sisco

Portable Radar Flow Meter

User's Guide

V1.1.1

sisco

First of all , Thank you for your choice of our products! radar wave flow meter is an advanced flow rate measuring instrument, which uses radar technology to achieve a simple, fast non-contact surface velocity. The instrument is small and lightweight, easy to carry, very suitable for floods or rapids other than other instruments which is difficult to use for measuring river flow velocity as water-immersed using and on-site testing.

Radar wave flow meter integrated a lot of leading technology. Such as the use of precision planar narrowband array radar sensor, FFT digital signal processing, flow direction identification, vertical and horizontal angle of the automatic correction; the instrument can measure the maximum flow rate is 20m/ s, detection sensitivity. Flow meter has a large color LCD screen, embedded guide menu-style software, very user-friendly operation.

We would like the user to read this manual before using the radar wave flow meter so that you will have better control of how to use this advanced speedometer. This manual describes in detail the use of radar wave flow meter, maintenance and precautions.

User's Manual

✧ Precautions and Terms of Use

Note: Our company's product design and manufacturing are safe and reliable, Please use it correctly (as indicated in the text below), and follow the following precautions completely, without harming the instrument and human body.

> Users of this manual must be aware of the hazards that may arise from the instrument and its accessories.
> All operators should be familiar with the safety instructions and warnings in this section before operating this instrument. Failure to follow the instructions may reduce the performance of the instrument.

Legend:

⚠Note: attention/caution

It is important to read carefully in the process of transportation, use and maintenance.

The items to be noted are as follows:

✧ **operating environment, and Electricity considerations**

⚠Warning: do not use instruments in places that have or may have flammable and explosive gases.

⚠Note: do not touch the surface or put it in water.

⚠Note: don't place instruments in extreme temperatures to avoid static.

✧ **instrument operation**

⚠**Note: be careful not to fall or fall as you use, store or transport equipment.**

✧ **batteries**

⚠**Warning:** use the lithium ion rechargeable battery and charger as specified in chapter 2.4.

⚠**Warning:** please charge when the battery is low.

⚠**Note:** waste batteries should be discarded in accordance with your local regulations.

✧ **keyboard button**

⚠ Note: don't push the button too hard.

✧ **RS232 interface, USB interface**

⚠ Warning: computer equipment connected with RS232 interface and USB must comply with BS EN60950/IEC950 standard.

✧ **instrument parts**

⚠ Warning: the instrument shall not be equipped with spare parts.

✧ **harmful material management**。

Please abide by the regulations of hazardous materials management when discarding .iscard and comply with hazardous material management regulations, according to waste electronics/electrical products.

⚠ Warning: don't throw old equipment into classified waste or municipal waste.

✧ **restrictions rules**。

The design of conforms to the requirements of safe and conventional method.

✧ **statement**

The design conforms to and obeys the requirements of low voltage.

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1 Introduction

The handheld radar wave flow meter adopts k-band radio waves to measure the non-contact velocity of rivers, sewage, mud and sea, The equipment is small, hand-held, lithium ion batteries and easy to use. Without water corrosion, not affected by sediment interference, through the non-contact measurement, ensure the safety of the measurer.

The instrument includes a highly sensitive planar narrow-band radar antenna and Angle meter, which is operated by hand. Embedded operating software is menu-type and easy to operate.

This manual introduces the method and maintenance of wave velocities in detail.

1.1 characteristics of instruments

- for single use, the weight is less than 1 kg, hand-held measurement or on a tripod (option);
- Chinese/English interface, easy operation;
- non-contact operation, is not affected by sediment, also not be eroded by water;
- the horizontal and vertical direction Angle automatic correction;
- a variety of measurement mode, can rapid measurement can also be continuous measurement;
- The data can be transmitted wirelessly via blue-tooth (as optional blue-tooth);
- can be used continuously for more than 10 hours using built-in high

capacity lithium ion battery,

- a variety of charging ways, you can use alternating current, vehicular charging and mobile power charging.

1.2 principle of operation

The radar velocity meter can measure the river flow in such mode :single flow rate, continuous flow rate and river discharge. The instrument is based on the principle of Doppler effect:

When the radar source and the target are relatively static, the receiving frequency and the transmitting frequency are equal:

$$f_{\text{Receive}} = f_0 = \frac{c_0}{\lambda}$$

When radar source waves is transmitted from fixed position, target is moving in the direction of source waves as speed v, the radar wave speed increase as $c_0 + v$,the receive radar wave frequency which is the number of the wave per unit time

$$f'_{\text{Receive}} = \frac{c_0 + v}{\lambda}$$

Doppler shift $f_D = f'_{\text{Receive}} - f_0$;

Moving speed of moving target: $v = f_D \cdot \lambda = \frac{f_D}{f_0} \cdot c_0$

When the f_D is positive, the velocity is the same as the transmitting wave, and the negative sign is opposite; The speed of the moving target is proportional f_D to the frequency shift.

$$v = \left(\frac{f'_{\text{Receive}}}{f_0} - 1 \right) \cdot c$$

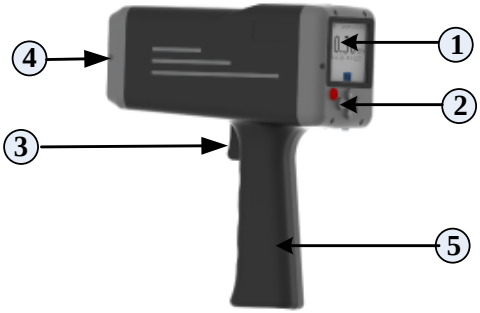
When user measures flow of river water,transmits radar wave to the water wave, bubble and floater (after tested mobile target), the microwave will be absorption, reflection, and part of the reflection wave are received by , the reflected wave is converted to electrical signals, handled by measuring circuit and measured the Doppler shift, then according to the principle of the above the water flow rate can be calculated. For there has a certain Angle between transmitting radar wave direction of and the direction of flow ;at the same time ,the radar wave transmitted from goes though the twice distance between the ,so the river speed is needed to modify for getting actual water flow rate as below:

$$v = \frac{1}{2}\left(\frac{f'_{\text{Receive}}}{f_0} - 1 \right) \cdot c_0 / \cos\alpha$$

2 basic operation

2.1 instrument structure

Appearance of the instrument:



① LCD screen ④ Radio emitter

② keyboard ⑤ Handle

③ Measuring shortcut key

Figure 1 appearance

2.2 Button function

Figure 2 button function introduction

Table 1 button function introduction

No	Button	legend	Instructions
①	on/off		Implement switch machine operation
②	menu	M	Enter the main menu interface at any interface
②	up	▲	Implement the upward roll operation
③	down	▼	Implement the downward roll operation
⑤	Identify	OK	Confirm the current operation
⑥	Measuring	spanner	Enter in measurement mode at any interface

2.3 Icon

 ---------- Low power mark

Figure 3 low battery power mark

2.4 Battery

This instrument uses a lithium ion rechargeable battery.

⚠Tip: for better using effect, please use the company's high-quality original lithium ion battery; when low power mark is displayed, please immediately charge the battery.

⚠Warning: please use the charger provided by the company to charge the battery; Using a charger that does not have a 3C certification can reduce battery life or have safety hazards. Please be careful!

⚠Note: the battery needs to be charged periodically (3 months), which can guarantee the life of the lithium ion battery.

2.5 Battery indication

Battery signs and battery status tips:

Table 3 battery specification

Battery marking	Battery status
	Sufficient battery
	High battery power
	Battery power halved
	The battery is low, please charge
	The battery is low, please charge

⚠Note: high temperature can shorten battery life, please keep the instrument in a cool and dry place.

2.6 Power on

Press button to start up the . The instrument buzzer rings once, and then the boot initialization image is showed . The instrument then performs its internal calibration procedure.

