

FULLKON

INSTRUCTION MANUAL

Preface

- Thank you for purchasing our product.
- This manual is about the various functions of the product, wiring methods, setting methods, operating methods, troubleshooting methods, etc.
- Please read this manual carefully before operation, use this product correctly to avoid unnecessary losses due to incorrect operation.
- After you finish reading, please keep it in a place where it can be easily accessed at any time for reference during operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- The content of this manual is strictly prohibited from reprinting or copying.

Version

U-FK-2100H-EN1

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- To ensure safe use of this product and the systems it controls, Please read carefully the operation manual and understand the correct application methods before putting into operation, to avoid unnecessary losses due to operation mistakes. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety. Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment. If applied, it is the responsibility of the user to use additional equipment or systems to ensure personal safety.

-
- Do not modify this product. The following safety signs are used in this manual:



Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.



Warning: Pay special attention to the important information linked to product or particular part in the operation manual.



- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Do not use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power immediately, otherwise there will be leakage, electric shock or even a

fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.



- Do not use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

Package contents

Serial number	Item Name	Quantity
1	Ultrasonic flowmeter	1
2	Manual	1
3	Certificate	1

After opening the box, please confirm the package contents before starting the operation. If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Content

Chapter 1 Introduction	1
1.1 Preface	1
1.2 Features	2
1.3 Principle of Measurement	2
1.4 Parts identification	3
1.5 Typical Applications	6
1.6 Data Integrity and Built.in Time.Keeper	7
1.7 Product Identification	7
1.8 Specifications	7
Chapter 2 Starting Measurement	8
2.1 Built.in Battery	8
2.2 Power On	9
2.3 Keypad	10
2.4 Menu windows	10
2.5 Menu windows Arrangement	12
2.6 Steps to Configure the Parameters	12
2.7 Transducers Mounting Allocation	14
2.8 Transducers Installation	16
2.8.1 Transducers spacing	16
2.8.2 V-method Installation	17
2.8.3 Z-method Installation	17
2.8.4 w-method Installation	17
2.8.5 N-method Installation	18
2.9 Installation Checkup	18
2.9.1 signal strength	18
2.9.2 signal Quality	19
2.9.3 Total Transit Time and Delta Time	19
2.9.4 Time Ratio between the Measured Total Transit Time and the Calculated Time	19
Chapter 3 How to use	20
3.1How to determine whether the flowmeter is working properly	20

3.2 How to determine the direction of liquid flow in the pipeline	20
3.3 How to change the measurement unit system	20
3.4 How to select the flow unit	20
3.5 How to select the accumulator multiplier	20
3.6 How to open and close the accumulator	20
3.7 How to zero the flow accumulator	21
3.8 How to restore factory settings	21
3.9 How to use the damper to stabilize the flow display	21
3.10 How to use zero cut to avoid invalid accumulation	21
3.11 How to statically calibrate the zero point	21
3.12 How to modify the meter coefficient (scale factor) calibration	21
3.13 How to use password protection	22
3.14 How to use the built-in data logger	22
3.15 How to use the frequency output function	22
3.16 How to set the cumulative pulse output	23
3.17 How to generate the output alarm signal I	23
3.18 How to use the buzzer	24
3.19 How to use the OCT output	24
3.20 How to change the date and time	24
3.21 How to adjust the contrast of the LCD monitor	24
3.22 How to use RS232/RS485 serial port	24
3.23 How to check the daily, monthly and yearly traffic	24
3.24 How to use the work timer	24
3.25 How to use the manual accumulator	25
3.26 How to view the electronic serial number and other details	25
3.27 How to know the operating time of the remaining battery power	25
3.28 How to charge the battery	25
Chapter 4 Menu window Details	26
Chapter 5 Troubleshooting	33
5.1 Power.on Error Displays and Counter.Measures	33
5.2 Error Code and Counter.Measures	34
5.3 Other Problems and Solutions	35

Chapter 6 Communication Protocol	36
6.1 General	36
6.2 Interface Pin.out Definition	36
6.3 The Protocol	37
6.3 Protocol Prefix Usage	38
6.4 Codes for the Keypad	39
Chapter 7 Warranty & After-sales Service	41

Chapter 1 Introduction

1.1 Preface

Welcome to the FK-2100H series ultrasonic flow meter that has been manufactured with patent technologies and is equipped with more functions and advanced performance than our previous versions.

The ultrasonic flowmeter has been upgraded on the basis of the previous version, and the new version retains most of the excellent features and functions of the previous version: pulse measurement technology, ultrasonic ignition and small signal receiving circuit, etc. Major improvements have been made to the battery powered circuit and the transmitter circuit. Since we have applied state-of-the-art measurement techniques and obtained a more reliable model of the ultrasonic flowmeter, all other circuits are simply integrated into this new version without major modifications.

The FK-2100H series flow meter incorporates the latest ICs manufactured from the famous semiconductor manufacturers like Philips, Maxim, TI, win bond, and xilinx. The hardware features the ease of operation, high accuracy and outstanding reliability, while the software provides a very user friendly interface and much more functions. It employs a patent balanced lower voltage multi-pulse igniting circuit which increases the anti-interference ability magnificently so that the flow meter will work properly even in demanding industrial environments such as those with power frequency transverter working nearby.

Other outstanding features:

----the signal receiving circuits feature self-adapting performance so as to ensure that the user can easily operate the instrument without any adjustment.

----the built-in rechargeable Ni-H battery can work continuously for more than 12 hours without recharge.

The advanced circuit design, the integration of the latest semiconductors, the user-friendly software interface both in English and Chinese languages and small-sized PCB board, all these features combine to make the FK-2100H series ultrasonic flow meter the best and the biggest seller on the market.

Moreover, it is gaining more and more recognition on the international flow meter market.

1.2 Features

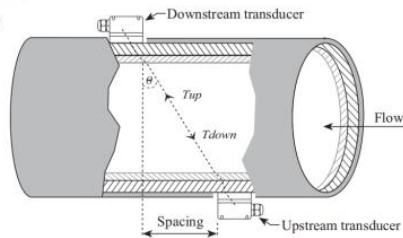
- 0.5% of linearity
- Bilingual interface in Chinese and English
- Patent balanced lower-voltage multi-pulse
- Ultrasonic igniting
- Built-in date totalizers
- 0.5 second totalizing period
- 100 Pico-second resolution of time measurement
- 0.2% of repeatability
- 4 flow totalizers
- Built-in data logger
- Good anti-interference

1.3 Principle of Measurement

The FK-2100H ultrasonic flow meter is designed to measure the fluid velocity of liquid within a closed conduit. The transducers are a non-contacting, clamp-on type, which will provide benefits of non-fouling operation and easy installation.

The FK-2100H transit time flow meter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe at a specific distance from each other. The transducers can be mounted in V-method where the sound transverses the pipe twice, or w-method where the sound transverses the pipe four times, or in Z-method where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. This selection of the mounting method depends on pipe and liquid characteristics. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that it takes for sound to travel between the two transducers. The difference in the transit time measured is directly and exactly related to the velocity of the liquid in the pipe, as shown in Figure 1.

