

## Features

Rechargeable battery:	24h lasting
Battery charger:	100÷240Vac
Display:	3.5", 320x240pixel, 65536 colours
Keypad:	8 pushing buttons
Displayed data:	flow rate, flow totalizer and more
Housing:	ABS
Linearity:	± 0.5%
Repeatability:	± 0.2%
Total accuracy:	± 1%
Max medium speed:	±20 m/s
Clamp-on transducers:	
	<b>S1 type-suitable for pipes from DN15 to DN100 (0-90 °C)</b>
	<b>M1 type-suitable for pipes from DN50 to DN700 (0-90 °C)</b>
	<b>L1 type-suitable for pipes from DN300 to DN6000 (0-90 °C)</b>
Clamp-on transducers mounted on metric frame:	
	<b>S1F type-suitable for pipes from DN15 to DN100 (0-90 °C)</b>
	<b>M1F type-suitable for pipes from DN50 to DN800 (0-90 °C)</b>
Clamp-on transducers for high temperature:	
	<b>HS1 type-suitable for pipes from DN15 to DN100 (0-160 °C)</b>
	<b>HM1 type-suitable for pipes from DN50 to DN700 (0-160 °C)</b>
	<b>HL1 types suitable for pipes from DN300 to DN6000mm (0-160)</b>
Flow measurement unit:	Selectable
Totalizer:	7 digits for positive, negative and net flow
Data logger:	8GB/16GB SD can store up to 10 years records
Communication interface:	USB



## General

The VEC-USM-3000 is composed by a digital converter and two clamp-on ultrasonic transducers. It is designed to measure the fluid velocity of a liquid inside a closed conduit. The transducers are a non-contacting, clamp-on type, which provide benefits of non-fouling operation and easy installation. The DSP digital technology (Digital Signal Processing) ensure a low sensibility of the instrument against potential transient factors.

## 0 WORKING PRINCIPLE

The VEC-USM-3000 utilizes two transducers which work as ultrasonic transmitters and receivers. They are clamped on the outside of a closed pipe at a specific distance from each other. They can be mounted in V position (the sound crosses the pipe twice), in W position (the sound crosses the pipe 4 times) or in Z position (mounted on opposite sides of the pipe - the sound crosses the pipe once). The selection of the mounting position depends on pipe and on liquid characteristics. The Teren-UFM-200H operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that takes the sound to travel between them. The difference in measured transit time is directly and exactly related to the velocity of the liquid inside the pipe (fig.1).

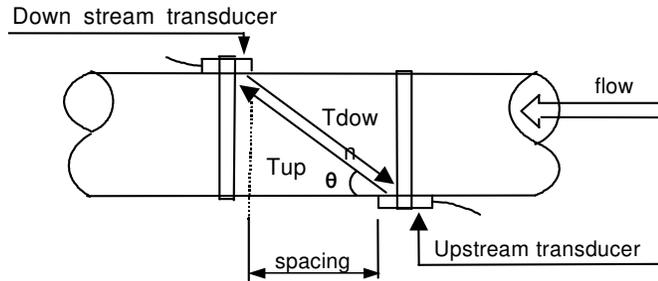


Fig.1

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

Where:

- $\theta$  = include angle for the flow direction
- M = transit time of the ultrasonic signal
- D = Internal pipe diameter
- $T_p$  = Transit time in the forward direction
- $T_{down}$  = Transit time in the reverse direction
- $\Delta T$  =  $T_{up} - T_{down}$

**1.1 Applications**

The VEC-USM-3000 can be applied to a wide range of measurement. The range of pipe dimensions is from 20 to 3000 mm (from 0,8 to 118 inches) and the liquids can be: ultra-pure, potable water, chemicals, raw sewage, cooling water, riverwater, plant effluent ecc. As the instrument and the transducers are non-contacting and have no moving parts, the flowmeter cannot be affected by system pressure, fouling or wear.

**1.2 Data Integrity**

All configuration values setted by the user are saved into the EE PROM.

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 it will lose time values and the user must re-enter them.

