MANUAL

Ultrasonic Open Channel Flow Meter

UOC Series

Version 1.4

Catalog

1.Introduction

1.1 Application

The series is a remote version ultrasonic open channel flow meter (UOC). It consists of two elements, a wall mounted host, which has a display and an integral keypad for programming, and a probe, which must be mounted directly above the surface to be monitored. Both of the host and the probe are plastic leak-proof structure.

The series OCM can be widely applied to the environmental protection, water treatment, irrigation, chemical, and other industries.

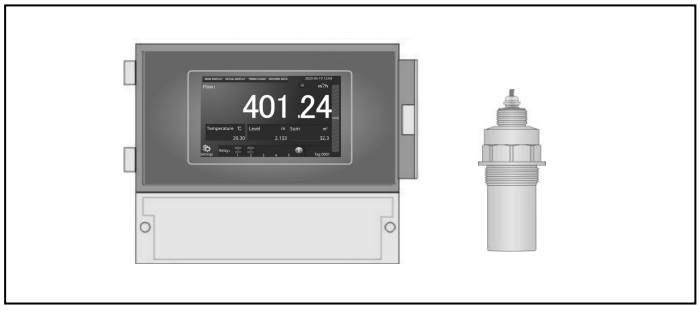
1.2 Features

The series UOC is capable of the following functions:

- High detection accuracy, the flow meter measurement changes with 1mm, the accuracy of change in level is 1 mm;
- Suitable for a variety of weirs and flumes, Parshall flumes (ISO), V-Notch weirs, rectangular weirs (With or Without End Contractions) and custom Formula type weir;
- 5-inch anti-interference ultra-high-definition color touch screen, stable work, not afraid of oily water stains; Modern display effect
- Displays flow rate in L/S, M^3/h or M3/min;
- Support displaying trend curves and historical records (Can be exported through mirco SD card)
- The setting interface is password protected
- AC and DC two-way power supply design, can be connected to AC or DC power supply.
- Super-capacitor powered clock design, no need to replace the built-in battery for life
- Excellent anti-interference capability;
- The cable length between probe and host up to 1000m;
- The probe with leak-proof structure and IP68 protect grade;
- Chemically resistant probe materials for maximum application flexibility;
- Provided 4-20mA output and RS485 serial communication (MODBUS-RTU) output;
- Provided programmable 5 relays at most for alarms;

1.3 Structure

The series UOC consists of a probe and a host.



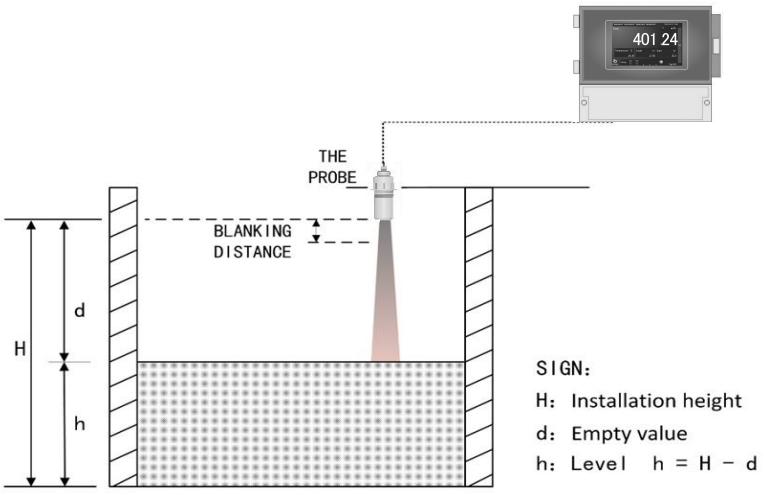
1.4 Measuring principle: Time-of-flight method

The probe is mounted on the top of the flume, and ultrasonic pulse is transmitted by the probe to the surface of the monitored material. There, they are reflected back and received by the pro be. The host measures the time t between pulse transmission and reception. The host uses the time t (and the velocity of sound c) to calculate the distance d between the sensor bottom and the monitored liquid surface: d = c •t/2. As the host knows the installation height H from parameters setting, it can calculate the level as follows: h = H – d.

Since speed of sound through air is affected by changes in temperature, the UOC has integrated a temperature senor to improve accuracy.

For determined flumes, there is a fixed functional relationship between the instantaneous flow and liquid level. The formula is Q=h (x). Q means instantaneous flow, h means liquid level in flumes. So the host can calculate the flow rate though determined flumes and the level value.

It is very important to understanding the working principle for further installation and operation.



Blind zone: Level echo from the blind zone cannot be evaluated due to the transient characteristics of the sensor. Span F may not extend into the blanking distance B.

1.5 Technical data

1.5.1 The host

Power supply	DC9-26V 0.2A and AC85-265V
Display	5-inch anti-interference ultra-high-definition color touch screen
The instantaneous flow rate range	0.000~999999L/S, m^3/h or m^3/min
The maximum of cumulative flow	99999999.9 m^3 (can be user-defined)
Accuracy of change in level	0.2% of measured distance from the probe at still water. (Whichever is greater)
Resolution	1mm
Analogue output	4-20mA into 500 Ohms, programmable with proportional with level or flow rate
Relays outputs	5 multi-function SPDT relays at most （optional）, rated 5A /250VAC/30VDC, High, low and failsafe alarm and control corresponding to instantaneous flow rate or level. And also, can be set as the pulse output.
Serial communication	RS485, MODBUS-RTU standard protocol
Ambient temperature	-40℃~75℃
Temperature compensation	Integral in probe
Pressure range	-0.04~+0.2MP (press definitely)
Measure cycle	1 second (changeable)
Cable gland	PG9 /PG11/ PG13.5
Material	ABS
Protect grade	IP67
Fix	Hang
Dimensions	235X184X119mm

1.5.2 The probe

Range	0.00-4.00m
Blind zone	0.20m
Ambient temperature	-40℃~70℃
Temperature compensation	Integral in probe
Pressure range	-0.04MP～+0.2 MP
Beam angle	8 (3db)
Cable length	10m standard (can be extended to 1000m)
Material	ABS, PVC or PTFE (optional)
Protect grade	IP68
Fix	Screw (G2) or flange (DN65/DN80/etc.)