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



Where

θ is the include angle to the flow direction

M is the travel times of the ultrasonic beam

D is the pipe diameter

T_{up} is the time for the beam from upstream transducer to the downstream one

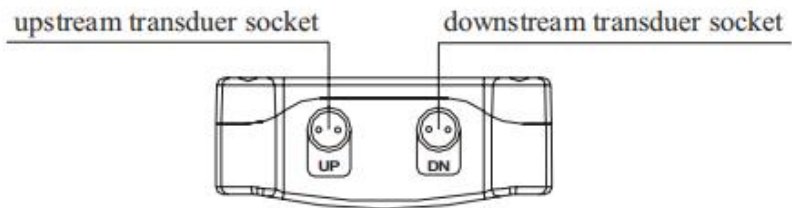
T_{down} is the time for the beam from downstream transducer to the upstream one

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

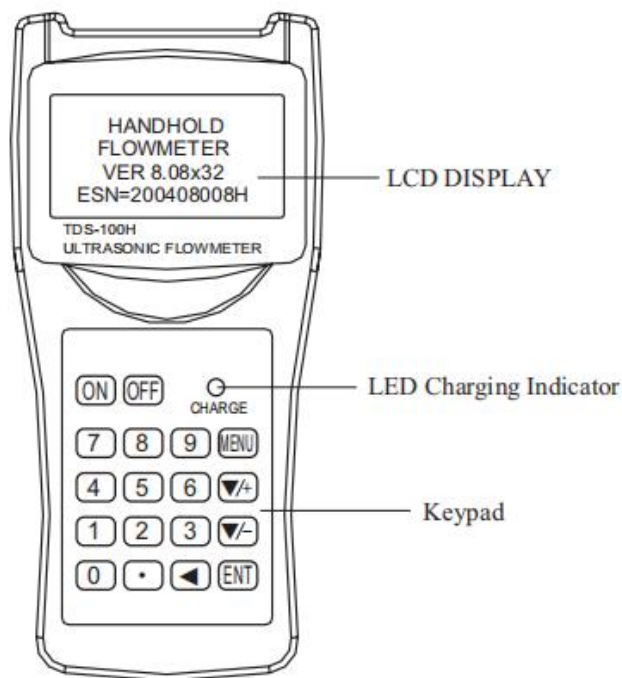
1.4 Parts identification

Converter:

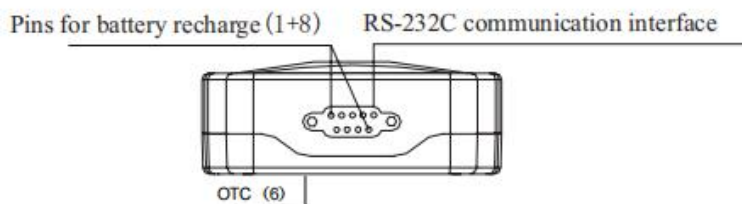
Top view



Front view

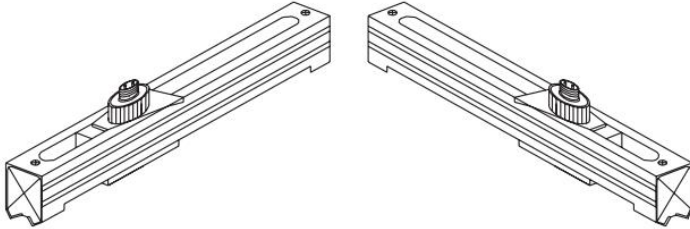
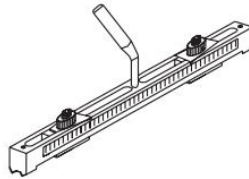


Bottom view

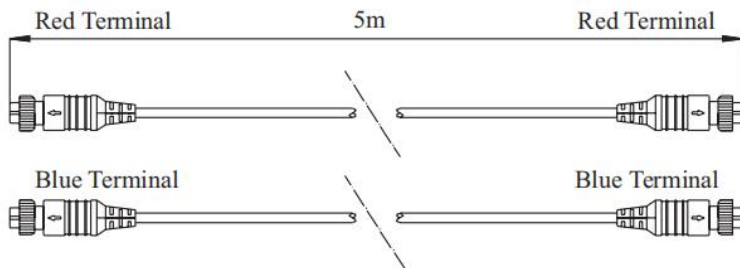


Transducers:

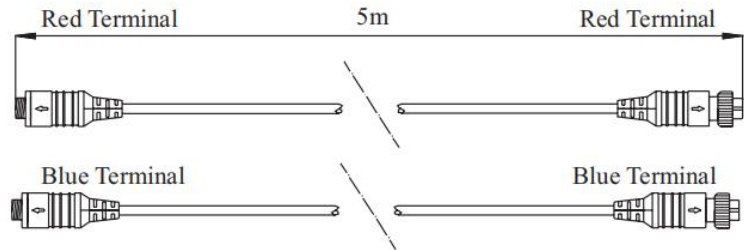
Standard-HM (50mm-700mm)

Standard-HS (20mm-100mm)
(Optional Accessories)

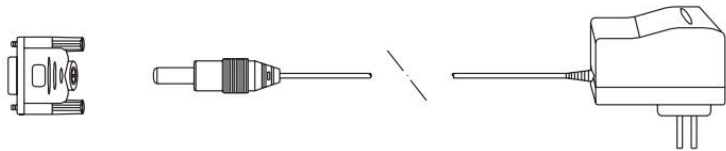
Cable 5m x2



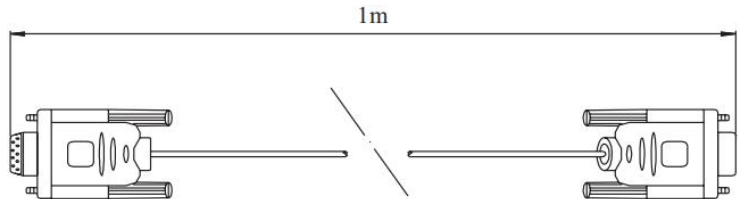
Extended Cable 5m x2(Optional Accessories)



Converted Terminal and AC/DC Adapter



Cable of RS-232C interface



1.5 Typical Applications

The FK-2100H flow meter can be virtually applied to a wide range of measurements. The measured pipe ranges 20-6000 mm [0.5 - 200 inch]. A variety of liquid applications can be accommodated: ultra-pure liquids, potable water,

chemicals, raw sewage, reclaimed water, cooling water, river water, plant effluent, etc. Because the instrument and transducers are non-contacting and have no moving parts, the flow meter can not be affected by system pressure, fouling or wear. standard transducers are rated to 110°C. Higher temperatures can be accommodated. For further information, please consult the manufacturer for assistance.

1.6 Data Integrity and Built.in Time.Keeper

All user-inputted configuration values are retained in the built-in non-volatile flash memory that can store them for over 100 years,even if power is lost or turned off. Password protection is provided to avoid inadvertent configuration changes or totalizer resets.