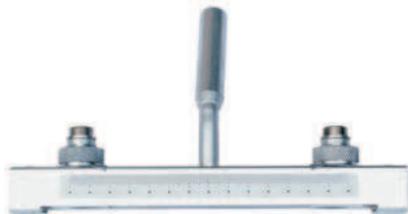
An improper time value affects no other functions but the date totalizer.

**1.3 Specifications**

Linearity:	<b>0,5%</b>
Repeatability:	<b>0,2%</b>
Accuracy:	<b>±1%; rates &gt; 0,3mps</b>
Maxspeed:	<b>±20m/s</b>
Pipe sizes:	<b>DN15÷DN6000, using different transducers</b>
SD size:	<b>512MB ÷ 32GB, SD card or SDHC card</b>
Data record method:	<b>Year and month is the folder, day and measure SN number is the file name</b>
Recording interval:	<b>5s, 10s, 20s, 30s, 60s</b>
Max data stored:	<b>According to the SD used, 16GB can store data for 10 years</b>
Data curve reading time:	<b>min 20m; max 4h</b>
Menu languages:	<b>English, Italian</b>
Display:	<b>3.5", 320x240pixel, 65536 colours</b>
Temperature:	<b>0°+160°C</b>
Power supply:	<b>Ni-MH integrate batteries. When fully recharged they last about 24 hours. 100÷253Vac for the charger.</b>
Electric current:	<b>Average 100mA, max 310mA, stand-by 100microA</b>
Housing material:	<b>ABS</b>
Size:	<b>218x103x35mm</b>
Weigh:	<b>400g</b>
Pipe materials:	<b>Carbon steel, stainless steel, cast iron, ductile iron, copper, PVC, aluminium, asbestos, fiber-glass-epoxy, other</b>
Inner lining materials:	<b>None, tar epoxy, rubber, mortar, polypropylene, polystyrol, polystyrene, polyester, polyethylene, ebonite, teflon (PTFE), other</b>
Liquids:	<b>water (general), sea water, kerosene, gasoline, fuel oil, crude oil, propane (-45°C), butane (0°C), other liquid, diesel oil, castor oil, peanut oil, gasoline #90, gasoline #93, alcohol, water (125°C),</b>
Measure method:	<b>V, Z, W, N</b>
S1 sensor:	<b>DN15-DN100, 0 - +90°C</b>
M1 sensor:	<b>DN50-DN700, 0 - +90°C</b>
L1 sensor:	<b>DN300-DN6000, 0 - +90°C</b>
HS (frame) sensor:	<b>DN15-DN100, 0 - +160°C</b>
HM (frame) sensor:	<b>DN50÷DN800, 0 - +160°C</b>
HS1 sensor:	<b>DN20÷DN100, 0 - +160°C</b>
HM1 sensor:	<b>DN50-DN700, 0 - +160°C</b>
HL1 sensor:	<b>DN300-DN6000, 0 - +160°C</b>

### Clamp-on trasducers

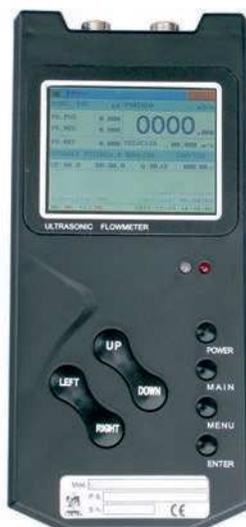
Standard HS (20-100mm)



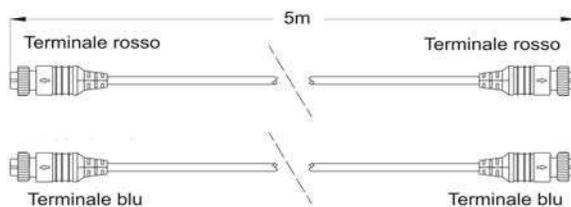
Standard HM (80-800mm)