2.Installation

Reasonable installation is critical factor of the instrument's normal working. Installation must be carried out by trained person in accordance with the manual.

2.1 Installation considerations

2.1.1Hints for the host mounting

- The host should not be mounted in a confined space where temperatures may exceed the normal working temperature (-40~+75), if the host is mounted outside, it must be protected from direct sunlight or severe weather conditions.

- Ensure that the mounting surface is not subject to vibration and is not in close proximity to high voltage cables, contactors or drive controls.

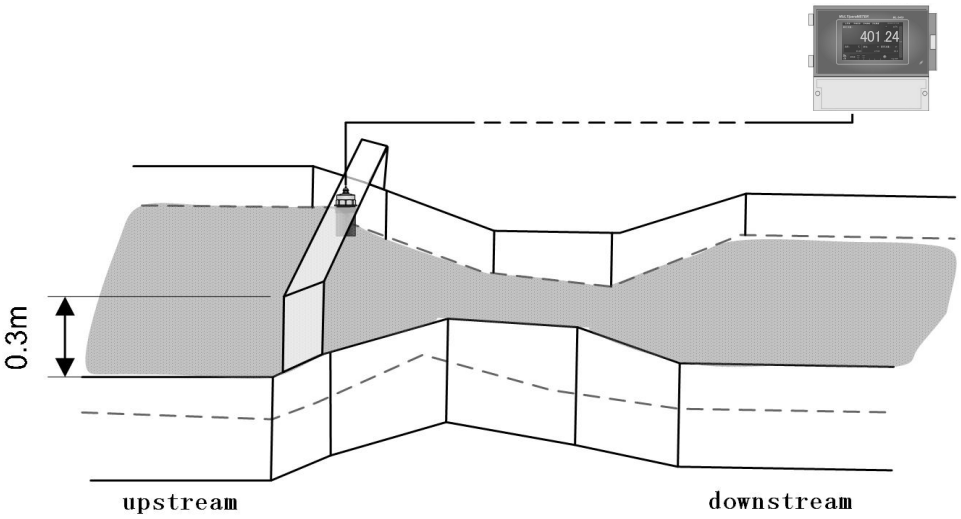
- Select appropriate knockouts in the base of the enclosure and fit appropriate cable glands to maintain the IP67 rating.

- Do not use excessive force when tightening the fixing and avoid any distortion of the enclosure.

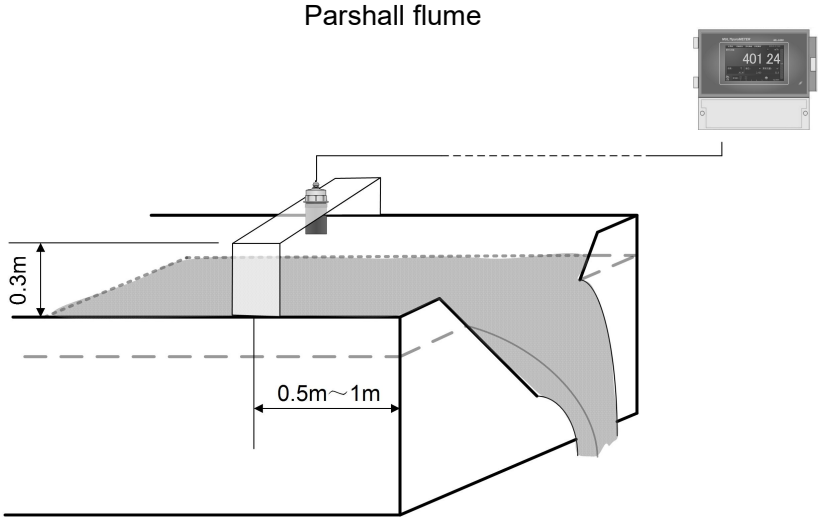
- Pay attentions to the dimensions of the host and the enclosure.

2.1.2 Hints for probe mounting

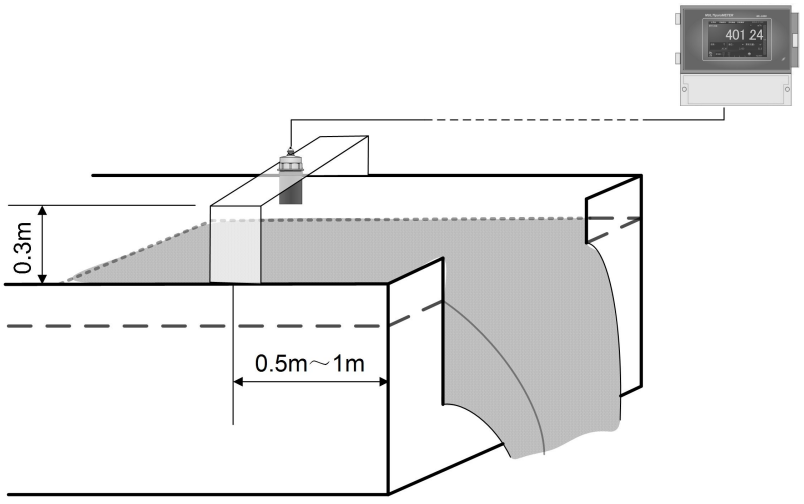
- The probe can be supplied as standard or with a screw nut or with an ordered flange.
- For applications requiring chemical compatibility the probe is available fully enclosed in PTFE.
- The use of metallic fittings or flanges is not recommended.
- For exposed or sunny locations, a protective hood is recommended.
- Make sure that the probe is mounted perpendicular to the monitored surface and ideally, at least 0.25 meters above it, because the probe cannot get response in the blind zone.
- The probe has a 10 inclusive conical beam angel at 3 dB and must be mounted with a clear unobstructed sight of the liquid to be measured. But smooth vertical sidewalls weir tank will not cause false signals.
- The probe must be mounted upstream of the flume or weir。
- Do not over-tighten the bolts on flange.
- The stilling well can be used when there is volatility in the water or needs to improve the accuracy of level measurement. The still well connect with the bottom of the weir or flume, and the probe measures the level in the well.
- When install to the cold area, should choose the lengthen sensor and make the sensor extend into the container, shun frost and icing.
- For Parshall flume, the probe should be installed in a position the 2/3 contraction away from the throat.
- For V-Notch weir and rectangular weir, the probe should be installed on the upstream side, the maximum water depths over the weir and 3~4 times away from the weir plate.