A time-keeper is integrated in the flow meter for the index of date totalizing and works as the time base of flow accumulation. It keeps operating as long as the battery's terminal voltage is over 1.5V. In case of battery failure, the time-keeper will not keep running and it will lose proper time values.

The user must re-enter proper time values in case the battery becomes totally exhausted. An improper time value affects no other functions but the date totalizer.

1.7 Product Identification

Each set of the FK-2100H series flow meter has a unique product identification or ESN written into the software that can only be modified with a special tool by the manufacturer. In case of any hardware failure, please provide this number which is located on menu window number M61 when contacting the manufacture.

1.8 Specifications

Linearity	0.5%
Repeatability	0.2%
Accuracy	±1% of reading at rates>0.2 mps
Response Time	0.999 seconds, user.configurable
Velocity	±32 m/s
Pipe Size	20mm.6000mm
Rate Units	Meter, Feet, Cubic Meter, Liter, Cubic Feet, USA Gallon, Imperial Gallon, Oil Barrel, USA Liquid Barrel, Imperial Liquid Barrel, Million USA Gallons. User configurable.

Totalizer	7.digit totals for net, positive and negative flow respectively
Liquid Types	Virtually all liquids
Security	Setup values Modification Lockout. Access code needs unlocking
Display	4x8 Chinese characters or 4x16 English letters
Communication Interface	RS-232C, baud.rate: from 75 to 57600. Protocol made by the manufacturer and compatible with that of the FUJI ultrasonic flow meter. User protocols can be made on enquiry.
Transducers	Model M2 for standard, other 4 models for optional
Transducer Cord Length	Standard 2x5 meters, optional 2x10 meters/2x15 meters
Power Supply	3 AAA Ni.H built.in batteries. when fully recharged it will last over 10 hours of operation. 100V.240VAC for the charger
Data Logger	Built.in data logger can store over 2000 lines of data
Manual Totalizer	7-digit press-key-to-go totalizer for calibration
Housing Material	ABS
Case Size	100x66x20mm
Handset weight	514g (1.2 lbs) with batteries

Chapter 2 Starting Measurement

2.1 Built.in Battery

The instrument can operate either from the built-in Ni-H rechargeable battery, which will last over 10 hours of continuous operation when fully recharged, or from an external AC/power supply from the battery charger.

The battery charging circuits employ a scheme of constant-current and constant-voltage. It has a characteristic of fast charging at the beginning and very slow charging when the battery approaches to full recharge. Generally, when the green LED starts coming on, the battery would be nearly 95% recharged and when the red LED is off, the battery would be 98% recharged.

since the charging current becomes tapered when the battery recharge is nearly completed, i.e. the charging current becomes smaller and smaller, therefore, there should be no over-recharging problem. That means the charging progress can last

very long. The charger can be connected to the handset all the time when an around-the-clock measurement is required.

when fully recharged, the terminal voltage reaches around 4.25V. The terminal voltage is displayed on window M07. when the battery is nearly consumed, the battery voltage drops to below 3V. The user can obtain an approximate battery working time from the battery voltage.

A software battery working time estimator is integrated in this instrument based on the terminal voltage. Please note that the estimator may have relatively bigger errors in the estimated working time, especially when the voltage is in the range of around 3.70 to -3.90 volt.

2.2 Power On

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

Once the flow meter is switched on, it will run a self diagnostic program, checking first the hardware and then the software integrity. If there is any abnormality, corresponding error messages will display.

Generally, there should be no display of error messages, and the flow meter will go to the most commonly used Menu window Number 01 (short for M01) to display the Velocity, Flow Rate, Positive Totalizer, signal strength and signal Quality, based on the pipe parameters configured last time by the user or by the initial program.

The flow measurement program always operates in the background of the user interface. This means the flow measurement will keep on running regardless of any user menu window browsing or viewing. Only when the user enters new pipe parameters will the flow meter change measurement to the new parameter changes.

when new pipe parameters have been entered or when the power has been just switched on, the flow meter will enter an adjusting mode to make the signals magnified with proper amplification. By this step, the flow meter is going to find the best threshold of receiving signal. The user will see the progress by the number 1, 2, or 3, which are indicated on the right lower corner of the LCD display

when the transducers have been adjusted on the pipe by the user, the flow meter will re-adjust the signal automatically.

Any user-entered configuration value will be retained into the NVRAM of the flow meter, until it is modified by the user.

2.3 Keypad

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

Keys **0~9** and **.** are keys to enter numbers

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

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

Key **◀** is backspace key, when the user wants go left or wants backspace the left character that is located to the left of the cursor.

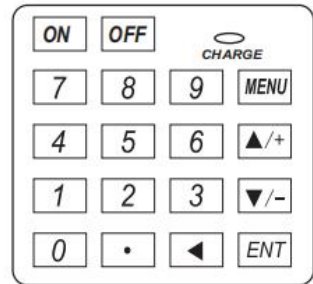
Key **ENT** is the ENTER key for any inputting or selections.

Key **MENU** is the key for the direct menu window jump over. When ever the user wants to proceed to a certain menu window, the user can press this key followed by 2-digit numbers.

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

The **OFF** key is for the power on.

The **ON** key is for the power off.



2.4 Menu windows

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

There are 2 methods to enter certain menu window:

(1) Direct going/entering. The user can press the **MENU** key followed by two-digit number keys. For example, the menu window M11 is for the entering of pipe outer

diameter. The display will go to the M11 menu window after the user presses **MENU** **1** **1**

(2) Pressing **▲/4** and **▼/3** keys. Each time of the **▲/4** key pressing will proceed to the lower-numbered menu window. For example, if the current window is on M12, the display will go to the number M11 window after pressing the **▲/4** key.

There are three different types of menu windows:

- (1) Menu windows for number entering, like M11 for the entering of pipe outer diameter.
- (2) Menu windows for option selection/selecting options, like M14 for the selection of pipe materials.
- (3) Displaying windows only, like M00 to display Velocity, Flow Rate etc.

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

2 **1** **9** **.** **2** **3** **4** **5** **ENT**

For the option selection windows, the user should first press the **ENT** key to enter into a selection modification mode, then either make the selection by pressing the **▲/4** and **▼/3** keys to select the option with a number antecedent to the option. In the end, the **ENT** key must be pressed to make the selection. For example, with menu window M14 for the selection of pipe material selection, (the **MENU** **1** **4** should be pressed first to enter this menu window if the current menu window is on a different window. The pipe material is stainless steel which has a number "1" antecedent to "stainless steel" on the display, the user should first press the **ENT** key to enter into a selection modification mode, then either make the selection by pressing the **▲/4** and **▼/3** keys to make the cursor on the line that displays "1. stainless steel", or make the selection by pressing the **1** key directly.

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

2.5 Menu windows Arrangement

M00~M09 windows for the display of the flow rate, velocity, date time, totalizers, battery voltage and estimated working hours for the battery.

M10~M29 windows for entering the pipe parameter.

M30~M38 windows for flow rate unit selections and totalizer unit selections.