Tip: if the battery is low, it will not be turned on. Or automatic shutdown after starting up. If this happens, please charge the battery in time.

Tip: if the clock in is not set, the device will first enter the time and date setting mode (see chapter 3.4.1), please set the clock and then perform other operations.

2.7 System initialization

After the machine is turned on, the instrument is switched on (see chapter 2.5). The system is initialized and the instrument performs 15 seconds initialization procedures.

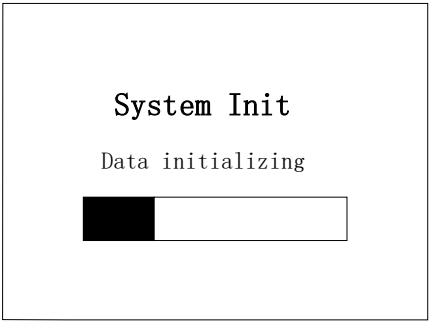


Figure 5. System initialization process

Note: when the instrument system is initialized, please place Please

place the instrument horizontally and motionlessly. When the instrument is initialized, it will enter the measurement mode selection, then the corresponding mode can be selected directly into the measurement. At the same time, the mark of battery power is indicated in this interface.

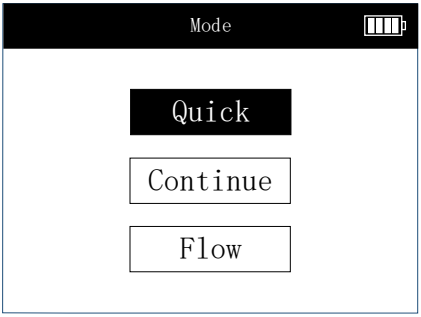


Figure 6 system initialization completion, mode selection

2.8 Power off

Long press button to turn off the power.

will turn off automatically when the instrument is not operated for 5 minutes (continuous measurement exception).

Tip: to avoid accidental shutdown, the shutdown key cannot be used during the velocity measurement.

3 Instrument setting

After the instrument is initialized, press the "M" button to enter the menu Settings; Or, press the "M" button to enter the main menu interface. Use the "▲" and"▼ "button scroll menu options, press" OK"to determine the entry options and press" ↺"button to exit.

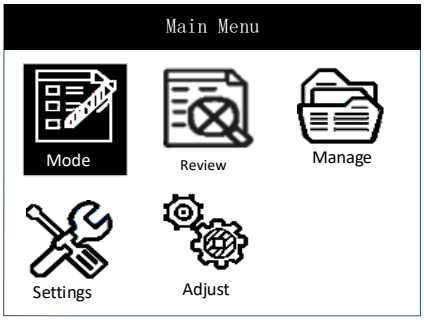


Figure 7 main menu interface

3.1 Mode selection

can support three measurement modes:fast, continuous and flow;As shown in the figure below, the user selects the measurement mode to use as required.

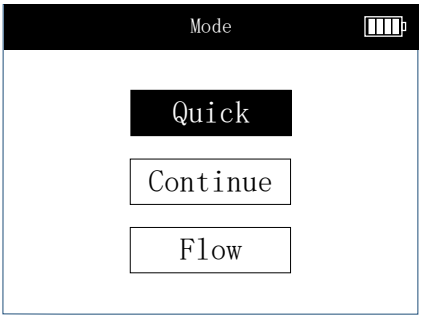


FIG. 8 mode selection

Tip: see chapter 4 for specific operations of each pattern.

3.2 View record

The instrument can permanently record 2,000 test results, and the recorded results will not be lost due to power failure. To view the saved result, press "▲" and"▼ "to select" recall"and press"OK "to enter the data playback interface under the menu interface.

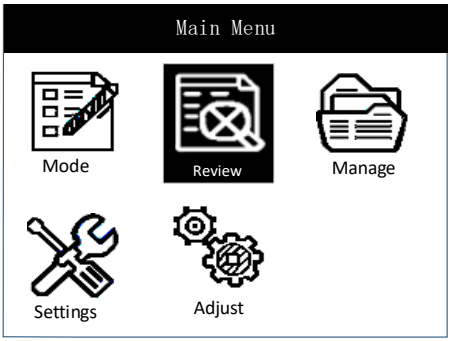


Figure 9a selects data playback

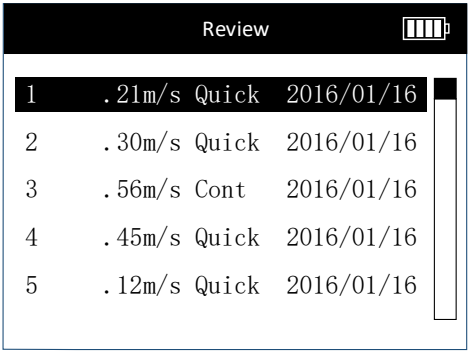


Figure 9b enters data back

In the data playback interface, press the "▲" or" ▼"key to select the

playback, and press the"OK "button to see the specific test results.

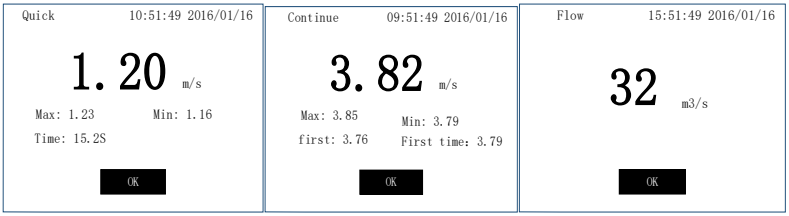


Figure 9c shows the historical results in three modes

3.3 Data management

Press "▲" or "▼"key to select" management "and press"OK "to enter the data management interface. Data management can delete all the data of the whole machine.

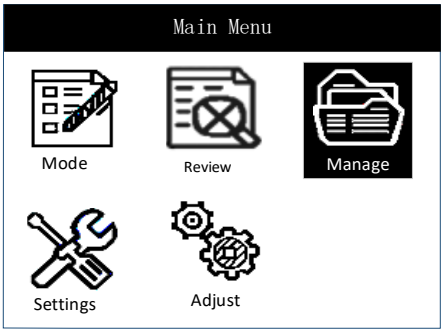


Figure 10a selects data management function

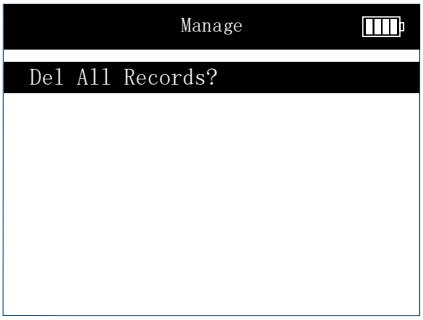


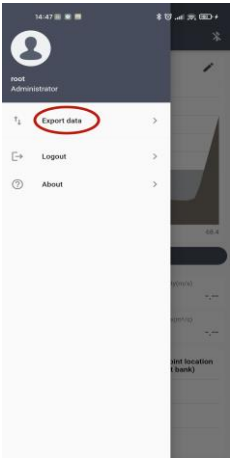
figure 10b enter data management function

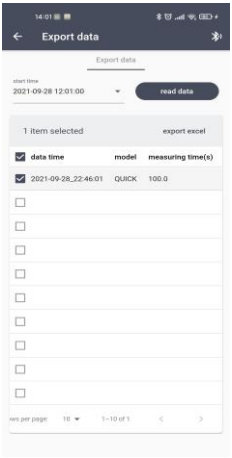
3.4 Data Export

1.Mobile phone installed multi-point flow measurement software, turn on the mobile phone Bluetooth and location information to ensure that the device can be connected normally;

2.Open the software, click the export data, click the Bluetooth icon, and find the corresponding Bluetooth number connection, Bluetooth number RD60-XXXX;

3.After connecting the device, the historical data can be exported by setting the start time, exporting the data is the starting time to the present data, and the data format is XLSX;





3.5 System setting

Press the "▲" or "▼"button to select" system Settings "and press" ⓞ"to enter the system Settings interface.