Parshall flume



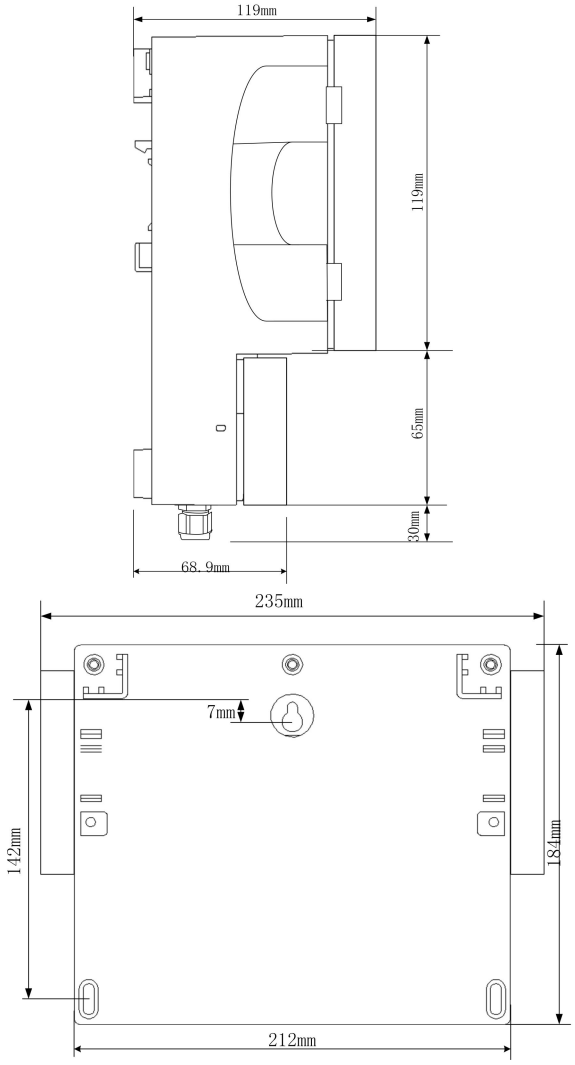
V-Notch weir



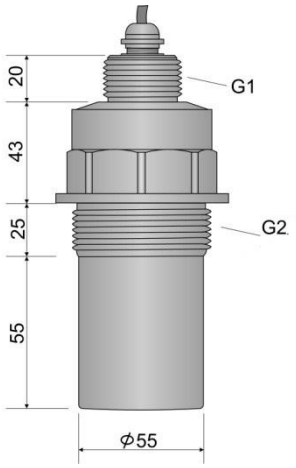
Rectangular weir

2.2 Mounting dimensions

- The host



- The probe



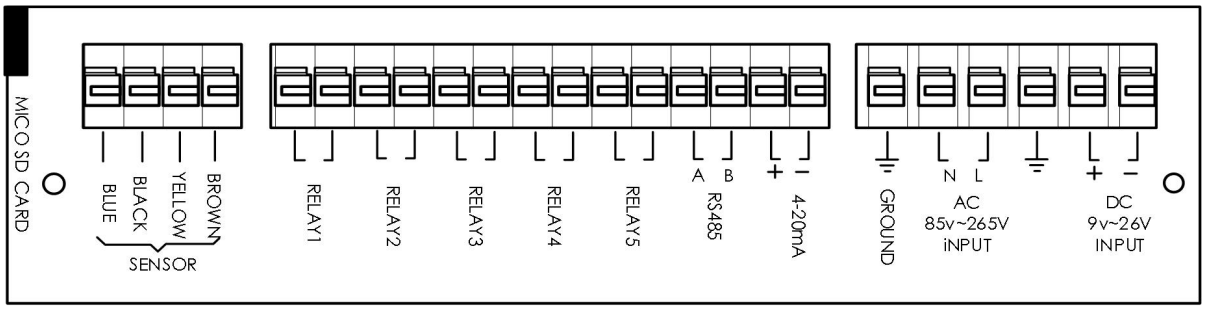
3.Wiring

The upper transparent window of the host is the color touch screen area of the instrument; the lower part is the junction box, and the wiring terminals can be seen after opening.

3.1 The host

3.2 Wiring diagram

Remove the terminal cover to expose the terminals shown below. The wiring instructions are on bottom of the terminals as below. The terminal block adopts the self-pressing design, and the wire is connected after pressing.



NOTES: The connection maybe different according to the different power supply and signal output.

Carefully confirm the marked power supply terminals, to ensure the correct power supply connection.

If you choose the version with an SD card, please note that the SD card does not support hot plugging. The flowmeter must be powered off when the SD card is inserted or removed, otherwise the SD card and the device may be damaged.
The flowmeter with SD card version needs to insert the SD card to start, otherwise it will take 10s to start normally.

The instrument host should be connected to the system ground or field ground to eliminate possible high-frequency noise signals inside the power supply. This high-frequency noise may be superimposed on the DC4-20mA current signal, causing the system to fail to collect the instrument current signal normally.

3.3 The cable

The cable between probe and host is 10m standard. Users can extend the cable when desired, and the max distance between probe and host is 1000m.
The cable with three core shield wire is recommended.

4.Operation

4.1 Display and operation

Screen touch (resistive touch screen): Touch the screen with your finger or stylus, you can touch with gloves, and it is forbidden to touch the screen with sharp objects.

4.2 Two working mode

The instrument has two working mode: measurement mode and programming mode. In running mode, the measurement data is displayed. In programming mode, user can setup parameters of the instrument.