M40~M49 windows for response time, zeroing, calibration and modification password setup. M50~M53 windows for the built-in logger

M60-M78 windows for time-keeper initialization, version and ESN information viewing and alarms.

M82 window for viewing date totalizer.

M90~M94 are diagnostic windows for a more accurate measurement.

M97~M99 are not windows but commands for the outputting of display copying and pipe parameter setups. $M + 0 \sim M + 8$ are windows for some additional functions, including a scientific calculator, viewer on records such as total working hours, turn-on and turn-off times, dates and times when the flow meter has been turned on or turned off.

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

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

2.6 Steps to Configure the Parameters

The following parameters need to be configured for a proper measurement:

- (1) Pipe outer diameter
- (2) Pipe wall thickness
- (3) Pipe materials (for non-standard pipe materials*, the sound speed for the material must be configured too)

*standard pipe materials and standard liquids refer to those with the sound parameters that have already been programmed into software of the flow meter, therefore there is no need to configure them

(4) Liner material and its sound speed and thickness, if there is any liner.

(5) Liquid type (for non-standard liquids, the sound speed of the liquid is also needed)

(6) Transducer type adapted to the flow meter. Generally the standard MI or the Frame M-sized transducers will be the selected option.

(7) Transducer mounting methods (the V-method or Z-method is the common option)

(8) Check up the space displayed on M25 and install the transducers accordingly. For standard pipe materials and standard liquids, the following detailed step-by-step set up is recommended.

(1) Press keys **MENU** **I** **I** to enter M11 window to input the digits for the pipe outer diameter, and then press **ENT** key.

(2) Press key **▼** to enter M12 window to input the digits for the pipe outer diameter and then press **ENT** key.

(3) Press key **▼** to enter M14 window, and press **ENT** key to enter the option selection mode. Use keys **▲** and **▼** to scroll up and down to the intended pipe material, and then press **ENT** key.

(4) Press key **▼** to enter M16 window, press **ENT** key to enter the option selection mode, use keys **▲** and **▼** to scroll up and down to the liner material, and then press **ENT** key. select "No Liner", if there is no liner.

(5) Press key **▼** to enter M20 window, press **ENT** key to enter the option selection mode, use keys **▲** and **▼** to scroll up and down to the proper liquid, and then press **ENT** key.

(6) Press key **▼** to enter M23 window, press **ENT** key to enter the option selection mode, use keys **▲** and **▼** to scroll up and down to the proper transducer type, and then press **ENT** key.

(7) Press key **▼** to enter M24 window, press **ENT** key to enter the option selection mode, use key **▲** and **▼** to scroll up and down to the proper transducer mounting method, and then press **ENT** key.

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

The first-time users may need some time to get familiar with the operation. However, the user friendly interface of the instrument makes the operation quite easy and simple. Before long, the user will configure the instrument with very little key pressing, since the interface allows the user to go to the desired operation directly without any extra steps.

The following tips will facilitate the operation of this instrument.

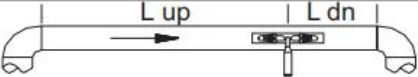
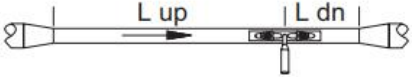
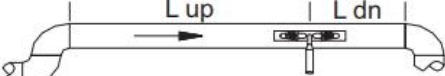
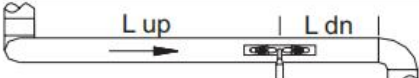
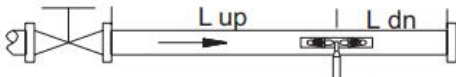
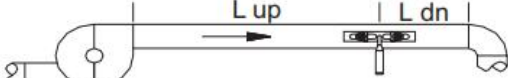
(1) when the window display is between M00 to M09, press a number key x , the user will go directly to the M0x window. For example, if the current window displays M01, press 7 and the user will go to M07.

(2) when the window display is under M00 to M09, press the ENT key and the user will go to M90; press ENT key to return. Press the dot key to go to M11 when the window display is under M25, press ENT key to go to M01.

2.7 Transducers Mounting Allocation

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

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

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

Examples of optimum locations.

Principles to selection of an optimum location

- (1) Install the transducers on a longer length of the straight pipe. The longer the better, and make sure that the pipe is completely full of liquid.
- (2) Make sure that the temperature on the location does not exceed the range for the transducers. Generally speaking, the closer to the room temperature, the better.
- (3) Take the pipe fouling into consideration. select a straight length of a relatively newer pipe. If the condition is not satisfying, consider the fouling thickness as part of the liner for a better result.

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

2.8 Transducers Installation

The transducers used by the FK-2100H series ultrasonic flow meter are made of piezoelectric crystals both for transmitting and receiving ultrasonic signals through the wall of liquid piping system. The measurement is realized by measuring the traveling time difference of the ultrasonic signals. since the difference is very small, the spacing and the alignment of the transducers are critical factors to the accuracy of the measurement and the performance of the system. Meticulous care should be taken for the installation of the transducers.

steps to the installation of the transducers

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

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

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

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

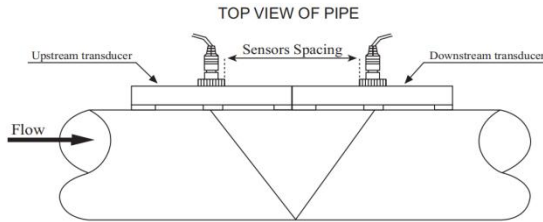
To avoid gas bubbles inside the upper part of the pipe, the transducers should be installed horizontally by the side of the pipe.

2.8.1 Transducers spacing

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

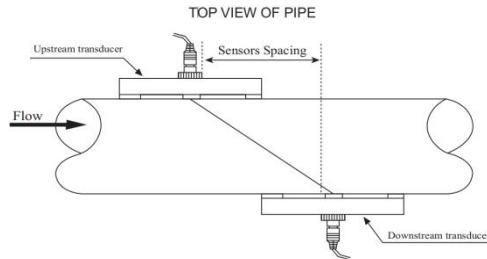
2.8.2 V-method Installation

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



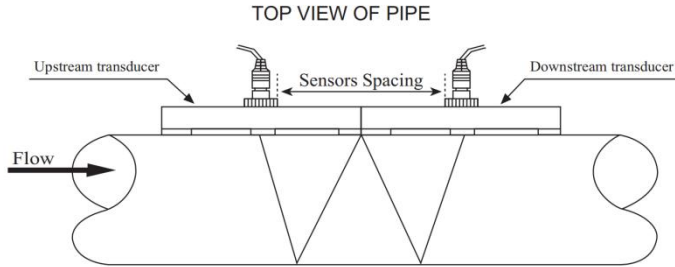
2.8.3 Z-method Installation

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



2.8.4 w-method Installation

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



2.8.5 N-method Installation

Rarely used method.

2.9 Installation Checkup

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

2.9.1 signal strength

signal strength indicates the amplitude of receiving ultrasonic signals by a 3-digit number. [000] means there is no signal detected, and [999] refers to the maximum signal strength that can be received.