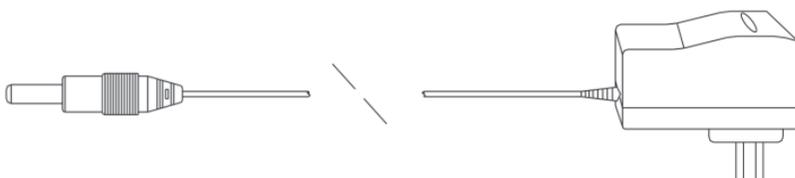
### HANDHELD Flowmeter



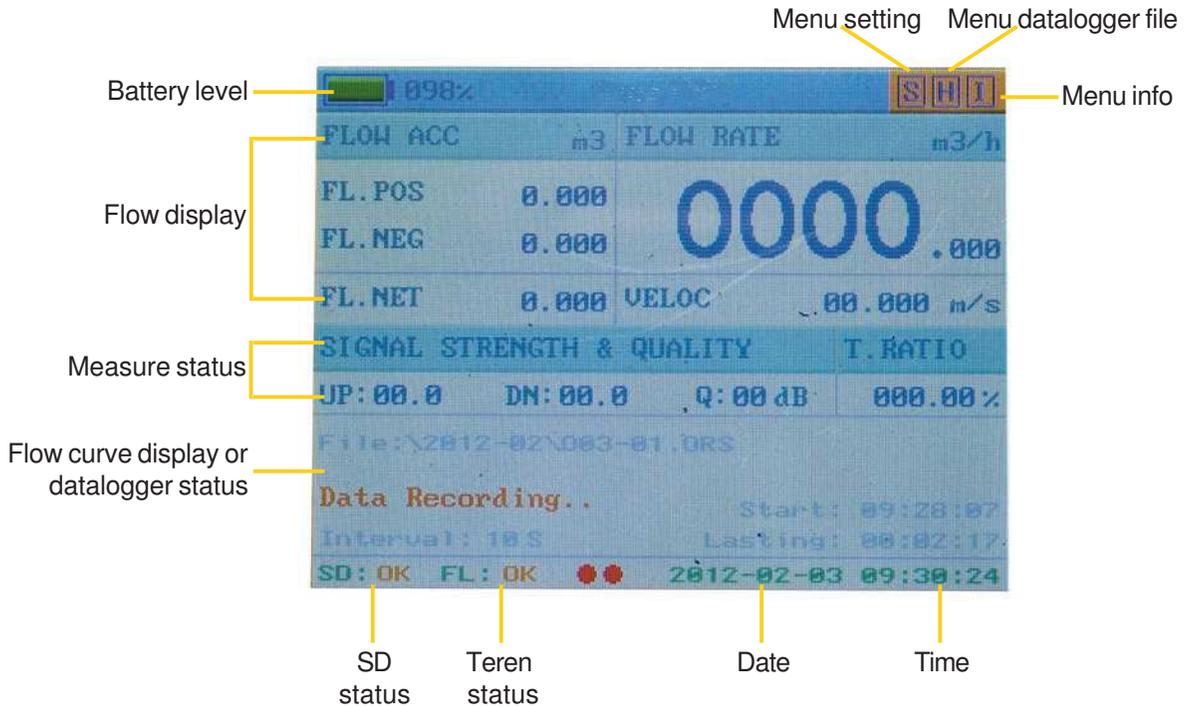
### Cable 2x 5m



### Battery charger



## 2.1 Keypad



## 2.1.1 ON/OFF

Press "POWER" button, Teren-UFM-200H turn on, and at the same time the LED lights.  
Press "POWER" button again, Teren-UFM-200H turn off, and at the same time the LED off

*Note:*

*The instrument switches off automatically when not in use*

*The instrument is locked during normal operation, is unlocked by pressing the "POWER"*