4.2.1 Measurement mode

When the power is turned on, the instrument takes several seconds to initialize and then runs into the running mode to start the normal level and flow measurement.

In the measurement state, the meter performs normal flow or level measurement. In this state, it contains 4 pages: main display, detailed display, trend curve and historical data. Touch the navigation bar on the top to quickly switch between these pages.

The main display page (display content sample is as follows):

Illustrated description:

1 Main display buttons

2 Detail page button

3 Trend curve page button

4 Historical data page button

5 Primary Variable（PV） identification（The display type can be selected in the settings）

6 Primary Variable（PV） data

7 Primary Variable（PV） unit

8 Level data

9 Temperature data

10 Cumulative flow data

11 Relay status

12 Relay opening and closing details button

13 Instrument tag information (click to pop up keyboard editing)

14 Primary variable histogram

15 Settings menu button

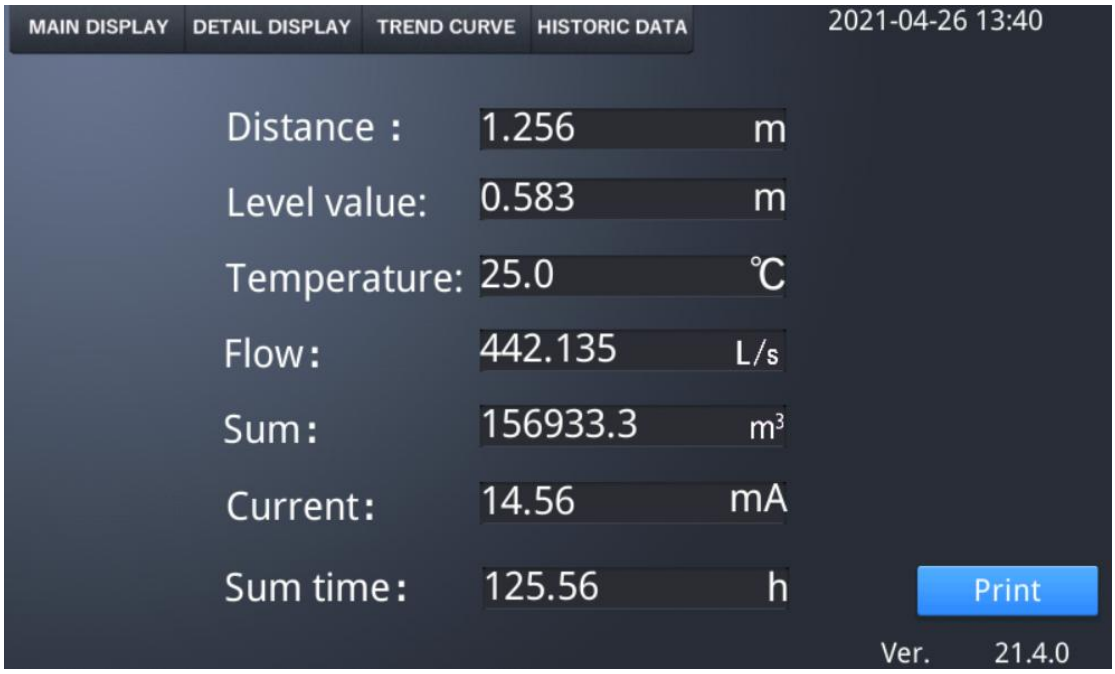
16 Working status indicator

17 Time

Detailed page

Can display distant level, water level, temperature, instantaneous flow, cumulative flow and current output information and the total sum time.

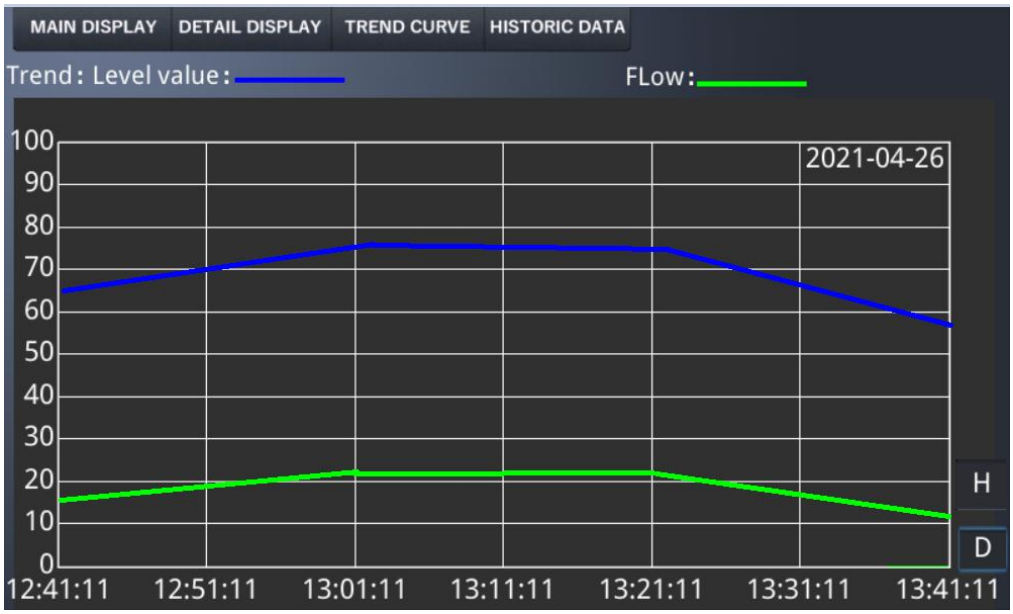
Print: print all the information of the current page to a portable printer. This function is optional. For details, please refer to the manufacturer's portable printer instructions



Real-time curve page

It can display the trend in percentage form of the level and instantaneous flow. Press the button in the lower right corner to switch the horizontal coordinate to view in hours or days . Drag the slider to move the time view.

Note : The graph will not be saved after power failure.