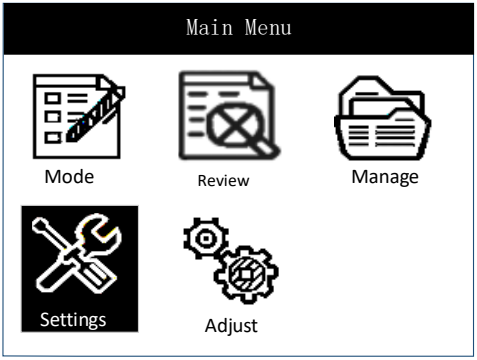


Figure 11a selection system setting

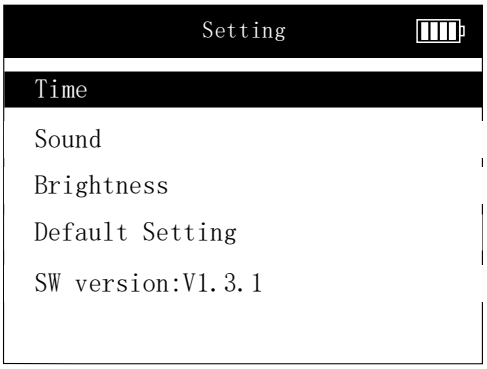


figure 11b enters system Settings

3.5.1 Adjust system time

Press "▲" or" ▼"button to choose time Settings," ⓞ"button to enter the time and date Settings menu, press" ▲"or" ▼"button by the time you need to set up, and then press"ⓞ "button to confirm and modify after select"

done ".

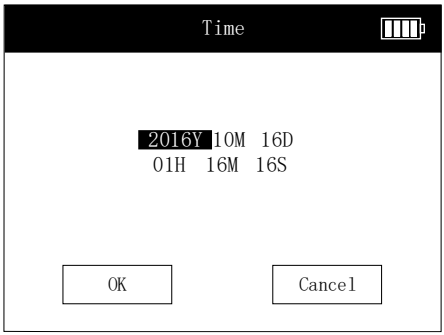
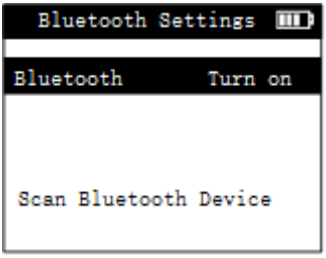


Figure 12 sets the system time

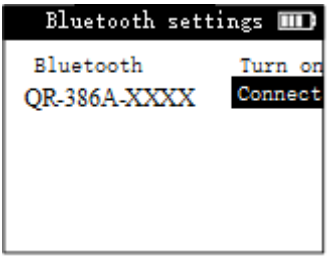
3.5.2 Bluetooth settings (optional)

Turn on the power of the Bluetooth printer, under the system setting menu of the flow meter, select "Bluetooth settings", press "OK" key to enter, press "OK" and "▲or"▼ "keys to turn on the Bluetooth, and the flow meter starts scanning nearby Bluetooth devices.



Pic 13 Scan for Bluetooth devices

After scanning, find the Bluetooth device with the device number "QR-386A-XXXX", and press the "OK" and "▲or"▼ "keys to connect to the Bluetooth device.



PIC 14 Connect Bluetooth device

After the connection is successful, return to the data playback menu, press the "OK" key to enter the measurement item, press the "▲or"▼ "key to select the "print" button, press the"OK "key to start printing.

PIC 15 Start printing

3.5.3 Adjust system sound

Under the system Settings menu, select "sound Settings", press "OK" button to enter, press" ▲"or"▼ "button to open or close the system sound, and select" finish "after setting.

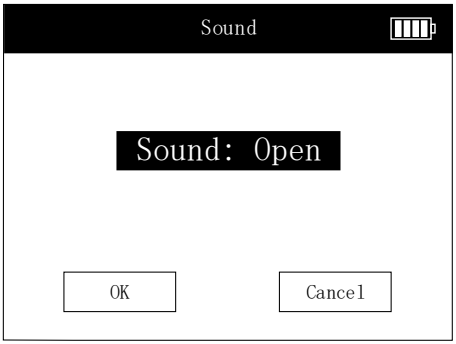


Figure 16 sets the system sound

3.5.4 Brightness setting

Select "brightness Settings", click "OK" button to enter, choose brightness Settings, press" OK"button to enter, and then press"▲ "or"▼ "button to adjust brightness, select" done "to save Settings, select" cancel "to give up the Settings. A total of 0~9 brightness can adjust, the number is higher, the screen is brighter.

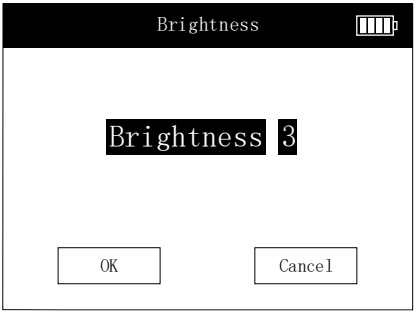


Figure 17 backlight brightness setting

Note: press "M" button on any interface to quickly enter the brightness setting interface and set the screen brightness. If screen is brighter, the battery power energy is used more and the reduced total use time.

3.5.5 Restore system Settings

Select "factory setting", press "OK" button to enter, select" confirm "or" cancel "setting.

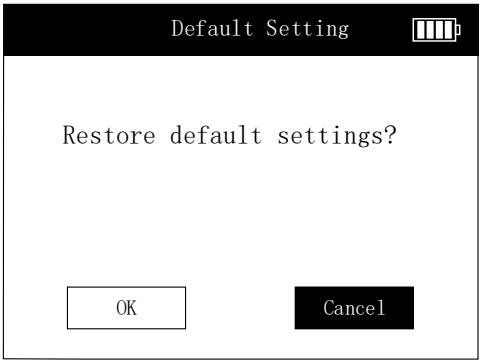


Figure 18 restore the default Settings

3.5.6 Version information

Select the "version" and press "OK" to access the version information.

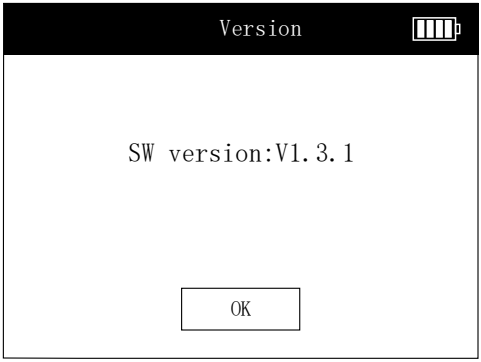


Figure 19 version information

3.6 Instrument calibration

Press the "▲" or"▼ "key to select" system Settings "and press"OK "to

enter the" instrument calibration "interface.