*During a storing data step, is not possible to turn off the instrument.*

### 2.1.1 Buttons function

The buttons have different functions

<b>Parameter selection</b>	"UP" and "DOWN" to scroll
	"LEFT" or "RIGHT" to change the menu page
	"ENTER" to confirm selection
	"MENU" to undo any changes to the parameter
	"MAIN" back to the main window
<b>Setting numbers</b>	"ENTER" to confirm selection, the number will be red.
	"UP" or "DOWN" to increase or decrease the digit value
	"LEFT" or "RIGHT" to select the digit to edit
	"ENTER" to save
<b>Setting options</b>	"ENTER" to confirm selection, the written will be red.
	"UP" or "DOWN" to change the parameter option.
	"ENTER" to save

### 2.1.2 Menu selection

In the display, top right, there are 3 letters that indicate which menu is displayed:

"S" indicates the parameter setting menu

"H" indicates the datalogger file management menu

"I" indicates the info menu

Pressing "MENU" button, the letter "S" will be highlighted, using the "LEFT" and "RIGHT" buttons to select the menu, and press "ENTER" button to display the selected menu

## 2.2 Rechargeable battery

When the battery level indicates 5% it's better to recharge it, because if the battery voltage is below 4.6 V, the meter turns off automatically

### 2.1.2 How to recharge the batteries

While charging the battery the LED light is red, when charging is completed the LED light turns green

To increase the batteries lifetime, and to prevent the memory effect, it would be appropriate to recharge when the batteries are low.

### 2.1.3 Save power

During the flow rate measurement, if the keys are not pressed for at least 45 seconds, the Teren-UFM-200H automatically starts the screen saver mode.

In the absence of the flow rate measurement and signal from the ultrasonic sensors, after 3 minutes, the instrument turns off automatically.

## 3 PARAMETERS

### 3.1 Parameters table

<b>Basic setting</b>	<b>01</b>	Pipe perimeter	<b>02</b>	Pipe diameter	<b>03</b>	Pipe thickness
	<b>04</b>	Pipe inner diameter	<b>05</b>	Pipe material	<b>06</b>	Pipe velocity
	<b>07</b>	Lining material	<b>08</b>	Lining velocity	<b>09</b>	Lining thickness
	<b>10</b>	Liquid type	<b>11</b>	Liquid viscosity	<b>12</b>	Special liquid viscosity
	<b>13</b>	Sensor type	<b>14</b>	Installing method	<b>15</b>	Installing distance
<b>Flow rate</b>	<b>16</b>	Unit system	<b>17</b>	Instantaneous unit	<b>18</b>	Totalizer flow unit
	<b>19</b>	Totalizer factor	<b>20</b>	Net totalizer switch	<b>21</b>	POS totalizer
	<b>22</b>	NEG totalizer	<b>23</b>	Totalizer reset	<b>24</b>	Cut the lowest flowrate
<b>System parameters</b>	<b>25</b>	Zero point setup	<b>26</b>	Clear the zero point set by user	<b>27</b>	Set zero point
	<b>28</b>	Damping coefficient	<b>29</b>	Meter factor	<b>30</b>	Series number
	<b>31</b>	Language	<b>32</b>	Data record interval	<b>33</b>	Date and time
	<b>34</b>	Curve measure range	<b>35</b>	Not used	<b>36</b>	Not used

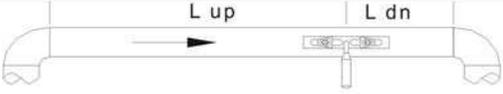
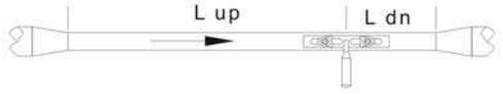
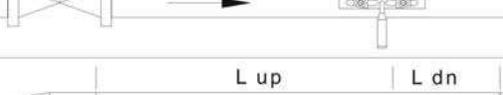
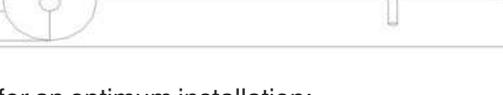
### 3.1 Basic parameters