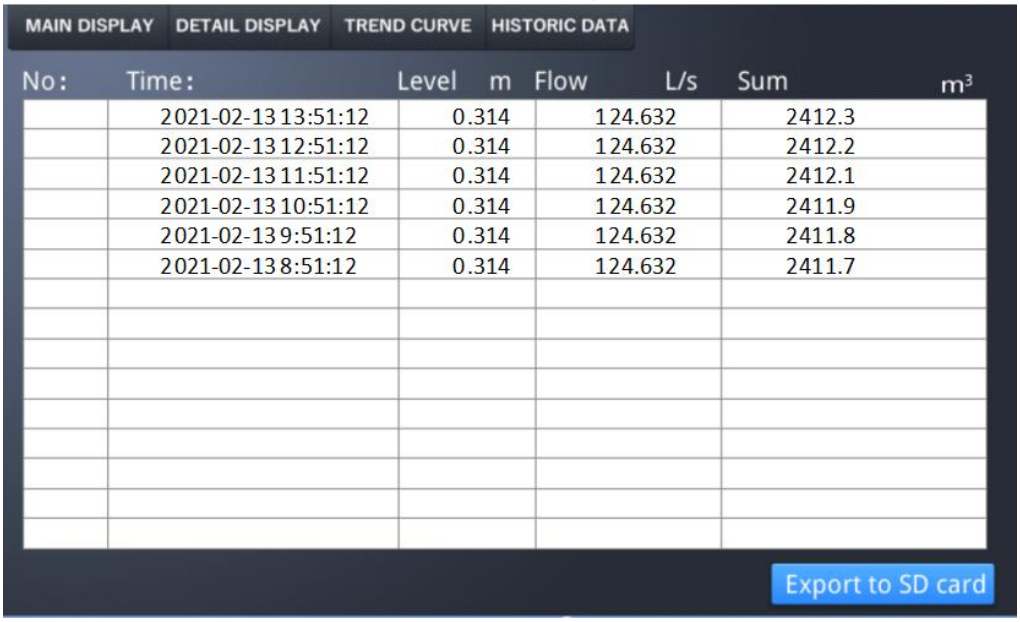
Historical data page

Timely record instantaneous flow (L/s) and cumulative flow (m³) , the storage time interval can be modified in the advanced settings. The data is saved after power off. If you need to

clear the data, please clear it in the advanced settings.

SD card export (SD card slot is optional), export all history records to mircro SD card and the storage format is csv format.

The device does not support hot plugging. The SD card needs to be plug when the flowmeter is powered off to prevent possible damage to the SD card or the device.



4.2.2 Parameter setting status

In this state, the meter displays various parameters that need to be set by the user. In the main interface, click Settings in the lower left corner to enter the settings interface (if a password is set, you need to enter the password to enter). The left side of the setting interface is the navigation, and the right side is the respective setting items. Navigation is divided into: weir and trough settings, advanced settings, current output settings, digital output settings, relay settings, other settings and internal settings.

·Application

After the flowmeter completes the parameter setting in the settings on this page, the flowmeter can complete the normal measurement work.

Installation height: from the probe launching surface to the lowest point of the weir tank liquid level

Channel selection: Parshall/triangular weir/rectangular weir/custom

For the detailed list of weirs and grooves supported by this machine, please refer to the chapter of "Types of Weir and Grooves Supported by This Machine" When the custom formula is selected (the formula format is shown in Figure 12), the format can basically meet the requirements of formulas in various situations. It should be noted that the liquid level unit corresponding to the formula is m, and the flow unit is L/s. The unit entered here does not change and convert with the system unit.

·Advanced Settings

Damping: The maximum allowable liquid level change. Increasing this value can respond to the error caused by fluctuations, and reducing this value can appropriately improve the response speed.

Low liquid level cut: The user can customize when the liquid level is lower than how much the flow will be automatically cut to 0 to prevent flow deviation caused by low liquid level. (Default 0.000m)
Note: By default, using Parshall groove will automatically cut off small flow according to the standard. If there is demand, the automatic low flow cutoff of the Parshall groove can be cancelled at the factory (customization required).

Cumulative flow full-scale: change the maximum value of the cumulative full-scale flow of this instrument. When the instrument reaches the set maximum cumulative flow full-scale, the accumulated flow will return to zero. (Default 99999999.9m3)
Historical record saving interval: The saving interval of historical data in historical data. The earliest record is automatically overwritten when the data is full. It can save 2700 days in one hour interval; 1350 days in half hour interval; 675 days in 15-minute interval; 5

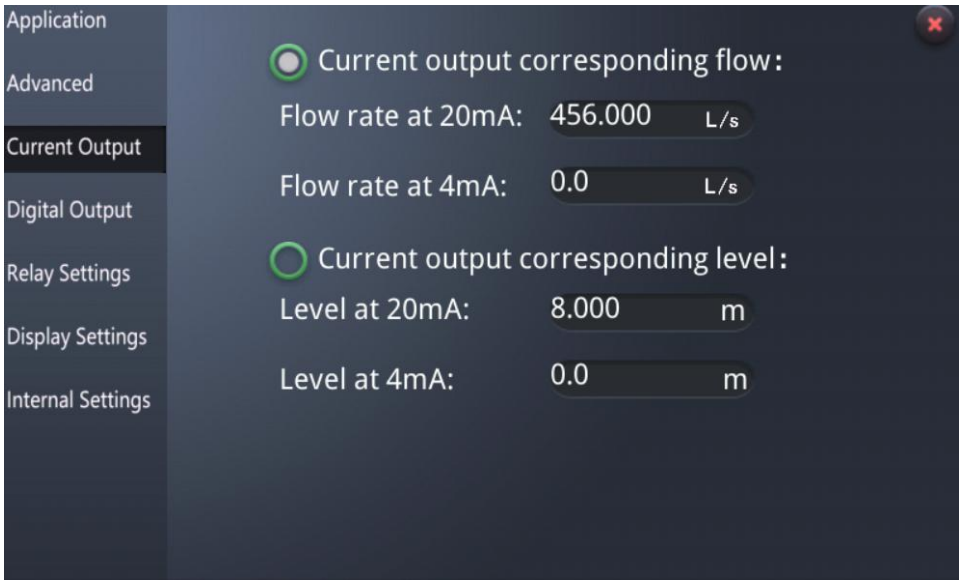
minutes in interval It can be stored for 225 days; it can be stored for 45 days at intervals of 1 minute.