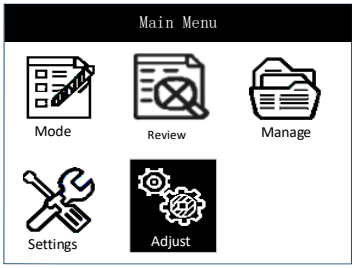


FIG. 20a selection instrument calibration

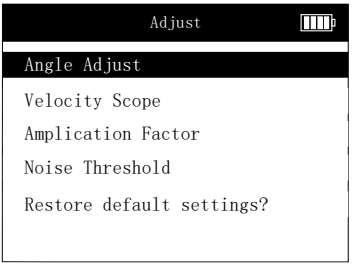


FIG. 20b instrument calibration

3.6.1 Calibrate the heading Angle

When measuring the flow rate, users generally select two kinds of measurement position: standing on the bridge and measuring on the shore; Standing on the bridge, the horizontal direction of the radar beam is parallel to the flow direction. When standing on the shore, the horizontal direction of the radar beam emission has a certain Angle with the flow direction. Ideally, horizontal deviation Angle of 0 ° is the best. Small Angle (less than 10 °) almost no effect on accuracy. Standing on the bridge measurement radar wave emission direction to the flow direction of horizontal Angle for small Angle, basic have no effect on accuracy, but stand on the shore The horizontal Angle of the radar beam and current flow will be larger (as the theta in the figure below), and the larger influence on the measured results, The course Angle calibration is designed to offset the deviation caused by this Angle deviation

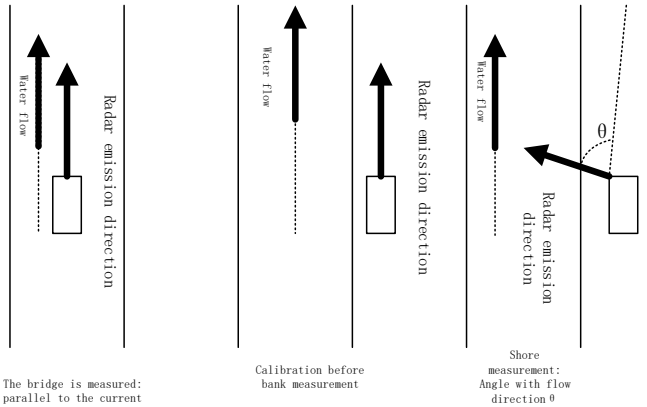


FIG. 21 Schematic diagram of the horizontal angle of radar waves

The instrument automatically corrects the horizontal angle to offset the deviation, select "course Angle calibration", press "OK" button to enter, during this period , keep the instrument body parallel to the flow direction, in the process of calibration, users have 4 seconds mobile body to keep parallel with the flow direction . course angle will change accordingly. After 4 seconds, will modify the direction of its course angle to 0, then select "OK", and the instrument automatically corrects the course angle. If you need to recalibrate, press the cancel button to recalibrate the course angle another times.

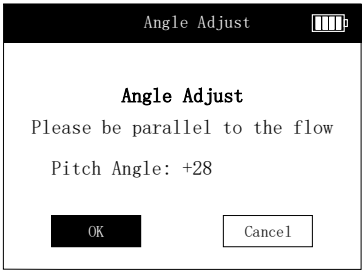


FIG. 22 course angle calibration

The pitch angle of radar waves in the measurement also affects the measurement results. The instrument automatically corrects the impact of the pitch angle. However, in order to ensure the intensity of the radar echo signal, it is important to keep the pitch angle and course Angle less than 60 degrees.

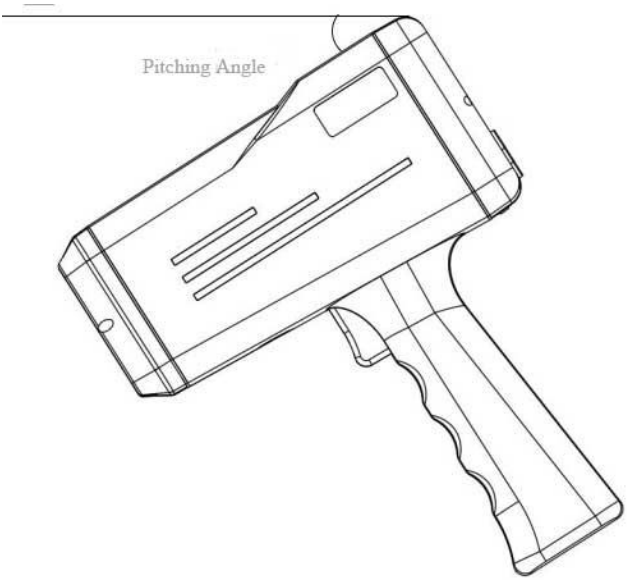


Figure 23 radar wave pitch Angle

3.6.2 Velocity range selection

Under the "Adjust" menu, select "velocity scope" and press the "OK" key to enter submenu, use the "▲ "or"▼ "key to select the flow speed range that is close to the current velocity. Click "OK" to enter the" velocity scope "interface and press"OK "button to select the right speed range. After selecting the appropriate speed range, pressing "OK "button. the instrument carries out "instrument calibration", the calibration time is 15 seconds. A total of 5 speed range can be selected, the appropriate speed range can improve the measurement accuracy.

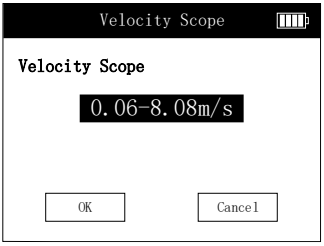


Figure 24a speed range setting FIG. 24b calibration of instrument parameters

3.6.3 Selection of magnification

Select "Magnification Setting", press "OK" key to enter, select the magnification, the magnification is switched between ×2, ×4, ×8 and ×16 times, press "OK" key to enter, then press "▲" or "▼" key Select the appropriate magnification and select "Finish" to save the settings. The instrument enters the calibration interface. Select "Cancel" to abandon the setting.

For the smaller ripple of water flow, it is suggested to select a larger magnification multiple, which can improve the water velocity recognition

ability of low velocity and low ripple.

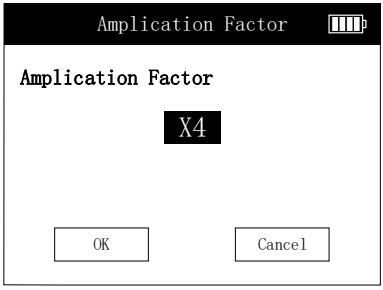


FIG. 25a magnification Settings Figure 25b calibration of instrument parameters

3.6.4 Noise threshold setting

Select "Noise Threshold Setting", press "OK" key to enter, select the noise threshold, the option can switch between weak anti-interference, low anti-interference, medium anti-interference, and strong anti-interference, press "OK" key to enter, and then press "▲" or Press the "▲" button to select the appropriate noise threshold and select "Finish" to save the settings. Select "Cancel" to abandon the setting.

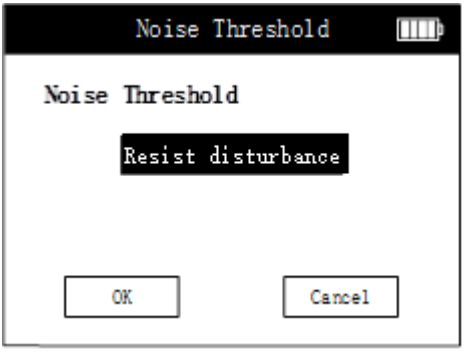


FIG. 26 Noise threshold setting

Noise threshold option from low to above high, on behalf of anti-

interference ability increases gradually, also means that sensitivity for picking up speed signal is decreasing, the appropriate threshold noise need to be determined according to the situation of environmental interference, generally "normal " noise threshold is selected.

3.6.5 Restore default setting

Select "restore default setting", press "OK" key to enter, select "OK "restore factory setting. Select "Cancel" to give up recovery. Restore the factory setting including the amplification factor, velocity scope and the noise threshold to the factory default setting.

