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**iESLab**  
**Ultrasonic Water Module**  
**User Manual**



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# Ultrasonic Water Module User Manual

## 1 Summary

### 1.1 Composition of principles and structures

The ultrasonic water metering module (UWM for short from here) uses the ultrasonic time difference principle to calculate the flow rate, built-in flow model and the temperature compensation algorithm. The UWM has a good capacity of small flow detection, which is conducive to the rational utilization and saving of water resources by the users. When UWM is in use, it does not produce mechanical friction, no wear, no blockage, accurate measurement, good reliability, long service life, and has the characteristics of small volume, good stability, low power consumption and strong anti-interference ability.

The core components of the module includes: flow sensor (tube segment, reduction tube, transducer), temperature sensor and module PCBA

## 2 Communication instruction

### 2.1 UWM and UART connection instruction

The communication mode of UWM is UART communication mode, Communication instruction set please find [“UWM Communication Protocol EN 20180621.doc”](#) 。

UART communication through the interface line of UWM, the location and description of the UART communication line are shown in Figure 1.

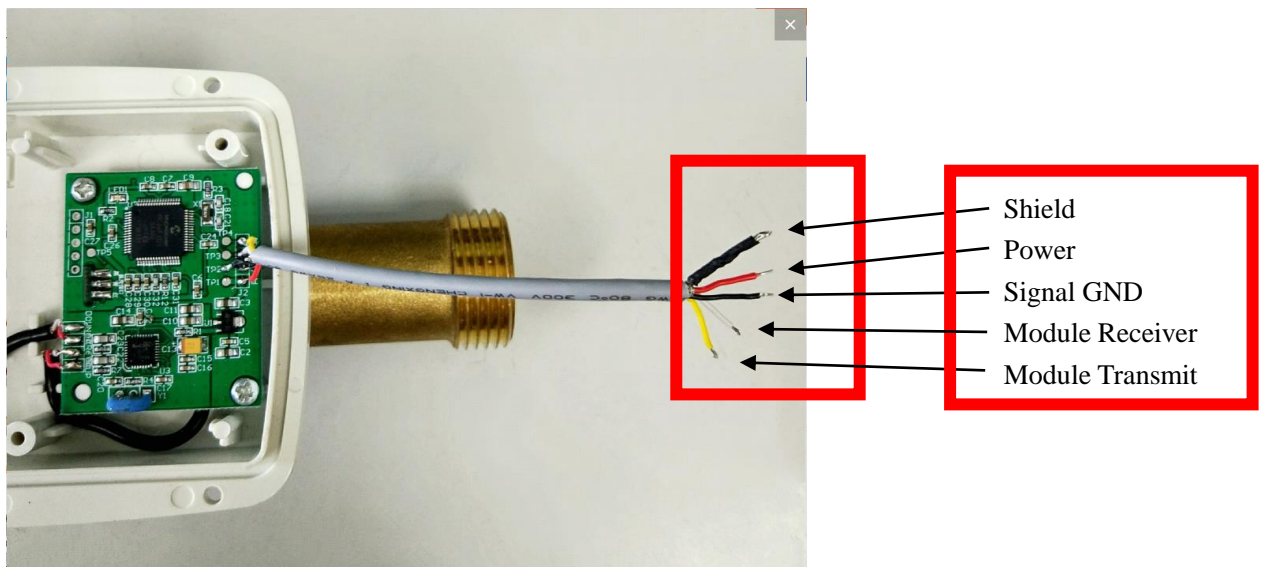


Figure 1 UWM communication connection diagram

The UART communication line on the UWM is connected with the USB-to-UART serial port line through the connector, and the USB-to-UART serial port line and the connector as shown in Figure 2.



Figure 2 USB-to-UART serial line and connector diagram

USB-to-UART serial tool one end is USB interface, USB interface inserts into the computer USB port; the other end of USB interface is line and connector, the interface line has 5 different colors, defined as: the red line is VCC (5V), the black line is GND, the blue line is TXD (transmitter), and the green line is RXD (receiver).