Clear cumulative flow: clear cumulative flow

Clear history records: delete all history records
Modify log: Can record some information about flowmeter changes.

·Current output Setting

Current output can choose corresponding flow or liquid level



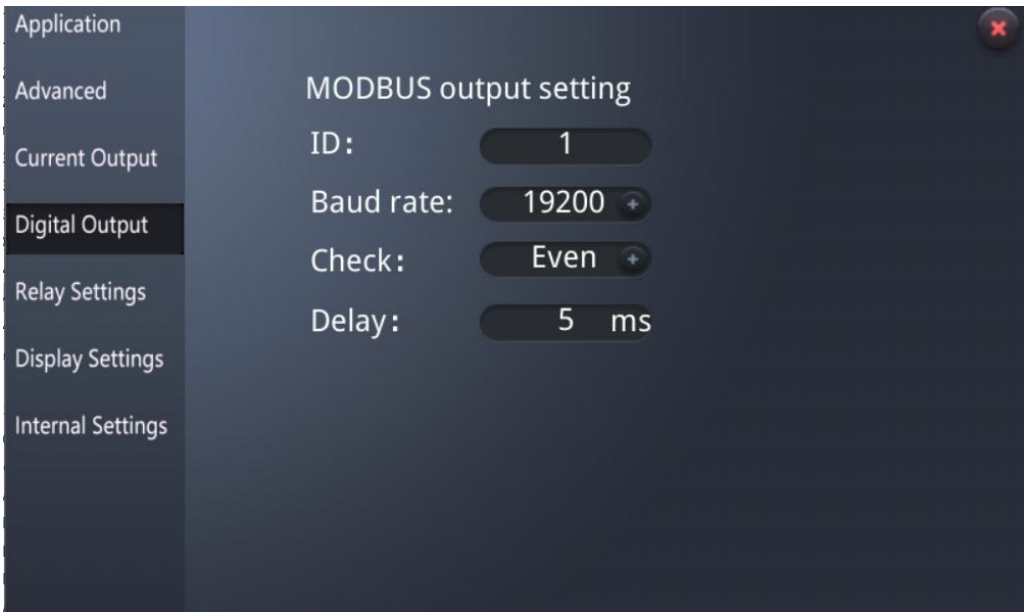
Flow rate at 20mA: the flow value corresponding to the current output of 20mA. The value is automatically filled in the maximum recommended fullness of the current weir trough after the user selects the weir trough, and the user can also manually adjust it.

Flow rate at 4mA: the flow value corresponding to the current output of 4mA. The default value of all weirs is 0, and the user can also adjust it manually.

Level at 20mA： the level value corresponding to the current output of 20mA.
Level at 4mA： the level value corresponding to the current output of 4mA.

·MODBUS Settings

After completing this part of the settings, the MODBUS communication function can be used normally.



ID: Device address1～247 valid (default 001)
Baud rate: 1200/2400/4800/9600 (default)/19200
Check: None (8n1)/None (8n2)/Odd/Even (default)

Delay: Increase the Modbus reply time delay to prevent the host from being unrecognized

·Relay Settings

After completing this part of the setting, the relay function can be used normally.

Relay selection: slide the current relay to be set

Enable: Enable/disable (default)

NC/NO(Normally open/ normally closed): normally open (default) / normally closed

Type: flow upper limit (default)/flow lower limit/liquid upper limit/liquid lower limit/pulse equivalent/fault alarm (action when there is no echo or the host cannot communicate with the probe).

Action point: If it is used as a flow upper limit alarm, when the instantaneous flow value is greater than this value, the relay will act and turn on or off, depending on the setting status of the corresponding relay; if it is used as a flow lower limit alarm, the relay will act when the instantaneous flow is less than this value. Turning on or off is determined by the setting state of the corresponding relay; if it is used as a liquid level upper limit alarm, the relay will act when the liquid level value is greater than this value, and the turning on or off is determined by the setting state of the corresponding relay; such as the liquid level Lower limit alarm. When the liquid level is less than this value, the relay will act and turn on or off, which is determined by the setting state of the corresponding relay; when it is output as a pulse equivalent, the value is invalid.

Relay delay: Change the relay action delay time. The relay can only operate after reaching the set value requirement for the delay time to avoid repeated fluctuations of the liquid level. It can be modified to (0-99s) (default 5s).

Pulse equivalent setting: When relay 1, 2 or 3 is set to pulse output, the setting takes effect. The relay outputs cumulative pulses, that is, each time the cumulative flow increases by a set amount, the relay will act once, the action holding time is 500ms, and then it will be disconnected. Unit m3 (default 1m3)

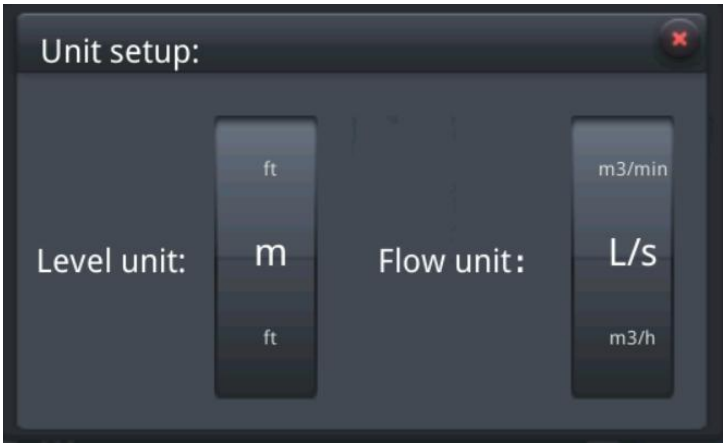
Note: Please select the appropriate pulse equivalent according to the actual weir and flume type and flow conditions to prevent the relay from operating too frequently.