- 01** Pipe outer perimeter
- 02** Pipe outer diameter; from 0 to 18000mm
- 03** Pipe wall thickness
- 04** Pipe inner diameter
- 05** Pipe material; if no option in the menu, you can select "other", and enter velocity in 6th parameter
- 06** Pipe material speed; only for non-standard pipe materials
- 07** Liner material, select none for pipes without any liner; if no option in the menu, you can select "other", and enter velocity in 8th parameter
- 08** Liner material speed; only for non-standard liner materials
- 09** for entering the liner thickness, if there is a liner
- 10** for selecting fluid type; if no option in the menu, you can select "other", and enter velocity in 11th parameter
- 11** for entering the fluid sonic velocity only for non-standard liquids
- 12** for entering the viscosity of the non-standard liquids
- 13** for selecting the proper transducers
- 14** for selecting the transducer mounting methods
- 15** Display the transducer mounting spacing (automatically calculated by the meter)

### 3 INSTALLATION

#### 3.1 Transducers mounting allocation

The first step of the installation process is the selection of an optimum place in order to obtain a more accurate measurement. For this reason it is important to have a basic knowledge of the piping and of its plumbing system. An optimum place would be defined as a straight pipe length full of liquid, horizontally or vertically positioned.

Configurazione tubi e posizionamento trasduttori	Lunghezza a monte	Lunghezza a valle
	L up [ D ]	L dn [ D ]
	10D	5D
	10D	5D
	10D	5D
	12D	5D
	20D	5D
	20D	5D
	30D	5D

Selection principles for an optimum installation:

- 1) Install the trasducers on the longer length of the pipe and make sure that the pipe is completely full of liquid.
- 2) Make sure that the temperature on the location does not exceed the temperature range of the trasducers. In general 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 external pipe and the liner there may be a certain thickness difference that will prevent the ultrasonic waves from direct travelling. Whenever possible try to avoid this kind of pipes; if impossible use the plug-in trasducers.

#### 3.2 Trasducers installation

The transducers are made of piezoelectric crystals, both for transmitting and receiving the ultrasonic signals through the wall of the 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 important factors for the accuracy of the measurement and for the performance of the measuring system.

How to proceed with the installation:

- 1) Locate an optimum position on the pipe, which has to be in good condition (no rust)
- 2) Clean and dust the pipe surface.
- 3) Apply adequate coupler on the spot where the transducers have to be installed and leave no gap between the pipe surface and the transducers.

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

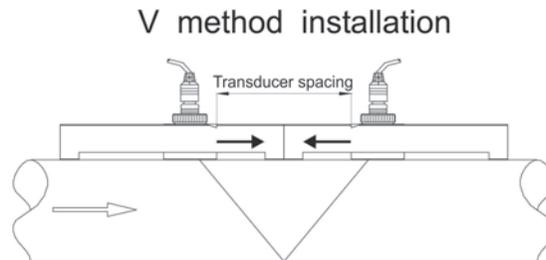
### 3.2.1 Transducers spacing

The spacing value shown in menu M25 refers to inner distance between the two transducers. The actual transducers spacing should be as close as possible to the spacing value. (see figures on next page).

NB A precise mounting is important in order to the measurement greater accuracy.

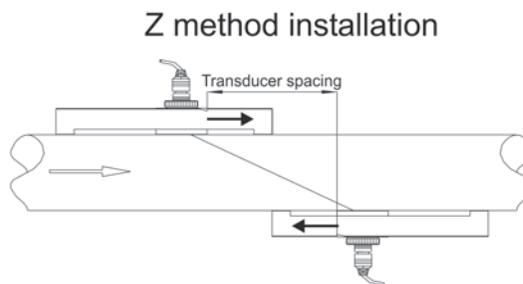
### 3.2.2 V method installation

It is the most common used method for pipe with diameters ranging from 20 to 300 millimeters.



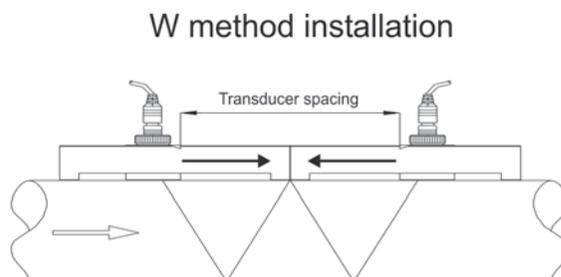
### 3.2.3 Z method installation

It is commonly used when the pipe diameter is between 300 and 500 millimeters.



