



SLHydroFlow Software User Manual

Manual Revision

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Preface

Introduction

Welcome to the SLHydroFlow software. This introduction describes how to use this software.

Experience Requirement

In order to help you use the SatLab series products better, we suggest you carefully read the instructions. If you are unfamiliar with the products, please refer to www.satlab.com.se

Tips for Safe Uses



Notice: The contents here are special operations and need your special attention. Please read them carefully.



Warning: The contents here are very important. Wrong operation may damage the machine, lose data, break the system, and endanger your safety.

Exclusions

Before using the software, please read these operating instructions carefully: they will help you to use it better. SatLab Surveying Instrument Co., Ltd assumes no responsibility if you fail to operate the product according to the instructions or operate it wrongly due to misunderstanding the instructions. SatLab is committed to constantly perfecting product functions and performance, improving service quality and we reserve the right to change these operating instructions without notice.

We have checked the contents of the instructions the software and hardware, without eliminating the possibility of error. The pictures in the operating instructions are for reference only. In case of non-conformity with products, the products shall prevail.

Technology and Service

If you have any technical issues, please call SatLab's technology department for help.

Relevant Information

You can obtain this introduction by:

1. Purchasing SatLab products: you will find this manual in the instrument container to guide you on operating the instrument.
2. Log onto the SatLab official website, downloading the electronic version introduction at "Download center" "Partners" and "Partner center".

Advice

If you have any comments and suggestions for this software, please email info@satlab.com.se.

Your feedback will help us to improve the software and service

Chapter 1

Software Introduction

This chapter contains:

- Introduction
- System Overview
- Software Requirements
- Software Installation
- Software Uninstallation

1.1 Introduction

SLHydroFlow software is a discharge measurement software used together with Satlab Acoustic Doppler Current Profiler. The SLHydroFlow Discharge Measurement can connect ADCP through network port, serial port, Bluetooth, and other devices, and supports real-time data collection and data playback operations.

1.2 System Overview

The SLHydroFlow system consists of HydroFlow ADCP, a 12V power supply, an I/O cable, and a computer. The HydroFlow ADCP provides high-quality data results and connects the power supply and computer through I/O cables. The computer is installed with SLHydroFlow software to display and process the flow result information.

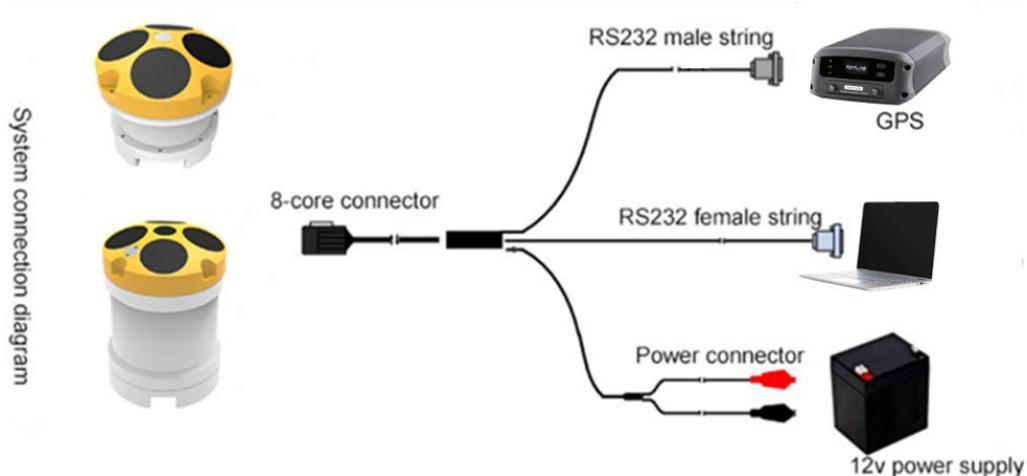


Figure 1-2-1 System diagram

1.3 Installation Requirements

The SLHydroFlow software runs on the Windows platform. The software can control ADCP to collect and store data. ADCP data is analyzed and displayed in SLHydroFlow software. Requirements of software for the computer are as follows:

- Windows 7 and above operating system, desktop or notebook computer.
- NET 4.0 SP1 or higher architecture
- Minimum display resolution 1024×768
- An available serial port or Bluetooth device

1.4 Software installation

SLHydroFlow software needs to be installed manually. The installation steps are as follows:

- Double-click the SLHydroFlow Setup.exe program to start the installation program, click "Next" to confirm the relevant license agreement for software use.
- Select "**I agree to the terms of this license agreement**", activate, and click the "Next" button to enter the user information setting interface.
- Enter the user name and company information, click "**Next**" to set the installation path, click "**Change**", and select the installation path.
- Click "**Next**" to set the shortcut path.
- Click "**Next**" to confirm the installation path information.
- Click "**Next**" to start the installation.
- When the interface displays a reminder of successful installation, it indicates that the software installation is completed. Click "**Finish**" to close the installation program.