Display Settings

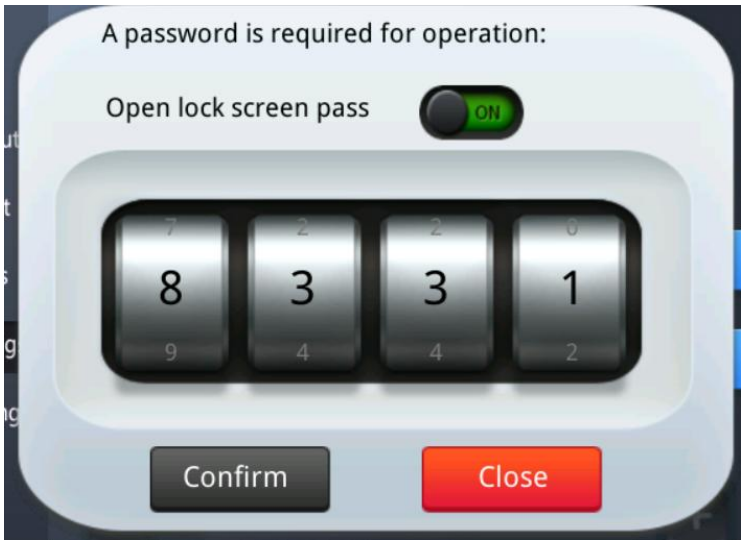
Language selection: Select system language

PV display settings: Select the PV of the main page, you can choose whether the main interface displays level or flow

Unit setting: system unit can be set
Level unit（m/ft） Flow unit (L/s m3/h m3/min)



Lock password setting: you can turn on and set the setting password, or you can turn it off. Please remember the password after the password is set.



The lock screen password is turned off by default at the factory. If you need to turn it on, first turn on the switch in the upper right corner, then slide to select your password, and click OK to save. Note: If you have set a password, please remember the password!
Time setting: set the system time

Backlight adjustment: adjust the brightness of the display backlight

Automatic power saving button: When the screen is not operated for 30 seconds, the screen brightness is reduced by half to reduce power consumption and extend the screen usage time.

4.3 The weir type table:

Parshall flume

Weir Type (ISO)	Throat Width and number shown in the OCM	Head Height
Parshall flume	1 1 in	0.21m
Parshall flume	2 2 in	0.24m
Parshall flume	3 3 in	0.33m
Parshall flume	4 6 in	0.45m
Parshall flume	5 9 in	0.6m
Parshall flume	6 1 ft	0.75m
Parshall flume	7 1ft6in	0.75m
Parshall flume	8 2 ft	0.75m
Parshall flume	9 2ft6in	0.75m
Parshall flume	10 3 ft	0.75m
Parshall flume	11 4 ft	0.8m
Parshall flume	12 5 ft	0.8m
Parshall flume	13 6 ft	0.8m
Parshall flume	14 7 ft	0.8m
Parshall flume	15 8 ft	0.8m
Parshall flume	16 10 ft	1.07m
Parshall flume	17 12 ft	1.37m
Parshall flume	18 15 ft	1.67m
Parshall flume	19 20 ft	1.83m
Parshall flume	20 25 ft	1.83m
Parshall flume	21 30 ft	1.83m
Parshall flume	22 40 ft	1.83m
Parshall flume	23 50 ft	1.83m

Customer Weir type (User-defined formulas)

Weir Type	Formulas	Head Height
Customer Weir type	Q=K1*K2*HPWR	Q is flow, unit is L/S K1 K2 represent the user-defined coefficient H represent level, unit is m PWR is the user-defined index

V-Notch weir

Weir Type (ISO)	Model and number shown in the OCM	Head Height
V-Notch weir	1 30°	31cm
V-Notch weir	2 45°	31cm
V-Notch weir	3 60°	31cm
V-Notch weir	4 90°	31cm
V-Notch weir	5 120°	31cm

Rectangular weir with End Contractions

Weir Type(ISO)	Gaps width and number shown in the OCM	Head Height
Rectangular weir with End	1 25cm	31cm
Rectangular weir with End	2 50cm	46cm
Rectangular weir with End	3 75cm	62cm
Rectangular weir with End	4 100cm	62cm
Rectangular weir with End	Custom Width	

Rectangular weir without End Contractions (Suppressed Weir)

Weir Type(ISO)	Gaps width and number shown in the OCM	Head Height
Rectangular weir without End	1 25cm	31cm
Rectangular weir without End	2 50cm	46cm
Rectangular weir without End	3 75cm	62cm
Rectangular weir without End	4 100cm	62cm
Rectangular weir without End	Custom Width	

5.Relay work

When the flow or liquid level is greater than the upper limit for 5 seconds (default value) or less than the lower limit for 5 seconds, the relay works, the contacts are closed, and the contact current capacity is 5A. When the flow or liquid level is less than the upper limit for 5 seconds or greater than the lower limit for 5 seconds, the relay contacts are released.

The design is to prevent the repeated opening and closing of the relay caused by the fluctuation of the liquid level, and to avoid frequent opening of the pump or alarm.

When used for pump control, avoid connecting the relay directly to the pump's power supply circuit.

The relay can also output cumulative pulses, that is, each time the cumulative flow increases by one unit (settable), the corresponding relay will be closed once, the holding time of the pull-in is 500ms, and then it will be disconnected. The relay can also be set as a fault alarm, which will act when there is no echo or other faults.

6.Calibration

The instrument should be calibrated indoor before installation to ensure the normal performance.

General consideration

1. The open channel flowmeter should be checked indoors before installation to ensure the normal performance of the meter.
2. Align the ultrasonic probe of the open channel flowmeter with a wall as vertically as possible to ensure it is measured.
3. According to the label below the terminal, connect the probe to the host, and according to the power supply label, power the meter correctly.
4. The open channel flowmeter first displays the startup screen, and then displays the main measurement page. The symbol on the upper right corner of the display flashes and the reading is stable, indicating that the communication between the host and the probe is normal.
5. Touch the navigation bar of the meter, the meter can switch to other measurement information pages (distance, temperature, current, liquid level), and you can also view real-time data trends and historical data records.
6. Slowly move the probe, the liquid level value and distance value displayed by the meter should change accordingly.