Note : It can be replaced by a user's USB UART serial port tool. Due to different brands, there are differences in the number, color and attributes of interface lines.

The 4 ends of the connector are identified as 4 colors: red, black, white and yellow. They are connected to the red, black, white and yellow lines on the UART communication line of UWM, and the screws are tightened. The connection methods are shown in Figure 3 and Figure 4.

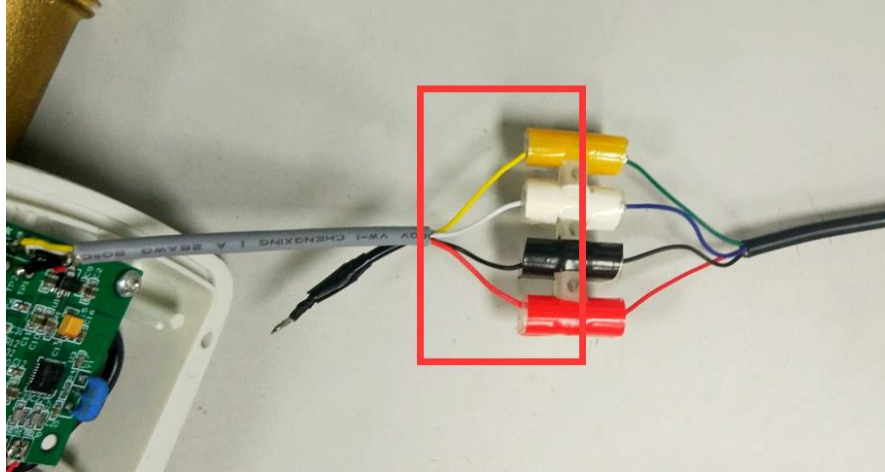


Figure 3 Color correspondence diagram of communication line between connector and UWM

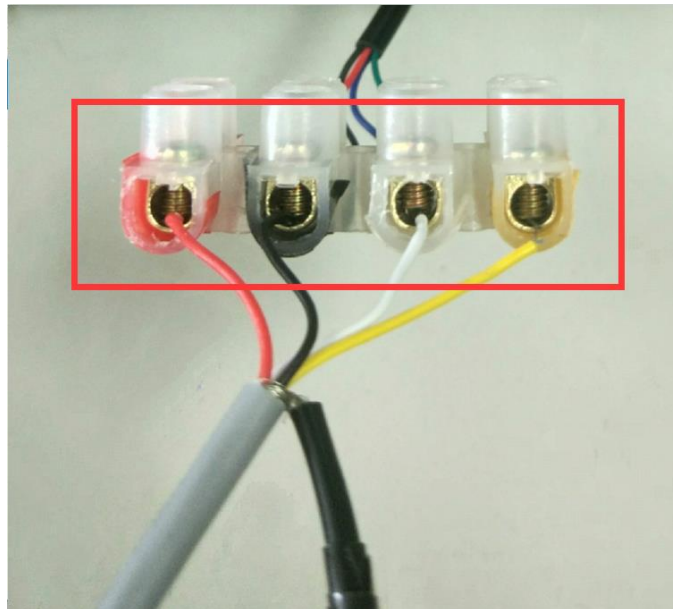


Figure 4 diagram of communication line fixed between connector and UWM

## 2.2 Communication instruction between UWM and software

The UWM has a set of upper computer software, and the running environment is Windows 64 bit system.