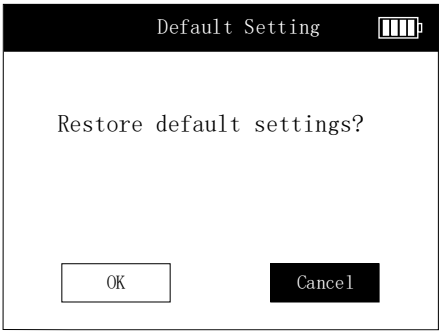


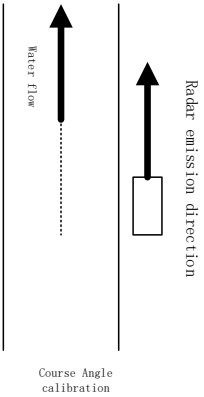
Figure 27 restore factory Settings

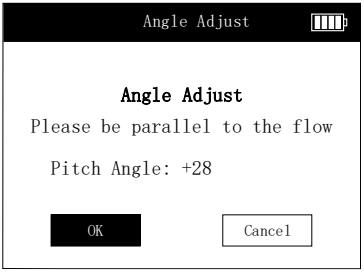
4 Operation mode

4.1 Quick mode

After initialization, is in mode selection, user can select quick mode with “▲”and “▼” navigation keys. Just pulling the trigger or pressing "OK" button, the instrument is ready to measure the river velocity. Before measurement, the instrument will prompt the user for horizontal direction

(heading Angle) calibration, at this time, please keep the machine body be parallel with the flow, then pull the trigger or press the "OK" key, the instrument calibrate horizontal angle automatically.





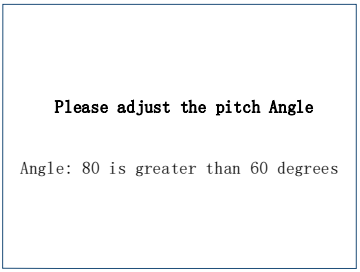
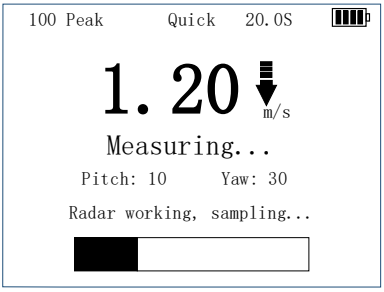


FIG. 28a calibration FIG. 28b elevation Angle adjustment

After the heading angle calibration is completed, the instrument will automatically monitor the pitch angle between the radar beam and the water flow, and automatically correct the impact of this angle on the measurement results.

Velocity measurement will continue to measure for 99 seconds, and the measurement results will be updated every 1 second. The upward arrow

" " indicates that the direction of the water flow is consistent with the radar beam direction (that is, the water flow is away from the measurer); the downward arrow " " indicates the water flow The direction is opposite to the direction of the radar beam (that is, the water flows in the direction of the surveyor). During the measurement, you can press the trigger to stop the measurement. After the measurement is completed, the instrument will display the average value, the maximum instantaneous value, the minimum instantaneous value and the measurement time of the flow rate during this measurement. During flow rate measurement, the screen prompt is as shown in Figure 25c. After the measurement is completed, the instrument automatically displays the measurement result. The screen prompt is shown in Figure 25d. The instrument displays the result as the current flow rate. If the measurement is no longer required, please select "End Measurement" and the instrument returns to the "Mode Selection" menu.



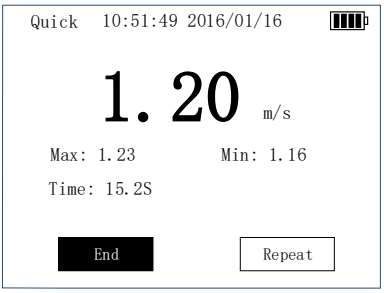


Figure 28c shows the instantaneous velocity figure 28d measurement completion interface

During the flow velocity measurement, the instrument will automatically measure the heading angle and pitch angle. Once the

instrument detects that the angle exceeds ±60 degrees, it will prompt the abnormal angle information. As shown in the figure below, press the **"OK"** key to return to the mode selection interface and restart Take measurements.

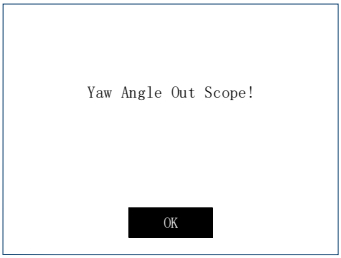


Figure 28 e heading Angle figure 28 f pitch Angle anomaly

⚠ Warning: if the "menu" button is pressed during the measurement, the measurement will be terminated, the instrument will return to the "mode selection" interface, so the "menu" key will be used carefully during the measurement process.

4.2 Continuous mode

Select the "continuous mode" with the "▲" and"▼ "navigation key and press"OK "key to enter the interface of measurement confirmation, as shown in the figure below:

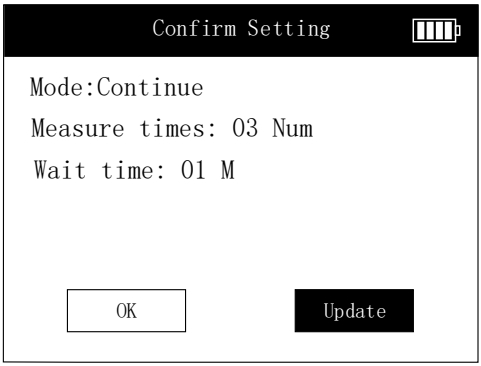


FIG. 29a continuous measurement confirmation setting

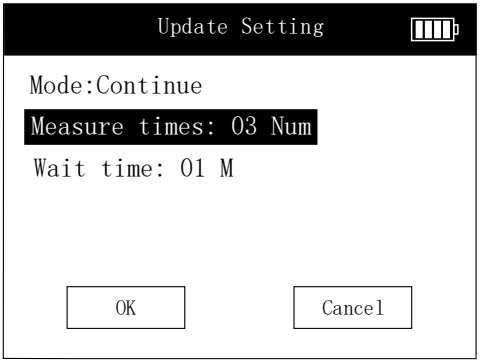


FIG. 29b continuous measurement modification Settings

If users need to measure multiple times or change the measurement interval, use "▲" and "▼" navigation button to select" Modify "option, press "OK" button to enter modify settings. use the"▲ "and"▼ "navigation button to modify "measuring times" and "measured interval" Settings, modification is completed with the navigation button" finish ", press "OK" button to complete parameter modification.

Tip: (1) Multiple measurement number is 1to 30 times.

(2) Measurement interval is 1 to 5 minutes.

In the confirmation setting interface pull the trigger or select "ok", the instrument is ready to start the measurement. Before measurement, instrument will prompt the user for horizontal direction (horizontal angle) calibration, at this time, please keep the radar beam shooting direction parallel to the flow direction, and then pull the trigger, or by selecting the "OK" key, the instrument calibration of horizontal angle.

When the course angle is calibrated, the instrument will automatically monitor the pitch angle between the radar beam and the river flow, and automatically correct the influence of the angle on the measurement results.

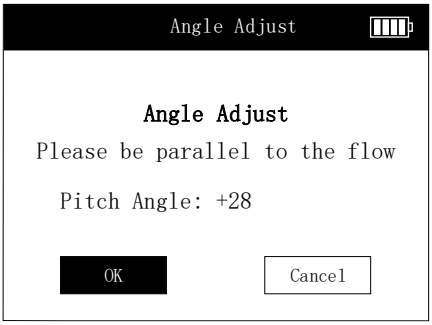


FIG. 30a course Angle calibration

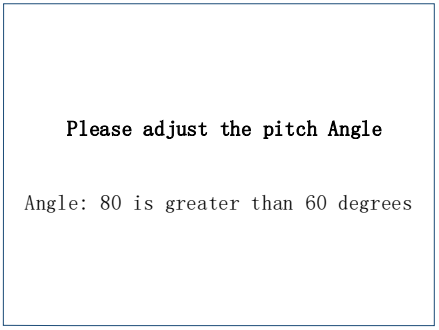


FIG. 30b elevation Angle adjustment

The screen prompt in the measurement is shown in figure 27c, where the upward arrow "  " indicates that the direction of flow is consistent with the direction of the radar beam emission (that is, the river flow relative to the current is far away); The downward arrow "  " indicates that the river flow direction is opposite to the radar beam direction (that is, the river flows towards the surveyor). Velocity data is updated once every 1 second, after 30 seconds measurement, first measurement period finished, is waiting for the interval time, as shown in figure tips "measuring, please wait for (3/10)", tips of"(3/10)," show a total measure times is 10 times, latest measurement is the third time; after 30 seconds measurement, is waiting for the interval time, and the latest velocity is displayed on the screen, the progress bar is also showed for indicating the interval time schedule. At the same time, the screen displays the average of the last measured flow. measuring mode, time, battery power, and the progress bar indicating the waiting time.

