operated as follows:

Step1. Pipe outside diameter:

Press [Menu] [1] [1] keys to enter the window M11 and enter the pipe outside diameter, and then press the [Enter] key to confirm.

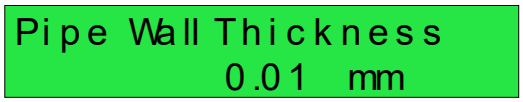
(For insertion transducer, M11 menu need to be entered the pipe inner diameter)




Step2. Pipe wall thickness

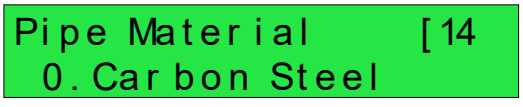
Press the [Menu] [1] [2] key to enter the window M12, and enter the pipe wall thickness, and press the [Enter] key to confirm.

(The Wall Thickness needs to be 0.01mm for use with insertion sensors.)




Step3. Pipe Material

Press the [Menu] [1] [4] keys to enter the window M14, press the [Enter] key, press the [^] or [v] key to select Pipe Material, and press the [Enter] key to confirm.




Step4. Transducers type

Press the [Menu] [2] [3] keys to enter the window M23, press the [^] or [v] key to select transducer type, and press the [Enter] key to

confirm.

2. Plug-in -W211 (W211 type insertion transducer).

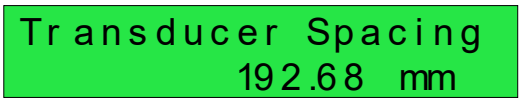
Step5. Transducer mounting methods

Press the Menu 2 4 keys to enter the window M24, press the Enter key, press the ^ or v key to select transducer-mounting method, and press the Enter key to confirm.

Choose according to the pipes on site.

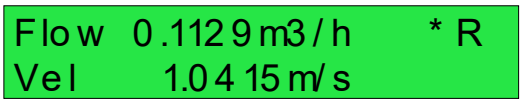

Step6. Adjust Transducer spacing

Press the Menu 2 5 keys to enter the 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).




Step7. Display measurement result

Press the Menu 0 1 keys to enter the window M01.




About other setup,please refer to the related information in the manual.

# 12 Appendix3-RTD Module and PT1000 Wiring (Module optional)

## 12.1 RTD Energy Meter Function

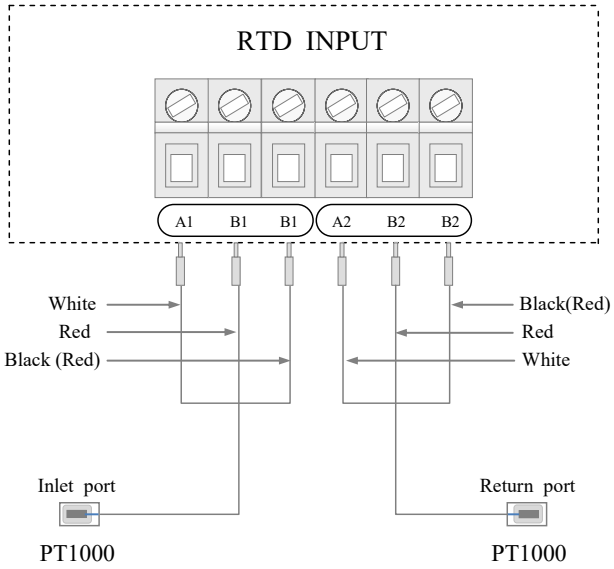
This function is applied to the following meter and measurement temperature range:

UDM101 Hot(Cold) Energy Meter:0~100℃,equipped with PT1000 temperature sensor.

The RTD Module's main function is to input the temperature values for the energy measurement. The UDM101 can automatically calculate the caloric content of water at different temperatures and deriving an instantaneous energy value and totalized energy value.

## 12.2 Wiring(PT1000)

Three-wire connections methods is used for the RTD module and PT1000 temperature sensors,connections methods is as follows.(Note: A1, A2, B1, B2 are the same color, C1 and C2 are the same color).




Three Wires Connection

The two PT1000 temperature sensors are installed on the inlet and return pipes and they will input temperature signals to the UDM101 transmitter.

## 12.3 Energy Measurement Methods

Energy Measurement Methods:

Formula 2: Q= m (h1-h2)

*Q—Energy Value*

*m—quality of the medium( density× 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 UDM101 transmitter, and the caloric value can be derived according to the above formulas and the caloric calibration index.

## 12.4 Temperature Calibration Methods

RTD Module Calibration has two methods, and customers can choose according to their actual situation.

Method 1: Resistance Box Calibration

Tools required: Two direct current resistance boxes, four wires (each wire should be no more than 40cm in length).

1. Connect RTD Module A1 and B1 terminals to the corresponding terminals of the first DC resistance box. Connect A2 and B2 terminals to the corresponding terminals of the second DC resistance box.
2. Set the resistance value of both DC resistance boxes to 1000.00Ω.
3. Press the [Menu] [v] [1] [Enter] key, enter the password "115800" to expand. The expansion is valid only during this power-on period and will automatically close after power-off.
4. Select "Adjust 0", press the [Enter] key, display OUT x.xx, use the [^] and [v] keys (use 6 and 9 for fast adjustment) to adjust the value to 0. Then press the [Enter] key, display IN x.xx, use the [^] and [v] keys to adjust the value to 0.
5. Set the resistance value of both DC resistance boxes to 1385.06Ω.
6. Use keys [^] and [v] to select "Adjust 100". Press [Enter] key. Display shows OUT xx.xx. Use [^] and [v] key(or 6 and 9 for fast adjustment) to adjust the value to 100. Press [Enter] key again. Display shows IN xx.xx. Use [^] and [v] key to adjust the value to 100.
7. Enter menu M07, set inlet and outlet water temperatures to 100±0.3, and temperature difference to 0.00±0.1. Set the resistance value of both DC resistance boxes to 1000.00Ω. Inlet and outlet water temperatures should then be set to 0.00±0.3, with a temperature difference of 0.00±0.1.

Method 2: Calibration with Standard Temperature Liquid

1. Directly immerse one end of two PT1000 temperature sensors into a mixture of ice and water (temperature at 0°C), and connect the other end to the RTD module.
2. Press [Menu] [v] [1] [Enter] key, enter password "115800" to expand. The expansion is valid only during the current power-on period and will automatically close after power-off.
3. Select "Adjust 0", press the [Enter] key, display OUT x.xx, use the [^] and [v] keys (use 6 and 9 for fast adjustment) to adjust the value to 0. Then press the [Enter] key, display IN x.xx, use the [^] and [v] keys to adjust the value to 0.
4. Enter menu M07. Inlet and outlet water temperature 0.00±0.3, temperature difference 0.00±0.1.
5. After immersing the sensor in the ice water mixture until it returns to room temperature, immerse it again in the constant temperature oil bath (temperature at 100°C).
6. Use keys [^] and [v] to select "Adjust 100". Press [Enter] key. Display shows OUT xx.xx. Use [^] and [v] key(or 6 and 9 for fast adjustment) to adjust the value to 100. Press [Enter] key again. Display shows IN xx.xx. Use [^] and [v] key to adjust the value to 100.
7. Enter menu M07. Inlet and outlet water temperature 100±0.3, temperature difference 0.00±0.1.