The communication between UWM and software:

- (1) Connect UWM and serial port of USB-to-UART through a connector, as shown in Figure 5

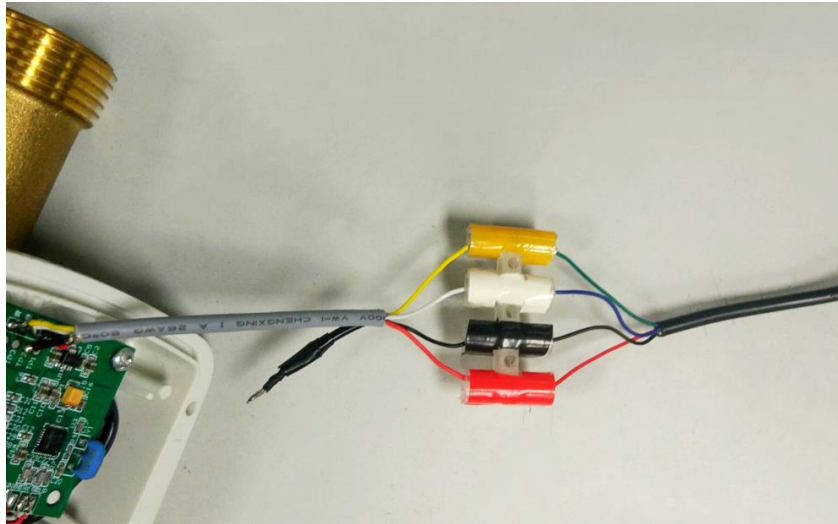


Figure 5 diagram of communication line connection between connector and UWM

(2) Insert the USB end of USB-to-UART serial port into the computer USB port, as shown in Figure 6.

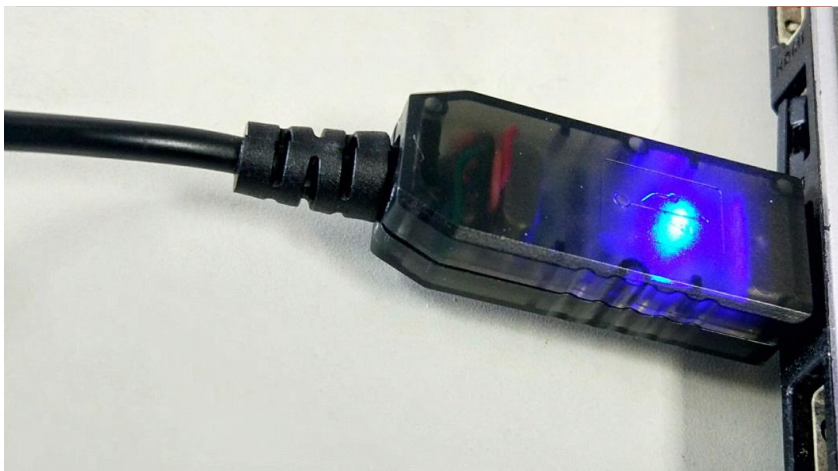


Figure 6 diagram of the connection between USB-to-UART and computer

(3) After plugging the USB-to-UART serial port, the computer automatically installs the driver, waiting for the driver to install it. As shown in Figure 7.

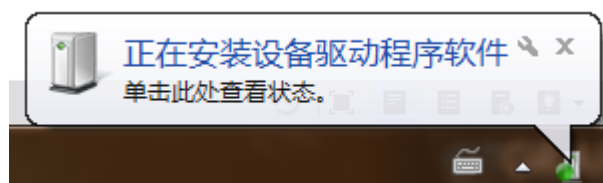
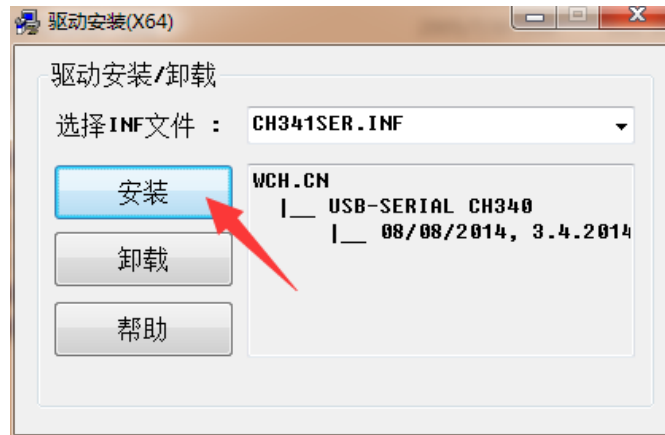


Figure 7 diagram of installation driver



Note : If the auto installing drive fails , open file CH340G\_USB Driver Setup, double click "SETUP.EXE" , press "安装" button, install the driver manually.