1.5 Software uninstallation

The unloading steps are as follows:

- Open the "**Start**" menu of the Windows system, click "**All Programs**", find and open the "SLHydroFlow software" folder, and click "**Uninstall SLHydroFlow Software**" to start the uninstallation program.
- Click "**Next**" to start uninstalling the program.
- When the page prompts that the software has been successfully uninstalled, it means that the software has been uninstalled. Click the "**Finish**" button to close the uninstallation program.



Notice: Before installing the software, make sure that the NET Framework version is higher than 4.0 (including 4.0). If it is lower than this version, the software will fail to run.

Chapter 2

System Mode

This chapter contains:

- Real-time Acquisition
- Playback Mode

On this main interface of SLHydroFlow software, user can click "File" and select "New Measurement", or click "New Project" on the main interface to start real-time data collection; Click "File" and select "Open Measurement" to open the project file .xpgm (compatible with the old version: .mea and .pgm formats) for data playback and post-processing.

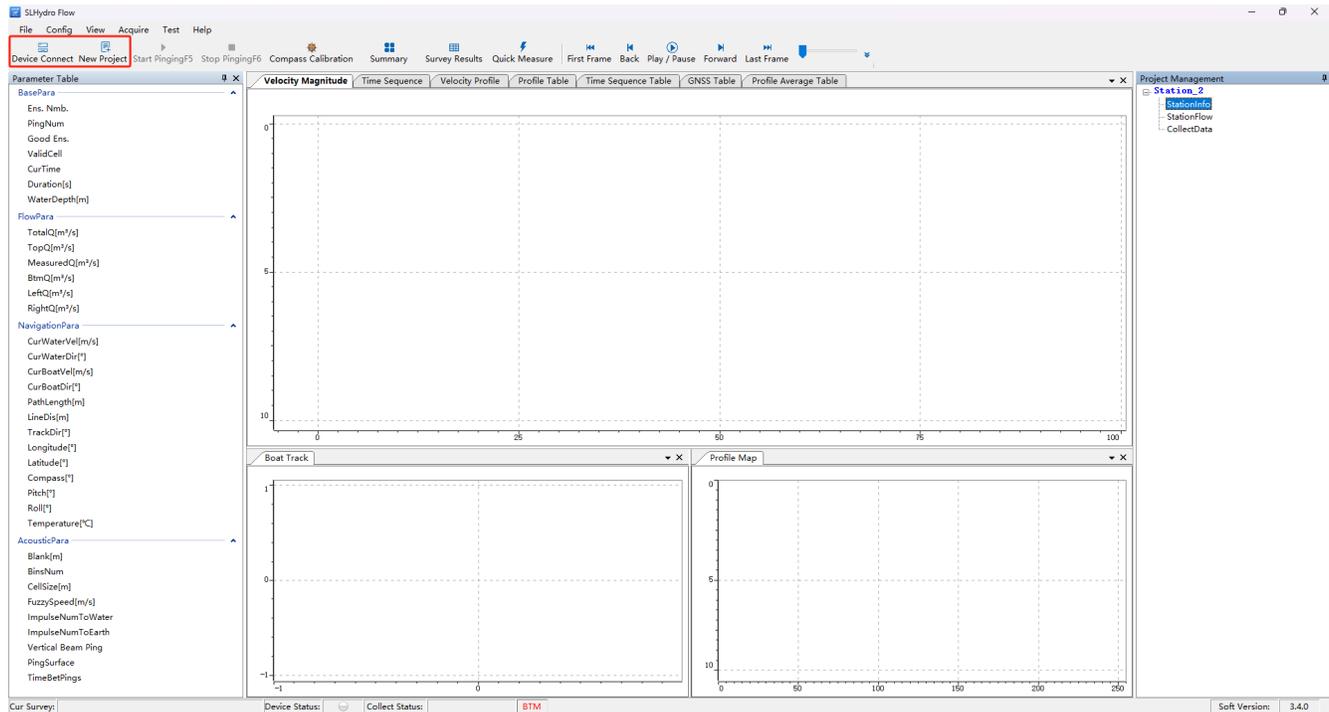


Figure 2-1 Start Page

2.1 Real-time Acquisition

Step 1. In the first step of the software, you can set "Device Connect" or "New Project". After selecting "New project", you will enter the Setup Dialog, where you can configure the parameters of your project according to the prompts. See "Parameter Setting" to explain how to set parameters. After clicking "Finish", a file will be created in the "Project Management" interface. See "Project Management" for details.