Although the instrument works well if the signal strength ranges from 500 to 999, stronger signal strength should be pursued, because a stronger signal means a better result. The following methods are recommended to obtain stronger signals:

- (1) Relocate a more favorable location, if the current location is not good enough for a stable and reliable flow reading, or if the signal strength is lower than 700.
- (2) Try to polish the outer surface of the pipe, and apply more coupler to increase the signal strength.
- (3) Adjust the transducers both vertically and horizontally while checking the varying signal strength, stop at the highest position, and then check the transducers spacing to make sure the transducers spacing is the same as what the M25 shows.

2.9.2 signal Quality

signal quality is indicated as the Q value in the instrument. A higher Q value would mean a higher signal and Noise Ratio (short for SNR), and accordingly a higher degree of accuracy would be achieved. Under normal pipe condition, the Q value is in the range 600-900, the higher the better. Causes for a lower Q value could be:

- (1) Interference of other instruments and devices such as a powerful transverter working nearby. Try to relocate the flow meter to a new place where the interference can be reduced.
- (2) Bad sonic coupling for the transducers with the pipe. Try to apply more coupler or clean the surface, etc.
- (3) Pipes are difficult to be measured. Relocation is recommended.

2.9.3 Total Transit Time and Delta Time

The numbers displayed on menu window M93 are called total transit time and delta time respectively. They are the primitive data for the instrument to calculate the flow rate inside the pipe. so the flow rate indication will vary accordingly with the total time and delta time.

The total transit time should remain stable or vary little.

If the delta time fluctuates higher than 20%, it means there are certain kinds of problems with the transducer installation.

2.9.4 Time Ratio between the Measured Total Transit Time and the Calculated Time

This ratio would be used to check the transducer installation. If the pipe parameters are entered correctly and the transducers are installed properly, the value for this ratio should be in the range of 1003. If this range is exceeded, the user should check:

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

Chapter 3 How to use

3.1 How to determine whether the flowmeter is working properly

Under normal circumstances, in the lower right corner of the LCD display with "R" appears, that the flowmeter is working properly. If "H" appears, it means that the received signal is poor, please refer to the self-diagnosis chapter.

If "I" appears, it means that no signal is received.

If "J" appears, it means the flowmeter may have a hardware failure, please refer to the self-diagnosis chapter.

3.2 How to determine the direction of liquid flow in the pipeline

Make sure the current flowmeter is working properly.

Check the instantaneous flow, if the display is a positive value, the direction of liquid flow from the red sensor to the blue sensor: if the display is a negative value, the direction of liquid flow from the blue sensor to the red sensor.

3.3 How to change the measurement unit system

Select the imperial or metric system in the M30 menu window.

3.4 How to select the flow unit

Select in the menu window M31.

After selecting the flow rate unit, select the time unit.

3.5 How to select the accumulator multiplier

Use window M33 to select an appropriate accumulator multiplier, not too fast or too slow, depending on the flow rate, and preferably keep it to a few pulses per minute. If the multiplication factor is too small, lost pulses will occur, as the minimum pulse period is designed to be 500 milliseconds.

If the multiplication factor is too large, the accumulated pulses will be too slow, which will affect the work of other secondary instruments.

3.6 How to open and close the accumulator

Use M34, M35 and M36 to turn the positive, negative and net accumulators on and off respectively.

3.7 How to zero the flow accumulator

Use M37 to select the accumulator to be zeroed.

3.8 How to restore factory settings

When "Select operation" is displayed in window 37, press and then press to restore the parameters entered by the user. The parameters entered by the user are restored to the original factory settings.

3.9 How to use the damper to stabilize the flow display

The function of the damper is to stabilize the flow display, which is essentially a section filter. Enter "0" in the window M40 to indicate no damping. Of course, the larger the value of the flowmeter display the more stable the instantaneous flow, it is generally recommended that the user enter a value of about 30 seconds, the size of this value will not have any effect on the cumulative flow.

3.10 How to use zero cut to avoid invalid accumulation

The data in window 41 is called the low flow rate cut-off value. The flowmeter treats flow rates below this value as "0" in absolute terms. This parameter can be set to avoid a false accumulation of measurement errors generated by the meter when the true flow rate is "0". In general, set this parameter to 0.03m / s.

When the actual flow rate of the pipeline fluid is greater than the low flow rate cut-off value, the low flow rate cut-off value and the measurement results are irrelevant, never affect the measurement results.

3.11 How to statically calibrate the zero point

When the flow in the pipe completely stopped, the flowmeter will not show "0", but a small "zero value", then you can set the zero point to achieve the purpose of accurate measurement.

Unify through the M42 window to complete this function.

The requirement is to recognize the liquid flow in the pipe must be completely stopped after the flow, enter the M42 window, press to start.

3.12 How to modify the meter coefficient (scale factor) calibration

The scale factor is the ratio of the "true flow" to the flow measured by the meter.

The scale factor can be obtained from the real flow test of the calibration device.

3.13 How to use password protection

The flowmeter is protected by a password lock to prevent unauthorized personnel from mistakenly modifying and zeroing the accumulator.

A password lock on the meter allows access to the data, but does not allow any modification.

The password entered in the M47 window can be composed of 1-4 digits: no password lock can be directly pressed the **ENT** key, M47 to unlock the meter, press the **ENT** key directly.

3.14 How to use the built-in data logger

The built-in data logger has 24K bytes of space and can store up to 2000 lines of data.

Use the M50 window to open the data logger and select the items you want to record.

Use window M51 to set the start time, recording interval and recording duration of the recorded data. Using window M52 to select the data storage direction, the meter can store the data in a buffer.

Data can also be transferred to the RS-232C interface without being stored in a buffer.

Use window M53 to view the data in the buffer.

Use window M52 to clear the data from the RS-232C interface and the buffer.

3.15 How to use the frequency output function

All handheld ultrasonic flowmeter has a frequency signal output function, networked to other devices with the frequency of the size of the instantaneous flow, Frequency output can be set by the user, only four parameters need to be set.

In the M68 window to set the lower limit of instantaneous flow, in the M69 window to set the upper limit of instantaneous flow.

In M67, only 4 parameters are set by the user.

The frequency range is set in window M68.

For example: a pipeline flow range is 0~3000m³/h, the corresponding frequency signal 200~1000Hz is required to be output. The user enters 0 in window M68, 3000 in window M69, and 200 and 1000 in window M67

Please note that the user should also select option 13 "Frequency Output" in window M78, and also make the hardware connection for OCT output.

3.16 How to set the cumulative pulse output

Each unit of flow, FK-2100H ultrasonic flowmeter can generate a cumulative pulse output to the external counting device.

Flow units and multiplication factor settings in 3.4, 3.5.

Accumulation pulse can only be through the hardware OCT or buzzer.

For example, if you want to use a buzzer to output positive accumulation pulses, each pulse representing 0.1m³ of flow, so that the buzzer will sound for every 0.1m³ of liquid flowing through the pipe.

Please follow the steps below:

In window M32, select the cumulative flow unit: "cubic meters (m³)".