( 4 ) open the software "Ultrasonic Water Metering Module Software 20180614.exe", in the "Port setting" window, at left side, choose COM interface, set the communication parameters: baud rate: 2400 Baud; word size: 8 Bits; stop bit: 1 Bit; Parity check: Even. Press "Open serial port" button. Shown as figure 8.

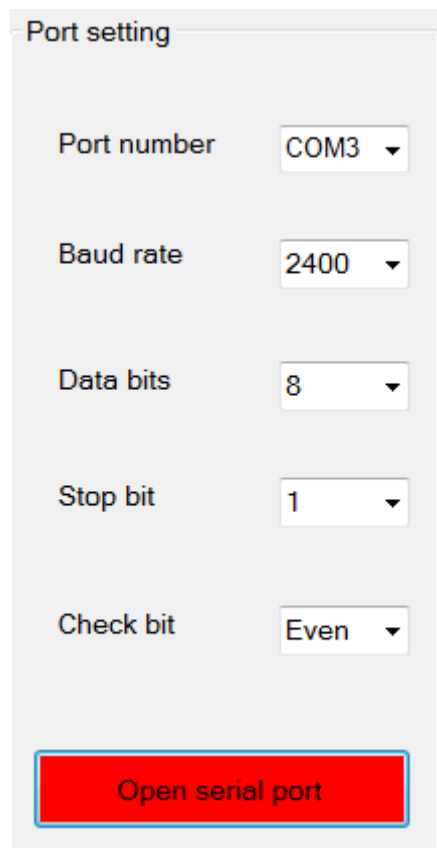


Figure 8 Serial port setting diagram

(5) after open the COM interface, press “Read communication address” button. The text box on the right side of the button shows the communication address of UWM means successful communication. As shown in Figure 9.

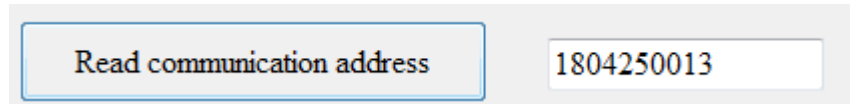


Figure 9 Read communication address diagram

### 3 Flow verification method

#### 3.1 Weighing method

Operation steps:

(1) According to the product installation instructions, the tested UWM should be correctly installed on the test pipeline of the verification device.

(2) Removing the air in the UWM and pipe by UWM allowed flow, meanwhile run the UWM stably for a while. The test pipeline from water metering module to calibration device should not be permeable.

(3) After removing the air in the UWM and pipe, stop provide water, connect the USB-to-UART device and UWM. Shown as figure 10.