The instrument automatically displays the measurement results after the measurement. The screen prompt is shown in figure 27d. The instrument shows the result of current velocity. If you do not measure again, select "end measurement" and return the "mode select" menu.

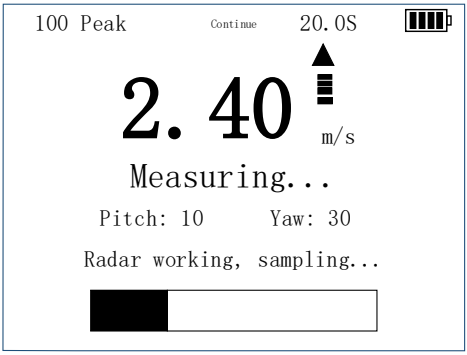


FIG. 30c shows the instantaneous velocity

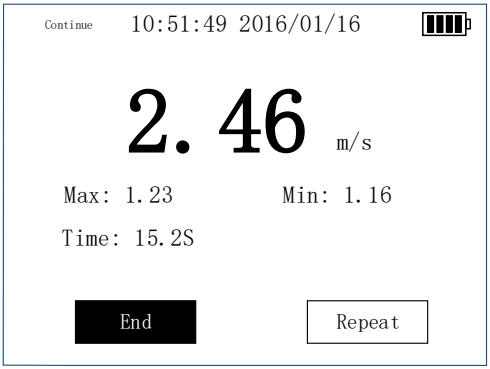


figure 30d continuous mode measurement results

About the other measurement results in the process of continuous mode may be reviewed in the "data review", in the data review interface ,all the velocity data is listed. Specific operations are described in section 3.2.

Select "repeat measurement", and the instrument indicates that a velocity measurement is carried out. Select "end measurement", the instrument returns the initial "mode selection" interface.

4.3 Flow mode

Use the "▲" and"▼ "navigation keys to select" flow "discharge mode,

press the trigger or"OK "key to enter the measurement interface.

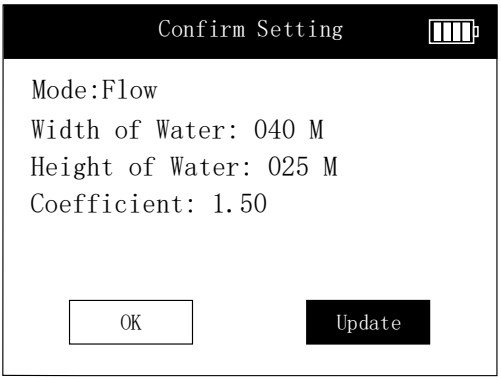


FIG. 31a continuous measurement confirmation setting

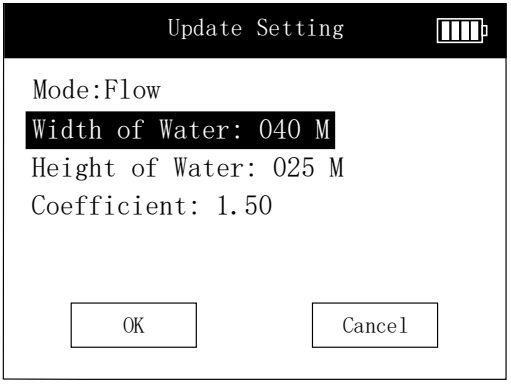


FIG. 31b continuous measurement modification Settings

If users need to modify the river width and depth of the river, use"▲" and "▼"navigation key to select" modify "option, then press "OK" button to enter parameters settings. Also use the" ▲"and"▼ "navigation button to select new water depth and width parameters, modification is completed with the navigation button" finish ", press "OK" button to complete parameter modification.

Tip: (1) The river width is optional between 1 to 999 meters;

(2) The river depth is optional between 1 to 30 meters.

In the confirmation setting interface, pull the trigger or select "ok", the instrument is ready to start the measurement. Before measurement, instrument will prompt the user for horizontal direction (horizontal angle) calibration, at this time, please keep the machine body parallel with river flow, then pull the trigger, or by selecting the "OK" key, the instrument calibrate horizontal angle automatically.

When the course Angle is calibrated, the instrument will automatically monitor the pitch angle between the radar beam and the current, and automatically correct the influence of the Angle on the measurement results.

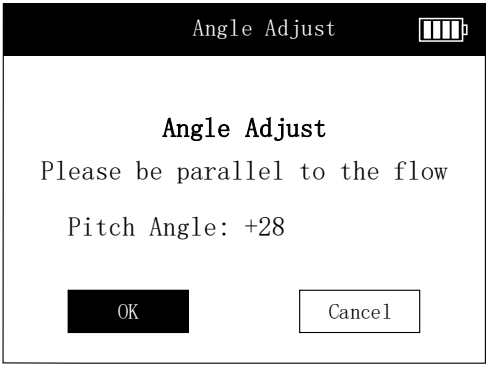


FIG. 32a abnormal Angle interface

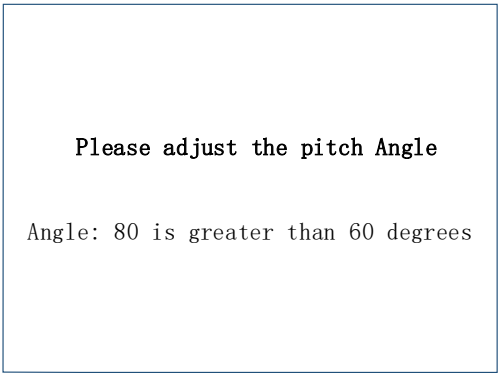


Figure 32b elevation Angle anomaly interface

The river velocity are updated every one second, and the upward arrow " " indicates that the direction of river flow is consistent with that of the radar beam. The downward arrow " " indicates the direction of the river flow is opposite withe the direction of the radar beam. after 30 seconds measurement, the interface shows the results of this river flow discharge. The river flow discharge comes from arithmetic product of the average velocity of the current 30 seconds, the width of the current, the product of the depth of the water. In addition to displaying the flow value, the measuring mode, time, and battery usage are also displayed. The interface displays as shown below:

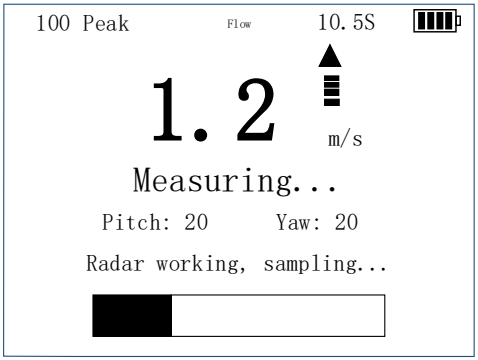


Figure 33a transient velocity value in flow measurement

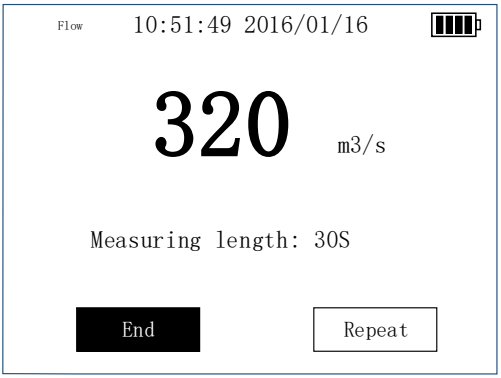


Figure 33b flow pattern measurement results

Select "repeat measurement", and the instrument prompts for a flow measurement. Select "end measurement", the instrument returns the initial "mode selection" interface.