In window M33, select the multiplication factor: "x 0.1".

In window M77 select: "Positive cumulative pulse output".

3.17 How to generate the output alarm signal I

Ultrasonic flowmeter can generate two types of alarm signals: audible alarm signal and switch output alarm signal. The following conditions can be used as the buzzer and switch output trigger source:

The probe does not receive the ultrasonic signal.

The probe receives the ultrasonic signal too poorly.

The flow meter is not in the normal measurement state.

The flow rate is reversed.

The frequency signal is out of range.

Instantaneous flow rate is out of range.

There are two alarms, called: Alarm #1 and Alarm #2. The user sets the output range in windows M73, M74, M75, M76.

For example, when the flow rate is less than 300 m³/h and more than 2000 m³/h, the buzzer will sound, and the setting process is as follows:

Enter the lower flow rate of 300 in window M73 as the #1 alarm trigger point.

In window M74, enter the upper limit flow rate of 2000 as the #2 alarm trigger point.

Select "6. #1 Alarm" in window M77

3.18 How to use the buzzer

Handheld ultrasonic flowmeter built-in buzzer is programmable , set in the M77 window.

3.19 How to use the OCT output

Handheld ultrasonic flowmeter OCT output open and close conditions are programmable, such as cumulative pulse output . The settings are made in window M77.

Please note that the frequency output signal is also output from the OCT.

OCT output and Rs-232C share a common interface, the connector is 6 pins, ground is 5 pins.

3.20 How to change the date and time

The date and time normally do not need to be modified, the clock power consumption is very small.

Only when the battery is completely depleted and it takes a long time to replace the battery is it necessary to change the date. To change the date and time in the M61 window, you can use the A key to skip the part that does not need to be changed.

3.21 How to adjust the contrast of the LCD monitor

The result of the adjustment is stored in the EEPROM and will not be adjusted even if the factory settings are restored.

3.22 How to use RS232/RS485 serial port

Set up the RS-232C serial port in the M62 window.

3.23 How to check the daily, monthly and yearly traffic

In window M82, you can check the past daily, monthly, and yearly historical traffic data and machine operating status.

3.24 How to use the work timer

The Work Timer allows you to time an operation, for example, how long the battery will continue to operate when fully charged.

Press ENT in the M82 window and select "Yes" to reset the timer.

3.25 How to use the manual accumulator

Press ENT in window M38 to start accumulation, and then press ENT to stop.

3.26 How to view the electronic serial number and other details

Handheld ultrasonic flowmeters use a unique electronic serial number (ESN) to distinguish a flowmeter, which consists of an 8-digit identifier containing software version and production date information.

Users can also use this electronic serial number for device management.

This electronic serial number is displayed in the M61 window.

Use window M+1 to view the total operating time since the meter was shipped.

Use window M+4 to view the total number of power failures since the meter was shipped.

3.27 How to know the operating time of the remaining battery power

Check in window M07, see section s.2.1 for instructions.

3.28 How to charge the battery

In chapter 2.1 for instructions.

Chapter 4 Menu window Details

Menu window No.	Function
M00	Display three positive negative net totalizers, signal strength, signal quality and working status
M01	Display P0s totalizer, flow rate, velocity, signal strength, signal quality and working status
M02	Display NEG totalizer, flow rate, velocity, signal strength, signal quality and working status
M03	Display NET totalizer, flow rate, velocity, signal strength, signal quality and working status
M04	Display date and time, flow rate, signal strength, signal quality and working status
M05	Display date and time, velocity, signal strength, signal quality and working status
M06	Display the wave shape of the receiving signal
M07	Display the battery terminal voltage and its estimated lasting time
M08	Display the all the detailed working status, signal strength, signal quality
M09	Display today's total flow, velocity, signal strength, signal quality and working status
M10	Window for entering the outer perimeter of the pipe
M11	Window for entering the outer diameter of the pipe 0 to 6000mm is the allowed range of the value
M12	Window for entering pipe wall thickness
M13	Window for entering the inner diameter of the pipe

M14	Window for selecting pipe material Standard pipe materials (that the user need not know the speed) include: (0) carbon steel (1) stainless steel (2) cast iron(3) ductile iron (4) copper (5) PVC (6) aluminum (7) asbestos (8) fiberglass
M15	Window for entering the pipe material speed only for non.standard pipe materials
M16	Window for selecting the liner material, select none for pipes without any liner standard liner materials that the user need not know the speed include: (1)Tar Epoxy (2)Rubber (3) Mortar (4) Polypropylene (5) Polystyrol (6)Polystyrene (7) Polyester (8) Polyethylene (9) Ebonite (10) Teflon
M17	Window for entering the liner material speed only for non.standard liner materials
M18	Window for entering the liner thickness, if there is a liner
M19	Window for entering the ABS thickness of the inside wall of the pipe
M20	Window for selecting fluid type For standard liquids that the user need not know the liquid speed include: (0) water (1) sea water (2) Kerosene (3)Gasoline (4) Fuel oil (5) Crude oil (6)Propane at -45C (7) Butane at 0C (8)Other liquids (9) Diesel oil (10)Caster oil(11)Peanut oil (12) #90 Gasoline (13) #93 Gasoline (14) Alcohol (15) Hot water at 125C
M21	Window for entering the fluid sonic velocity only for non.standard liquids
M22	Window for entering the viscosity of the non.standard liquids

M23	Window for selecting the proper transducers There are 14 different types of transducers for selection. If the user.type.transducers are used, 4 user type wedge parameters, which will be prompted by the software, should be entered following. If the n type transducers are used, 3 π type transducers and pipe parameters should be entered following.
M24	Window for selecting the transducer mounting methods Four methods can be selected: (0) V-method (1) Z-method (2) N-method (3) W-method
M25	Display the transducer mounting spacing
M26	Entry to store the parameter configuration into the internal NVRAM
M27	Entry to load one set of saved parameters
M28	Select YES or NO for the instrument to determine whether or not to hold (or to keep) the last correct value when poor signal condition occurs. YES is the default setup
M29	Enter a value ranging from 000 to 999. 0 is the default value
M30	Window for selecting unit system. Default value is 'Metric'. The change from English to Metric or vice versa will not affect the unit for totalizers.
M31	Window for selecting flow rate that will be used by the instrument afterward. Flow rate can be in 0. Cubic meter short for (m3) 1. Liter (l) 2. USA gallon (gal) 3. Imperial Gallon (igl) 4. Million USA gallon (mgal) 5. Cubic feet (cf) 6. USA liquid barrel (bal) 7. Imperial liquid barrel (ib) 8. Oil barrel (ob) The flow unit in terms of time can be per day, per hour, per minute or per second. so there are 36 different flow rate units in total.