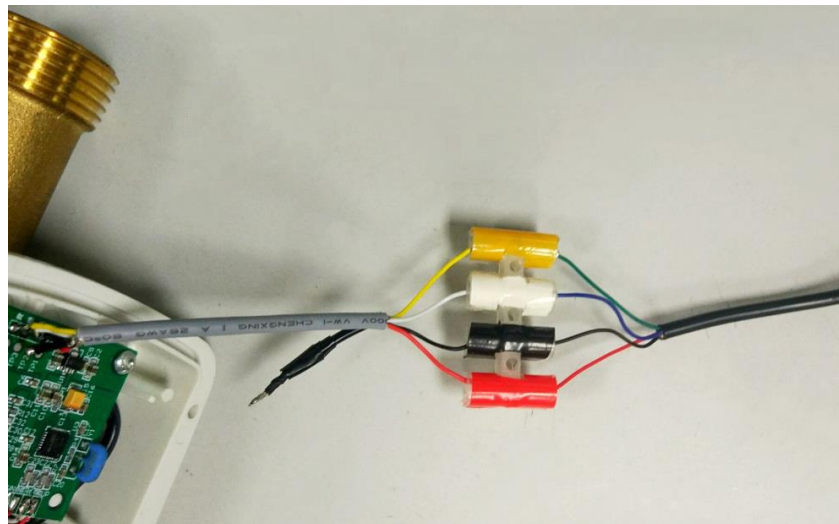
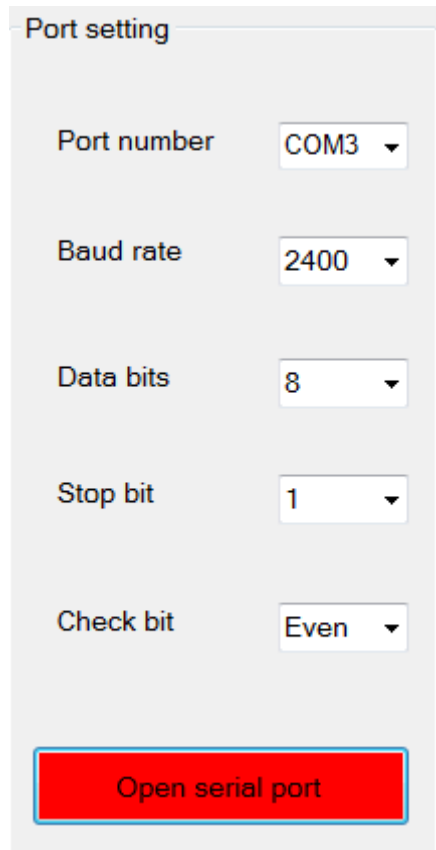


Figure 10 diagram of communication line connection between connector and UWM

(4) Insert the USB end of USB to UART serial port into the computer USB port. Open the software “Ultrasonic Water Metering Module Software 20180614.exe”, open serial port, Shown as figure 11.



Port setting

Port number: COM3

Baud rate: 2400

Data bits: 8

Stop bit: 1

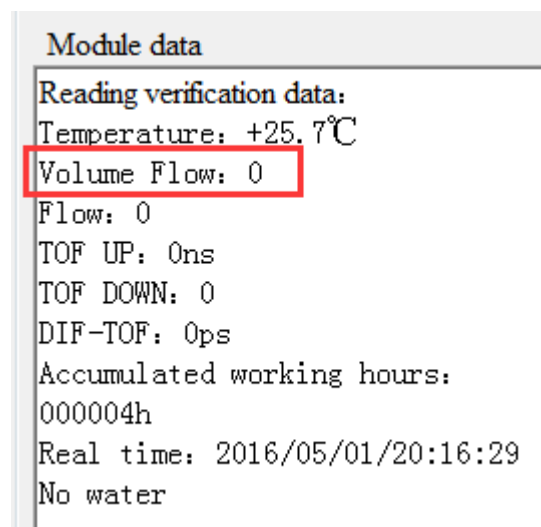
Check bit: Even

Open serial port

Figure 11 Serial port setting diagram

(5) Press “Read communication address” button, after reading the communication address successfully, press “Set to verification mode” button, Enter the verification mode.

(6) Press “Read verification data” button, read the accumulative flow V0 (unit: m<sup>3</sup>) in the “Module data” display box. Shown as figure 12.



Module data

Reading verification data:

Temperature: +25.7℃

Volume Flow: 0

Flow: 0

TOF UP: 0ns

TOF DOWN: 0

DIF-TOF: 0ps

Accumulated working hours:

000004h

Real time: 2016/05/01/20:16:29

No water

Figure 12 read accumulative flow in module data diagram

(7) Keep UWM power supply, pass the mass  $M_a$  water through UWM via specified flow, after that cut off the water source and make the water completely static.