### 3.2.4 W method installation

It is usually used on little pipes with a diameter from 10 to 100 millimeters.



### 3.3 Installation Check-up

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.

#### 3.3.1 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 external 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 shown in menu M15.

#### 3.3.2 Signal quality (Q)

Signal quality is indicated as the Q value on 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 of 60÷90, 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.

#### 3.3.3 Time ratio (T.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  $100\pm 3$ . If this range is exceeded, the user should check:

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

## 4 HOW TO OPERATE

### 4.1 How to start and stop data record

Press "LEFT" and "ENTER" at the same time, then start to record

Press "LEFT" and "MENU" at the same time, then stop to record

Data record content	Data length,time record interval,record time		
Data record time	Data length	Record interval(S)	Record time(H)
Instantaneous flow rate	~70KB	5	1
Instantaneous velocity	~70KB	10	1
Totalizer flow rate	~35KB	20	1
POS totalizer flow	~18KB	30	1
NET totalizer flow	~12KB	60	1
Up stream signal strength	~6KB	5	8
Down stream signal	~552KB	10	8
Signal quality	~138KB	20	8
Transmitter time ratio	~92KB	30	8
Battery	~46KB	60	8

#### NB:

before data recording, the SD card is inserted in the right way

please do not put the card out during data recording, or the data would be lost

please do not modify the specification during data recording

during data recording, the specification window would not be available

### 4.2 How to check flow curve

Press "UP",

the window would display the flow curve,

the data collect interval time is the same as the recording interval time.

To different data storage time interval corresponds different Curve length.

Curve interval time	Collecting interval time
20minutes	5 seconds
40minutes	10 seconds
1 hour and 20minutes	20 seconds
2hours	30 seconds
4hours	60 seconds

### 4.3 How to check data recording status

Press "DOWN", data recording status would be displayed, including data name, storage interval, storage beginning time, continued storage time.

### 4.4 How to check SD card memory

Holding down the "RIGHT", the display will show the available memory capacity. When the "RIGHT" button is released the information disappears

### 4.5 How to set the measurement systems

Set English or Metric flow units system in M16.

**4.6 How to set flow unit**

Set instantaneous flow measurement unit in M17  
Set totalizer flow unit in M18

**4.7 How to use the totalizer multiplier**

Use window M19 to select a proper totalizer. Make sure that the totalizer pulse is appropriately speeded.

**4.8 How to enable or disable the totalizers**

Use M20, M21 and M22 to enable or disable the POS, NEG, or NET totalizer respectively.

**4.9 How to reset the totalizers**

To reset the totalizers use M23

**4.10 How to use the damper**

The damper acts as a filter for a stable reading. If "0" is entered in window M28, that means there is no damping. A bigger number brings a more stable effect. Bigger damper numbers will prevent the instrument from acting quickly. Numbers 0 to 15 are commonly used for the damper value.

**4.11 How to use the zero-cutoff function**

The number displayed in window M24 is called the low-cutoff value. The flow meter will replace these flow rate values that are absolutely less than the low-cutoff value with "0". This means the flow meter will avoid any invalid accumulation when the actual flow is below the zero-cutoff value.

The low-cutoff value does not affect the flow measurement when the actual flow is absolutely greater than the low-cutoff value.

**4.12 How to get a meter factor for calibration**

The meter factor is the ratio between the "actual flow rate" and the indicated value by the flow meter. The meter factor can be determined by calibration with flow calibration equipment. You can set it in M29

**4.13 How to chose the menu language**

Select menu language in M31

**4.14 How to set data record interval time**

Set in M32: 5s; 10s; 20s; 30s; 60s.

**4.15 How to set date and time**

Set date and time in M33.