M32	Window for selecting the totalizers' working unit
M33	Select totalizer multiplier The multiplier ranges from 0.001 to 10000
M34	Turn on or turn off the NET totalizer
M35	Turn on or turn off the P0s totalizer
M36	Turn on or turn off the NEG totalizer
M37	(1) Totalizer reset (2) Restore the instrument to the default parameters as the manufacturer did
	By pressing the dot key followed by the backspace key. Take care or make note on the parameters before doing the restoration
M38	Press a key to run or to stop totalizer for easier calibration
M39	Operational interface language selection in Chinese and English. This selection makes it possible that more than 2 billions of people on the world can read the menu.
M40	Flow rate damper for a stable value. The input range is 0 to 999 seconds. 0 means there is no damping. Default value is 10 seconds
M41	Lower flow rate cut.off to avoid invalid accumulation.
M42	Zero point setup under the condition when there is no liquid running inside the pipe.
M43	Clear the zero point set by the user, and restore the zero point set by the manufacturer
M44	Set up a manual flow bias. Generally this value should be 0.
M45	Scale factor for the instrument. The default value is '1'. Keep this value as '1', when no user calibration has been made.
M46	Network environment Identification Number. Any integer can be entered except 13(0DH, carriage return), 10 (0AH, 1 line feeding), 42 (2AH), 38, 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer to the chapter for communication.

M47	System locker to avoid modification of the parameters
M48	Not used
M49	Communication tester
M50	"Option" selection for the built.in logger. It also functions as the switch of logger
M51	Time setup for the data logger
M52	(1) Data logging direction control. If 'To RS232' is selected, all the data produced by the data logger will be transmitted out through the RS232 interface (2) If 'To buffer' is selected, the data will be stored into the built.in logger memory (3) Buffer transferring and buffer clearing
M53	Logger buffer viewer. It functions as a file editor. Use Dot, backspace UP and DN keys to browse the buffer. If the logger is ON, the viewer will automatically refresh once new data are stored
M54	Not used
M55	Not used
M56	Not used
M57	Not used
M58	Not used
M59	Not used
M60	99-year calendar. Press ENT for modification. Use the dot key to skip the digits that need no adjusting.
M61	Display Version information and Electronic serial Number (ESN) that are unique for each 2100H series flow meter. The users can employ the ESN for instrumentation management
M62	RS-232 setup. Baud rate can be 75 to 115200 bps
M63	Not used
M64	Not used
M65	Not used

M66	Not used
M67	Input the frequency range for the frequency output. The biggest range is 0Hz.9999Hz. Default value is 1-1001 Hz
M68	Enter a flow rate value that corresponds to lower frequency
M69	Enter a flow Rate value that corresponds to higher frequency
M70	LCD display backlight control. The entered value indicates how many seconds the backlight will be on with every key pressing.
M71	LCD contrast control. The LCD will become darker when a small value is entered.
M72	Working timer. It can be cleared by pressing ENT key, and then select YES
M73	Enter Lower Flow Rate value that will trigger the #1 Alarm. There are two virtual alarms in the system. By "virtual" we mean that the user must redirect the output of the alarms by setting up the output hardware in M78 and M77
M74	Enter the higher flow rate value that will trigger the #1 Alarm.
M75	Enter the lower flow rate value that will trigger the #2 Alarm.
M76	Enter the higher flow rate value that will trigger the #2 Alarm.
M77	Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs
M78	OCT (Open Collect Transistor Output) setup By selecting a proper input source, the OCT hardware will close when the trigger event occurs
M79	Not used
M80	Work as a keypad and display for another handheld set by RS-232 connected with the handset
M81	Not used
M82	Date totalizer
M83	Not used

M84	Not used
M85	Not used
M86	Not used
M87	Not used
M88	Not used
M89	Not used
M90	Display signal strength, signal quality, time ratio on the upper right corner.
M91	Displays the Time Ratio between the Measured Total Transit Time and the Calculated time. If the pipe parameters are entered correctly and the transducers are properly installed, the ratio value should be in the range of $100 \pm 3\%$. Otherwise the entered parameters and the transducer installation should be checked.
M92	Displays the estimated fluid sound velocity. If this value has an obvious difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again.
M93	Displays total transit time and delta time(transit time difference)
M94	Displays the Reynolds number and the pipe factor used by the flow rate program.
M95	Not used
M96	Not used
M97	Command to record the pipe parameters entered by the user either to the built.in data logger or to RS-232C serial interface
M98	Command to record the diagnostic information either to the built.in data logger or to RS-232C serial interface
M99	Command to copy the current display either to the built.in data logger or to RS-232C serial interface
M+0	Browse the 64 recorded instrument power.on and power.off date and time with the flow rate at the time of power on and off
M+1	Displays the total working time of the instrument
M+2	Displays the last power.off date and time

M+3	Displays the last power.off flow rate
M+4	Displays the times of instrument powered on(the instrument has been powered on)
M+5	A scientific calculator for the convenience of field working. All the values are in single accuracy. The drawback is that the user can't operate it by direct key.pressing
M+6	Not used
M+7	Not used
M+8	Not used
M+9	Not used
M.0	Entry to hardware adjusting windows only for the manufacturer

Chapter 5 Troubleshooting

5.1 Power.on Error Displays and Counter.Measures

The 2100H series ultrasonic flow meter provides an automatic power.on diagnosis for the hardware problems. when any message (with the power on) in the following table displays,counter-measures should be taken.

Error message	Causes	Counter.measures
ROM Testing Error Segment Test Error	Problem with the Software	(1)Power on again (2)Contact with factory
Stored Data Error	The parameters entered by the user lose integration.	when this message displays, the user should press ENT key, and all the configuration will be restored to the default state.
Timer slow Error Timer Fast Error	Problem with the timer.keeper or the crystal oscillator.	(1)Power on again (2)Contact with factory
Date Time Error	Number errors with the calendar	Initialize the calendar by menu window M61
Reboot repetitively	Hardware problems	Contact the factory

5.2 Error Code and Counter.Measures

The 2100H series ultrasonic flow meter will show Error Code in the lower right corner with a single letter like I, R etc. on menu windows M00, M01, M02, M03, M90 and M08. when any abnormal Error Code shows, counter.measures should be taken.

Error code	Correspondent Message displayed on M08	Causes	Counter.measures
R	System Normal	No error	
I	Detect No signal	(1)No signals detected (2)Transducers installed improperly (3)Too much fouling (4)Pipe liners are too thick. (5)Transducer cords are not properly connected	(1)Relocate measuring location (2)Clean the spot (3)Check the cords
J	Hardware Error	Hardware problem	Contact the factory
H	Poor signal Detected	(1)Poor signal detected (2)Transducers installed improperly (3)Too much fouling (4)The pipe liners are too thick. (5)Problem with transducers cords	(1)Relocate measuring place (2)Clean the spot (3)Check the cords (4)Check the coupler

Q	Frequency output over	The actual frequency for the Frequency output is out of the range set by the user	Check the value entered at M66, M67, M68 and M69, and try to enter a larger value on M69
F	System RAM Error Date Time Error CPU or I/O Error ROM Parity Error	(1) Temporary problems with RAM, RTC (2) Permanent problems with hardware	(1) power on again (2) contact factory
1 2 3	Adjusting Gain	Instrument is in the progress of adjusting the gain for the signal, and the number indicates the progressive steps	
K	Empty pipe	(1) No liquid inside pipe (2) setup error on M29	(1) Relocate where the pipe is full of liquid (2) Enter 0 on M29

5.3 Other Problems and Solutions

(1) when the actual flow inside the pipe is not standstill, but the instrument displays 0.0000 for the flow rate, and 'R' displaying signal strength and the signal quality O (value) has a satisfactory value?