5 Measurement procedure

5.1 Quick mode

- Press the power button to start the , the instrument can be used after the self-test is completed;
- Pull and release the trigger, performs horizontal calibration, please keep the radar beam emission direction and water flow direction parallel, then press the trigger key or **"OK"** key; the direction calibration is completed; at the same time, please align the instrument to be measured Water flow target, the instrument starts to measure at this time;
- The instrument enters the measurement state, the screen displays the instantaneous water flow speed, and the progress of the measurement is displayed with a progress bar;
- The instantaneous speed is updated every second;
- After 99 seconds, the measurement is completed, the interface displays the average water flow rate of this measurement, and the maximum speed and minimum speed within 99 seconds;
- After the single measurement is completed, press the navigation key, select continue measurement, press the **"OK"** key, the instrument continues to measure, at this time the instrument will no longer perform horizontal calibration.

5.2 Continuous mode

- Press the power button to start the , the instrument can be used after the self-test is completed;
- Select “Continuous Mode” through the navigation keys; at this

time, the instrument enters the mode setting interface, set the number of continuous measurements and measurement interval, press the trigger or **“OK”** button, the instrument enters horizontal calibration;

- Keep the radar beam emission direction and the water flow direction parallel, and then press the trigger key or the **"OK"** key to enter the direction calibration; after the direction calibration is completed, please align the instrument with the water flow target to be measured, and the instrument starts measuring at this time;
- The instrument enters the measurement state, the screen displays the instantaneous water flow speed and updates once per second; at the same time, the measurement progress is displayed with a progress bar;
- After 99 seconds, the instrument completes the first measurement and enters the measurement interval. During this period, the screen displays the last measurement result, prompting "measurement cycle wait" and displaying a progress bar; after the interval time, the instrument automatically enters the next measurement;
- After the measurement of all the measurement points is completed, the instrument completes this measurement, and the measurement interface displays the average water flow rate of the last measurement, as well as the maximum and minimum speeds;
- The results of all processes can be viewed in a list on the "Data Playback" interface.

5.3 Flow mode

- Press the power button to start the , the instrument can be used after the self-test is completed;

- Use the navigation keys to select "Flow" and press the trigger or **OK** key; at this time the instrument enters the mode setting interface, set the depth and width of the water flow, press the trigger or **OK** key, the instrument enters horizontal angle calibration;
- Keep the radar beam emission direction and the water flow direction parallel, and then press the trigger key or the "OK" key to complete the direction calibration; and aim the instrument at the water flow target to be measured, and the instrument starts measuring at this time;
- The instrument automatically enters the measurement state, the screen displays the instantaneous water flow speed, and the progress is displayed with a progress bar; the instantaneous speed is updated every second;
- After 99 seconds, the instrument completes the measurement, and the result shows the flow of water;
- In the result interface, use the navigation keys to select “repeat measurement”, the instrument will continue to measure, select “end measurement”, the instrument will end the measurement and return to the mode selection interface

5.4 Multi-point measurement of the flow mode

- Mobile phone install multi-point measurement flow App, open mobile phone Bluetooth and location information；
- Press the equipment power button to start the , instrument after the self-inspection can be used;
- Click the Bluetooth icon as shown in opening the multi-point

measurement flow App, click interface, as shown in Figure 35a;

- Connect to devices with Bluetooth number RD60-XXXX, as shown in Figure 35b;

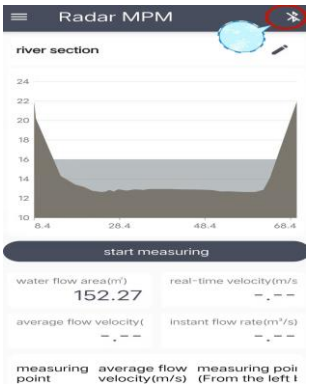


Figure 35a

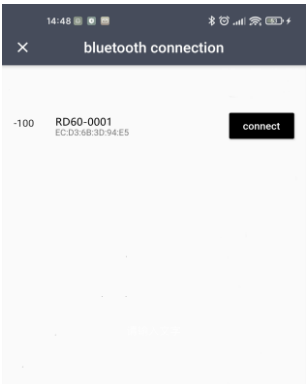


Figure 35b

- Edit section parameters, as shown in Figure 35c, the interface can set water depth and measurement points, etc., set off can save data, as shown in Figure 35d;

Figure 35c

Figure 35d

➢ The device is measured in fast mode at the App interface of the mobile phone and can be measured according to the software prompt, as shown in Figure 35e；

➢ The measurements are shown as shown in Figure 35f;

Figure 35e

Figure 35f

6 Maintenance

does not require special maintenance by operators or users.

6.1 Clean

Wipe with a dry or slightly wet soft cloth.

⚠Warning: do not wipe with wet cloth or rinse the instrument with water.

⚠Note: do not use solvents or strong detergents to clean the instrument, as this may damage the plastic casing of the instrument and reduce its performance.

6.2 Battery charging

To ensure the accuracy of the results, please charge the instrument immediately when the battery is low.

Specification of external charger: 5V 1A;

It will take about 6 hours for a full charge, and please charge it immediately before use.

⚠Warning: please use the charger provided by the our company to charge the charge; Using a charger that does not have 3C certification can reduce battery life or safety hazards. Please take precautions!

⚠Note: the battery needs to be charged periodically (3 months), which can guarantee the life of the lithium ion battery.

7 Warranty

Supplier guarantee radar flow meter have not any defects in both the quality and performance, for the problems in the use process, can be repaired or exchanged according to different situation.

Please contact the supplier before repairing the instrument. The returned products must be well packed in order to ensure that the equipment is not damaged by the transport process.

7.1 Warranty period

The free warranty period is one year (counting from the date of purchase). manufacturer will provide paid maintenance for the equipment beyond the warranty period.

7.2 Warranty coverage

During the warranty period, the manufacturer has free warranty for the faults caused by the quality of the products.

The failure caused by the following circumstances does not belong to the warranty scope:

-Warranty period;

-Failure to use, maintain, or damage as required by the product instruction manual;

- Damage caused by disassembly (unauthorized repair) by a repairer not authorized by our company;

-Other failures caused by non-quality reasons such as natural disasters and mechanical damage.

8 Terms and abbreviations

m/s	Velocity unit
LCD	LCD
Li	Lithium ion rechargeable battery
m^3/s	Flow unit

9 Technical parameters

Conventional	
Operating temperature range	-20℃~+70℃
Relative humidity range	20%~80%
Storage temperature range	-30℃~70℃
Instrument details	
Measuring range	0.03~20m/s
measurement accuracy	±0.03m/s
Radio wave emission angle	12°
Radio wave emission standard power	100mW
Radio frequency	24GHz
Angle compensation	Horizontal and vertical angle automatic
Horizontal and vertical angle automatic compensation range	±60°
Storage size	2000 measurement results
Maximum measuring distance	Within 100m
Battery details	
Battery type	Lithium ion rechargeable battery
Battery capacity	3100mAh
Standby state (at 25℃)	More than 6 months
Continuously working	More than 10 hours

10 Appendix A

Bluetooth and Streaming Software Connection

1. Keep the handheld radar velocity meter host hold on;
2. Turn on Bluetooth in the phone settings;
3. Open the mobile APP to select the regional settings and set the region, name and device number;