Step 2. After setting the parameters, click "Device Connect" to connect the equipment in this interface. See "Config" to explain how to set parameters. You can also choose to click "Quick Measurement" instead of "Device Connection" or "New Project", Quick Measurement will use the default parameters for measurement. See "Project Management" for details.

Step 3. After the equipment is connected, close the interface. Click the "Start Pinging" button on the toolbar to start surveying, then SLHydroFlow displays the data. The data is not saved at this time. When the data quality is good and the number of effective cells shown in the profile is no less than two, the data can be formally saved.

Step 4. According to the test times selected in the "Project Management" interface, click "Start Shore" in the shortcut key to set the number of Pings, shore distance, shore type, etc. After setting it, you can start to save the data.

Step 5. At the end of the current test, click "End Shore" in the shortcut key to end the data collection of the current test. When it is necessary to create a new test, click "Start Shore" again, and the project management interface will automatically create the test and record the data.

Step 6. Click "Stop transmitting" to stop data collection.

Step 7. Repeat steps 3-5 to repeat the test. At least 4 sections shall be collected and the error of sample data shall not exceed 5%.

2.2 Playback Mode

Step 1. Click "Open Measurement" under "File", select the project file(.xpgm、.pgm、.mea) to be played back, and then enter the playback interface. In addition, the software supports dragging and opening the project file.