The problems are likely caused by the user who has used the 'set Zero' function on this non-standstill flowing pipe. To solve this problem, use the 'Reset Zero' function on menu window M43.

(2) The displayed flow rate is much lower or much higher than the actual flow rate

in the pipe under normal working conditions.

(a) There is probably an offset value wrongly entered by the user in M44. Enter '0' in M44.

(b) Problem with transducer installation.

(c) There is a 'Zero Point'. Try to 'zero' the instrument by using M42 and make sure that the flow inside the pipe should be standstill.

(3) The battery can not work as long as the time period as indicated by M07

(a) Battery should be replaced due to the end of the service life.

(b) Newly changed battery does not fit the battery estimating software. Customizing the battery with the software should be taken. Please contact the factory

(c) The battery has not been fully recharged or the recharge has been stopped too many times halfway.

(d) There is indeed a time difference between the actual working time and the estimated one, especially when the terminal voltage is in the range 3.70 and 3.90 volt. Please refer to battery voltage for a closer estimated working time.

Chapter 6 Communication Protocol

6.1 General

The 2100H series ultrasonic flow meter integrates a standard RS-232C communication interface and a complete set of communication protocols that are compatible with that of the Fuji's ultrasonic flow meter.

6.2 Interface Pin.out Definition

Pin	1	for battery recharge, positive input
	2	RXD
	3	TXD
	4	not used
	5	GND
	6	OCT output
	7	not used
	8	for battery recharge, negative input
	9	RING input for connecting a MODEM

6.3 The Protocol

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

Command	Function	Data Format
DQD(CR)	Return flow rate per day	$\pm d.dddddddE \pm dd(CR) (LF)^*$
DQH(CR)	Return flow rate per hour	$\pm d.dddddddE \pm dd(CR) (LF)$
DQM(CR)	Return flow rate per minute	$\pm d.dddddddE \pm dd(CR) (LF)$
DQS(CR)	Return flow rate per second	$\pm d.dddddddE \pm dd(CR) (LF)$
DV(CR)	Return flow velocity	$\pm d.dddddddE \pm dd(CR) (LF)$
DI+(CR)	Return POS totalizer	$\pm ddddddE \pm d(CR) (LF) \quad **$
DI-(CR)	Return NEG totalizer	$\pm ddddddE \pm d(CR) (LF)$
DIN(CR)	Return NET totalizer	$\pm ddddddE \pm d(CR) (LF)$
DID(CR)	Return Identification Number	dddddd (CR) (LF)
DL(CR)	Return signal strength and quality	s=ddd,ddd O=dd (CR) (LF)
DT(CR)	Return date and time	yy-mm-dd hh:mm:ss(CR) (LF)
M@(CR)***	send a key value as if a key is pressed	
LCD(CR)	Return the current window display	
Fodddd(CR))	Force the FO output with a frequency in dddd Hz	
ESN(CR)	Return the ESN for the instrument	Dddddddd(CR)(LF)
RING(CR)	Handshaking Request by a MODEM	
OK(CR)	Response from a MODEM	No action
GA	Command for GSM	Please contact factory for detail

	messaging	
GB	Command for GSM messaging	
GC	Command for GSM messaging	
DUMP(CR)	Return the buffer content	In ASCII string format
DUMP0(CR)	Clear the whole buffer	In ASCII string format
DUMP1(CR)	Return the whole buffer content	In ASCII string Format, 24KB in length
W	Prefix before an Identification Number in a network environment. The IDN is a word, ranging 0-65534.	
N	Prefix before an Identification Number in a network environment. The IDN is a single byte value, ranging 00-255.	
P	Prefix before any command	
&	Command connector to make a longer command by combining up to 6 commands	

Notes: * CR stands for Carriage Return and LF for Line Feed.

** 'd' stands for the 0~9 digit numbers.

*** @ stands for the key value, e.g., 30H for the '0' key.

6.3 Protocol Prefix Usage

(1) Prefix P

The prefix P can be added before any command in the above table to have the

returning data followed with two bytes of CRC check sum, which is the adding sum of the original character string.

Take the DI+(CR) command as an example. Assume that DI+(CR) would return +1234567E+0m3(CR)(LF) (the string in hexadecimal is 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H, 0DH, 0AH), then PDI(CR) would return +1234567E+0m3!F7(CR)(LF). '!' acts as the starter of check sum which is yielded by adding up the string 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H.

Please note that there will be SPACES (20H) before '!'.
(2) Prefix W

The prefix W should be used in the network environment. The usage format is w + digit string which stands for the IDN + basic command.

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

For example, if the IDN=12345 instrument is addressed and returning the velocity of that instrument is requested, the command will be w12345DV(CR).

(3) Prefix N

The prefix N is a single byte IDN network prefix, not recommended in a new design. It is reserved only for the purpose of the compatibility with the former versions

(4) Command Connector &

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

For example, assume that the measurement of an instrument with IDN=4321 are going to be returned, and (then) all the following 3 values... (1) flow rate (2) velocity (3) POS totalizer...will be returned simultaneously. The combined command would be W4321DQD&DV&DI+(CR), and the result would be:

+1.234567E+12m3/d(CR)

+3.1235926E+00m/s(CR)

+1234567E+0m3(CR)

6.4 Codes for the Keypad

The codes for the keypad should be used when the instrument is connected with

other terminals that operate the instrument by transmitting the 'M' command along with the keypad code. By this function, remote operation of this instrument can be realized, even via the Internet.

Key	Hexadecima1 Key code	Decimal Key code	ASCII Code
0	30H	48	0
1	31H	49	1
2	32H	50	2
3	33H	51	3
4	34H	52	4
5	35H	53	5
6	36H	54	6
7	37H	55	7
8	38H	56	8
9	39H	57	9
•	3AH	58	:
◀	3BH,0BH	59	;
MENU	3CH,0CH	60	<
NET	3DH,0DH	61	=
▲/+	3EH	62	>
▼/-	3FH	63	?

Chapter 7 Warranty & After-sales Service

We promise to the customer that the hardware accessories provided during the supply of the instrument have no defects in material and manufacturing process. From the date of the purchase, if the user's notice of such defects is received during the warranty period, the company will unconditionally maintain or replace the defective products without charge, and all non customized products are guaranteed to be returned and replaced within 7 days.

Disclaimers:

- During the warranty period, product faults caused by the following reasons are not in the scope of Three Guarantees service
- Product faults caused by improper use by customers.
- Product faults caused by disassembling, repairing and refitting the product.

After-sales service commitment:

- We promise to deal with the customer's technical questions within 2 hours. For the instruments returned to the factory for maintenance, we promise to issue the test results within 3 working days and the maintenance results within 7 working days after receiving them