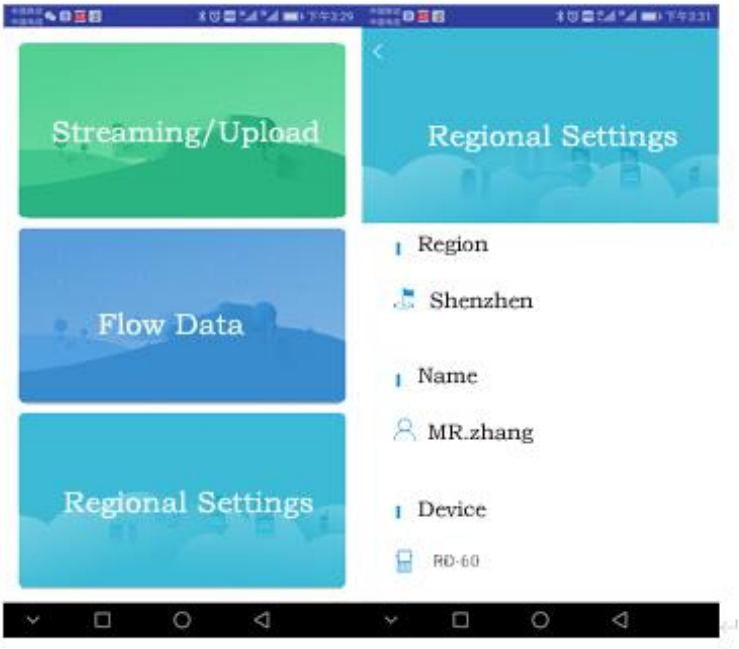


Figure 1. Regional settings

Return to the main menu to select flow measurement/upload. The handheld can start to measure the flow rate. During the flow rate measurement, the mobile phone APP can display the real-time flow rate. After the measurement is completed, click the end measurement button and the APP

will automatically import the measurement results;

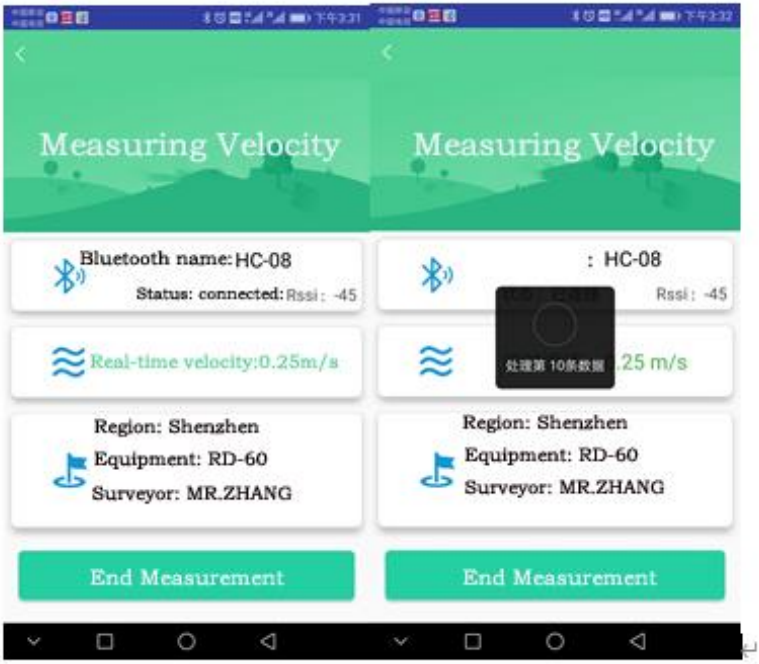


Figure 2. Flow measurement/upload

After the measurement is completed, return to the main menu and select the measurement data to view the measurement results. Click Upload All Data to upload the measurement results to the background server. Use a computer web browser to log in to the background server to view the historical measurement data.

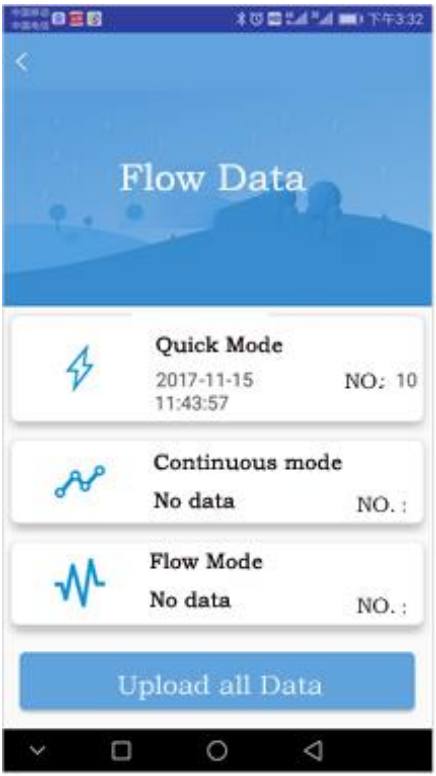


Figure 3. Flow measurement data

11 Appendix B

1、Asking：Why is my water surface speed reading much higher than the last reading?

Answer：If the water surface is smooth, not rough or the roughness is very small, the may not receive enough return radar energy from the water surface. Try to measure close to the water surface, or in the presence of

turbulence, roughness, or even floating objects.

2、Asking：I just completed a survey and changed to another area of the river. The current measurement results seem to be very different.

Answer：Check to see if the horizontal (deviation) angle compensation has been adjusted. In the case of high flow rates, incorrect or inappropriate angle input may cause large differences in speed readings.

3、Asking：The roughness of the water surface is good, and the water surface has ripples, but the reading of is still high and/or much lower than I expected.

Answer：Make sure not to get too far from the water surface when measuring. The specific distance is sometimes difficult to determine because the measurement result is a function of the amount of signal returned to the . The returned signal is directly related to the distance of from the water surface and the roughness of the water surface. The closer the is to the water surface, the better the measurement effect even when the water velocity is low. You need to point to the same place in multiple measurements. Try to minimize the horizontal (deviation) angle in the measurement. In addition, different vertical (downward) angles are taken in multiple measurements to determine the consistency of the readings. Make sure to hold the firmly and keep the angle unchanged during the measurement.

4、Asking：I am measuring the water flow velocity below 0.60m/s visually, but the reading is higher than expected.

Answer：Check the effect of wind on the water surface. Wind may

affect the measurement of low-speed water flow (such as water flow below 0.50m/s). If possible, measure in two directions, one is the direction of water flow towards , and the other is the direction of water flow away from . Try to point to the same location for measurement.

5、Asking：I measured the surface speed when the flood occurred. The water flow is very fast, the water is turbulent, the water surface is rough, and there are many debris and floating objects. In this case, can the be used to obtain accurate measurement results?

Answer：yes. The turbulent water flow, coupled with floating objects on the water surface, can provide a good return signal for the . Please note that in this case, the will read multiple speeds with different sizes in different directions. will measure these speeds and get the average speed.

6、Asking :During the measurement, the speed value changes every 1 second.

Answer： Each measurement of lasts 99 seconds. During the measurement process, the display screen updates the test data every 1 second. The data is the result of sampling the water surface velocity multiple times. After the measurement of 99 seconds, the screen displays the average of 99 seconds. speed.

7、Asking：When measuring, the reading appears high and low.

Answer：Make sure to keep the position of stable during measurement. Angle sensors that can compensate for vertical (downward deviation) and horizontal angle cosine velocity errors are very sensitive. If the vibrates or bumps, it will cause an incorrect angle reading.

12 Appendix C

Table 4 .System component table

Product Name	Specification	Quantity	Remarks
handheld radar velocity meter	set	1	
User Manual	book	1	
Warranty Card	pcs	1	
Angle meter	pcs	1	Built-in
Rechargeable Battery	pcs	1	Built-in
Charger & charging cable	pcs	1	5V/1A
Carrying case	pcs	1	