(8) after the water stop flowing, press “Read verification data” button in the software, read the accumulative flow  $V_I$  (unit:  $m^3$ ) in the “Module data” display box. Calculate the volume of the water  $V_i$  ( $V_i = V_I - V_0$ ).

(9) Determine the actual volume  $V_a$  for the flow of UWM. Calculate follow the formula (1).

$$V_a = c \times \frac{M_a}{\rho} \quad (1)$$

when:

$c$ ——correction factor, Dimensionless;

$M_a$ ——the actual mass of water determined by the metering standard device passing through the UWM, unit:kg;

$\rho$ ——Water density at UWM, unit:kg/m<sup>3</sup>。

In Formula (1), when weighing method is used to determine the mass, the effect of air buoyancy on symmetric and heavy results should be considered. At this time  $C$  is called the air buoyancy correction factor, normally  $c=1.0011$ ; When the mass flowmeter is used as the standard meter,  $c=1$ 。

The density of water can be directly measured by water densitometer, or by measuring the temperature of water at the water metering module, then get the value from the temperature-density look-up table.

During the verification process, when the water temperature variation is less than 5 degrees C, the water density  $\rho$  can be calculated with the result of one measurement. When the test results are questioned or the water temperature variation is more than 5 degrees C, the water density should be re-measured.

When using the method of measuring water temperature then get the density, we should pay attention to the difference between the actual water density and the pure water density. When necessary, the formula (2) can be used to correct the density of the table.

$$\rho = \rho_{tm} - \rho_{tp} + \rho_t \quad (2)$$

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when:

$\rho_{tm}$ ——Under a certain condition that the water temperature is similar to the atmospheric temperature, the actual density of water measured by a standard densitometer, the maximum allowable error of standard densitometer should not exceed  $\pm 0.01\%$ ,  $\text{kg/m}^3$ ;

$\rho_{tp}$ ——under the water temperature when measuring  $\rho_{tm}$ , the density value obtained by the pure water temperature-density look-up table,  $\text{kg/m}^3$ ;

$\rho_t$ ——measure temperature, get the value of the density of the water by pure water temperature-density look-up table,  $\text{kg/m}^3$ 。

When the difference between  $\rho_{tm}$  and  $\rho_{tp}$  does not exceed  $0.05\%$ , no need to modify.

(10) calculate the indication error, the indication error formula is as formula (3):

$$E = \frac{V_i - V_a}{V_a} \times 100\% \quad (3)$$

when:

$E$  ——Relative indication error of water meter by percentage;

$V_a$ ——The actual volume of the water through UWM,  $\text{m}^3$ ;

$V_i$ ——Increased (or reduced) volume indicated by UWM,  $\text{m}^3$ 。

### 3.2 Flow time method

Operation steps:

(1) According to the product installation instructions, the tested UWM should be correctly installed on the test pipeline of the verification device

(2) Removing the air in the UWM and pipe by UWM allowed flow, meanwhile run the UWM stably for a while. The test pipeline from water metering module to calibration device should not be permeable.

(3) After removing the air in the UWM and pipe, stop provide water, connect the USB-to-UART device and UWM. Shown as figure 13.