**4.16 How to set graph measurement**

Set measure range in M34: 0÷5m3/h, 0÷10m3/h, 0÷20m3/h, 0÷50m3/h, 0÷100m3/h, 0÷200m3/h, 0÷500m3/h, 0÷1000m3/h, 0÷2000m3/h, 0÷5000m3/h.

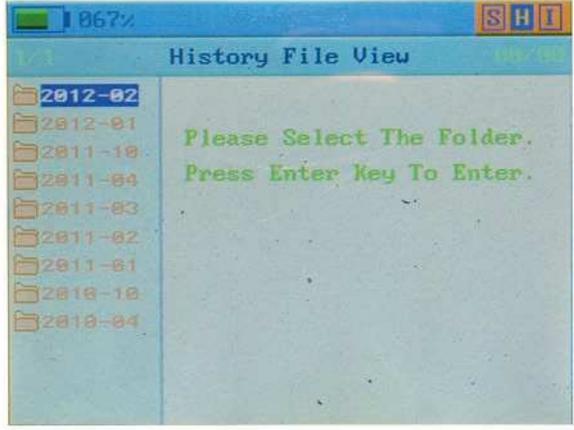
**4.17 Folders and files menu**

Meter can read 32 months folder with 64 folder files

**4.17.1 Choose folder**

When entering the menu, the cursor is in the folder column.

Press "UP"/"DOWN" to select folder, the selected folder would change to blue, then press "LEFT"/"RIGHT" to change the page.



#### 4.17.2 Enter in folder

Press "ENTER" to reach the folder, all the files are displayed, at the same time the folder color changes to orange.

#### 4.17.3 File selection

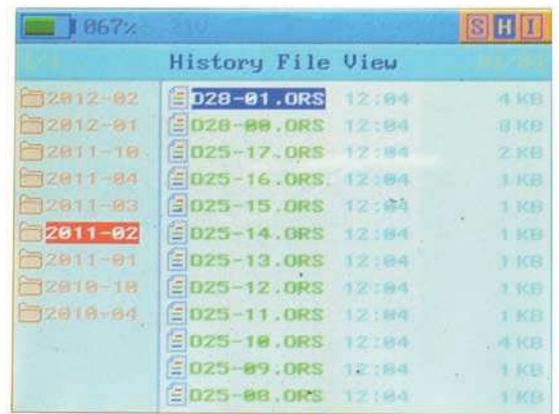
Press "UP"/"DOWN" to select a file, the file name changes to blue.

Press "LEFT"/"RIGHT" to change the page.

Press "ENTER" to open the file and display the flow curve graph.

Press "MENU/CANCEL" to go back.

Press "MAIN" to return to the main window.



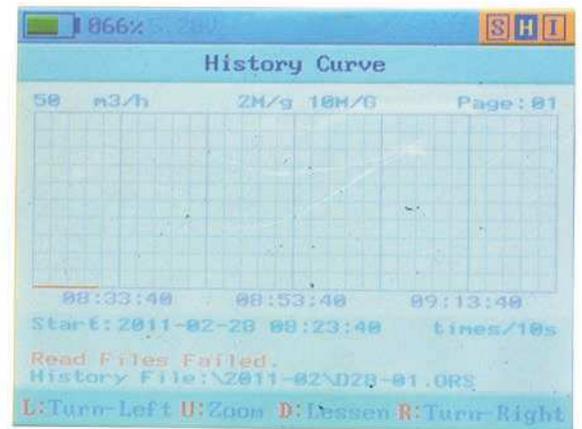
#### 4.17.4 Flow curve graph

Press "LEFT"/"RIGHT" to change a page.

Press "UP"/"DOWN" to enlarge and reduce the graph value.

Press "MENU/CANCEL" to go back to the window, and continue to read and select file and folder.

Press "MAIN" to return to the main window.



Interval time	Time of small form	Time of big form	Time of curve
5s	1m	5m	30m
10s	2m	10m	1h
20s	4m	20m	2h
30s	6m	30m	3h
60s	12m	60m	6h