When moving within a short distance (1m), the speed should not exceed 0.1m/s.

There is a detection window inside the instrument, and the target instrument beyond the detection window needs a judgment time of about 5s. The window of the level gauge below 10m is usually ±0.5m, and the window of the level gauge above 10m is ±1.2m. Due to the existence of the detection window, the meter will sometimes

make mistakes when the distance is about 1/2 times the distance from the far to the near. The sudden change of distance usually does not exist in the actual measurement process.

7. In the basic settings, modify the weir/ flume model and installation height, save and exit, the flow value displayed by the meter will change, and observe that the cumulative flow of the meter is increasing.
8. Use a multimeter to measure the DC4-20mA current output, the current output always corresponds to the instantaneous flow value.
9. Modify the working status of the relay and the set value of the action point, and use a multimeter to check whether the relay is correctly delayed action.
10. Connect with the host computer to test the RS485 communication function of the instrument.

7.Serial communication-Modbus-RTU

The serial communication is optional for the O.C.M, with standard Modbus protocol, RTU serial transmission mode. (This function should be confirmed when it is ordered.)

Address number

The valid address numbers are in the range 1-247, and the address number is corresponding to the address code in Modbus communication. It can be set in the programming mode.

Baud rate

This series allows the following baud rate (RTU mode): 19200bit/s, 9600bit/s, 4800bit/s,2400bit/s,1200bit/s. The baud rate can be set in the programming mode.

Parity Check

Three check modes: Odd parity、even parity , no parity(8n1) and no parity(8n2) . The check mode can be set in the programming mode.

Function code

According to the specific application of this instrument, only one function code ”03” is used, to read the read holding registers. Other Modbus function code is not valid in this instrument.

Abnormal corresponding

According to the specific application of this instrument, three abnormal data are supported in the RTU mode.

01: false function

02: false data address

03: false data

Electrical connection

The instrument supports the EIA/TIA-485 standard 2-wire communication link.
This instrument does not require polarity of the bias circuit.
The cable is suggested to be a pair of balanced twisted-pair cable, and shielded cable is best. When the baud rate is 9600bit / s, maximum length of the cable (AWG26 specification and above) is 1000m.

The RTU mode

The RTU frame format: the representation of data is hexadecimal byte. Each byte has 11 bits: 1 start bit, 8 data bits, 1 parity check bit, 1 stop bit, 2 stop bits when without parity check.

1) The master request:

1	2	3	4	5	6	7	8
Slave Address	0x 03	Starting register high byte	Starting register low byte	number of registers to read high byte	number of registers to read low byte	CRC Check High	CRC Check Low

1: Slave Address: Slave address range (001 ~ 247)

2:0x03: function code of read keep register

3, 4: The starting register

5, 6: number of registers to read

7, 8: CRC check

2) The slave response:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
Slave Address	0x0 3	Data Count	Register Data 1	Register Data 2	.....	Register Data M	CRC Check High	CRC Check Low

1: Slave Address: Slave address range (001 ~ 247)

2:0x03: function code of read keep register

3: Data count.

4, 5: Register Data 1

6, 7: Register Data 2

M-1, M: Register Data M

M+1, M+2: CRC check

3) The Modbus Table:

The Function 0x03 Read Holding Register

Register Address	Data Form	
0x0000	Unsigned int (32bit) 2 WORD	0.001*Instantaneous Flow l/s Unit is L/S
0x0002	Unsigned int (32bit) 2 WORD	0.1*Cumulant flow m³, Unit m³
0x0004	Unsigned int (32bit) 2 WORD	temperature Unit ℃
0x0005	Signed short int (16bit) 1 WORD	Level Value ， Unit mm
0x1000	Float （swapped float/Big Endian Format) Byte order :4,3,2,1	Instantaneous Flow Unit l/s
0x1002	Float （swapped float/Big Endian Format) Byte order :4,3,2,1	Cumulant flow Unit m3/h
0x1004	Float （swapped float/Big Endian Format) Byte order :4,3,2,1	Level Unit mm

Example:

1.read the Instantaneous flow and the cumulant flow

Host: 0x01 0x03 0x00 0x00 0x00 0x04 0x44 0x09

Slave: 0x01 0x03 0x08 0x00 0x00 0x44 0xD9 0x00 0x01 0x52 0xA8 0xEA 0x5E

Instantaneous flow: 0x00 0x00 0x44 0xd9 17625*0.001L/S =17.625l/S

Cumulant flow:0x00 0x01 0x52 0xA8 86696 *0.1 m³=8669.6m³

Note： Because of the precision of the float format (IEEE754), it is not recommended to use the float format to read the cumulative flow. When the accumulated flow is very large, the precision of reading in the float format will be lost. ~ Use 0x0002 Unsigned int format to read the accumulated flow.

8.Trouble-shooting

Trouble Phenomenon	Trouble Reason	Solution
The instrument does not show, and does not work.	Power supply error. Wiring error.	Check the power supply. Check the wiring.
The instrument doesn't work but with show.	The probe doesn't aim at the liquid or the material. The surface has great fluctuations. Liquid surface with lots of foam. The container is empty and the bottom is not flat. The battery is low	Adjust the sensor and aim at the material. Add a tube to the container or use the static water Wells. Add a tube to the container. Add the water and the instrument will work well. Charge the meter for 1 hours and reset the time in the basic setup
The instrument shows unstable or the measured value has a great deviation.	Wrong setting about the weir type number or the installation height or the flow rate unit. The level enters the blanking distance. There is strong electromagnetic interference. There is Obstruction of the ultrasonic wave. There are floaters on the liquid.	Check the settings. Increase the installation height of the instrument, or prevent the level too high. Increase shielding to the instrument. Change the installation site or using a plastic tube. Eliminate floater.
The probe is fixed in circular tube	Suggest the diameter of the tube is greater than 80 mm, the length is not more than 400 mm.	
The display takes a long time to show	The flowmeter with sd card version needs to insert the sd card to start, otherwise it will take 10s to start normally.	