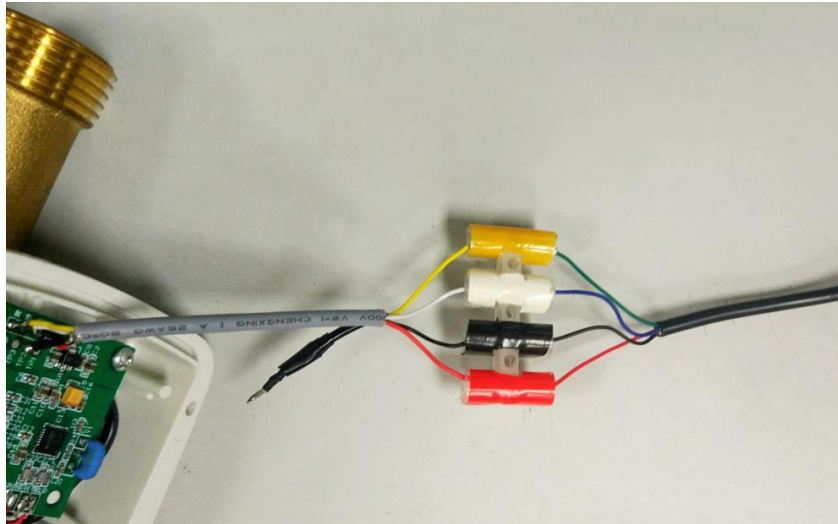


Figure 13 diagram of communication line connection between connector and UWM

(4) Insert the USB end of USB to UART serial port into the computer USB port. Open the software “Ultrasonic Water Metering Module Software 20180614.exe”, open serial port, Shown as figure 14.

**Port setting**

Port number	COM3 ▼
Baud rate	2400 ▼
Data bits	8 ▼
Stop bit	1 ▼
Check bit	Even ▼

Open serial port

Figure 14 Serial port setting diagram

( 5 ) Press “ Read communication address ” button , after reading the

communication address successfully, press “Set to verification mode” button, Enter the verification mode.

(6) Set up verification flow point  $F_a$  and verification flow point time  $T_a$ , In order to maintain the verification flow point  $F_a$  to verification flow point time  $T_a$ ,  $F_a$  and  $T_a$  should be satisfied: if verification flow point  $F_a$  is a large flow ( $F_a > 0.15 \text{ m}^3/\text{h}$ ), verification flow point time  $T_a$  should be more than 10s; if verification flow point  $F_a$  is a small flow ( $F_a \leq 0.15 \text{ m}^3/\text{h}$ ), verification flow point time  $T_a$  should be more than 40s.

(7) Keep UWM power supply, start measurement of verification device

(8) After the flow through the UWM is stable, press “Start test” button, UWM starts measurement.

(9) Before verification flow point time  $T_a$ , press “Stop test” button, UWM stops measurement.

(10) Press “Read verification data” button, read the instantaneous flow  $F_i$  (unit:  $\text{m}^3/\text{h}$ ) in the “Module data” display box. Shown as figure 15.

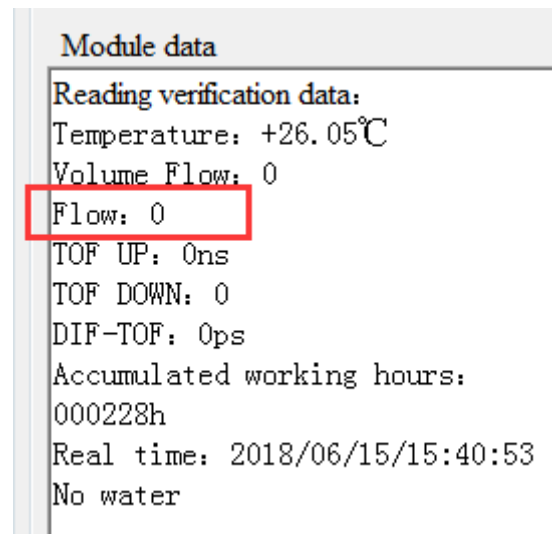


Figure 15 read instantaneous flow in module data diagram

(11) calculate the indication error, the indication error formula is as formula (4):

$$E = \frac{F_i - F_a}{F_a} \times 100\% \quad (4)$$

when:

$E$  ——Relative indication error of water meter by percentage;

$F_a$  ——Set up verification flow point  $F_a$ ,  $\text{m}^3/\text{h}$ ;

$F_i$  —— Instantaneous flow indicated by UWM,  $\text{m}^3/\text{h}$ 。

(12) repeat (6) to (11), complete the verification of all flow points.