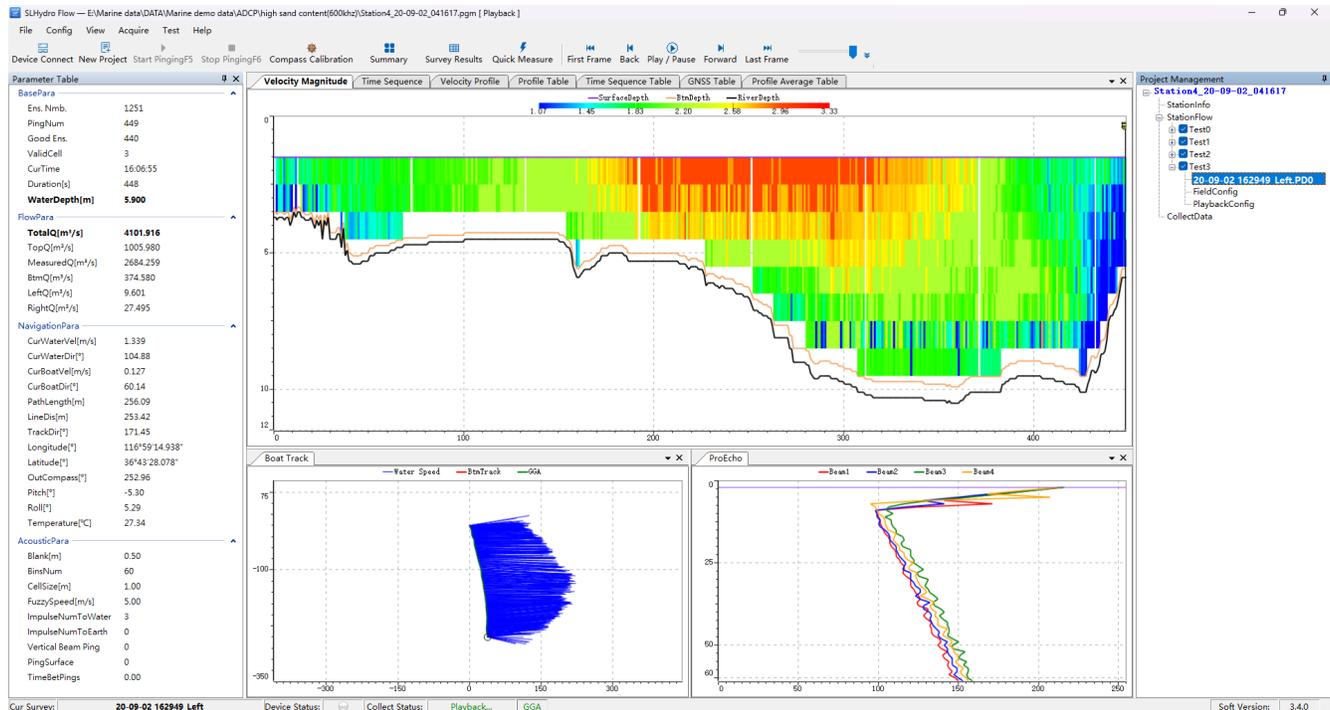


Figure 2-2-1 Data playback

Step 2. In the project information window on the right, double-click the corresponding Test number (Test*) or Test name (xxx-xxx.PD0) node to open the current data file. After opening, the software will enter the playback by default.

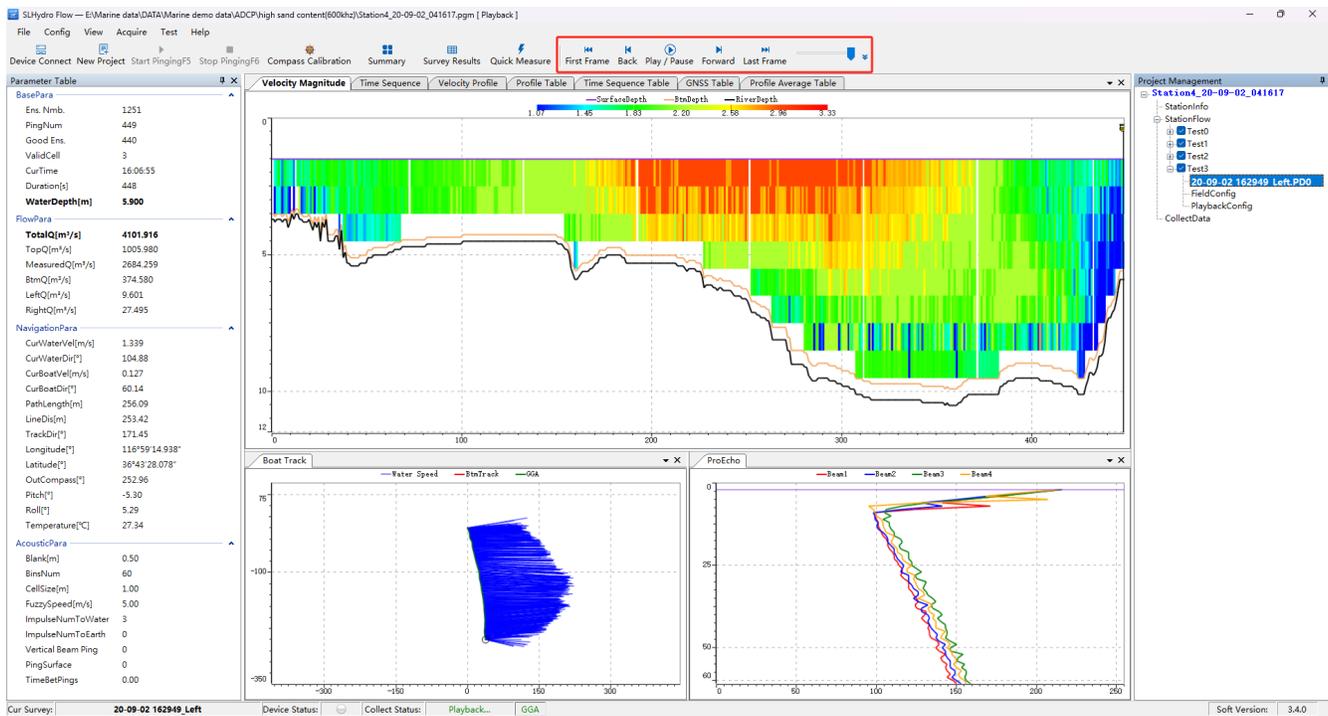


Figure 2-2-2 Data playback control

Select the **Start** button in the interface to play back the current data. Click the button, fill in the number of frames to manually jump in the expansion panel, and click "Jump" to manually jump. The playback interval is used to set the playback speed.

Select "**Summary Table F10**" under "**View**" or **Summary** in the shortcut bar to view the flow summary information.

Select "**Flow Record Table**" under "**File**" to export to Excel or PDF format.

Select "**View**" - "**Table**" - "**GNSS Data Table**" to view the original GGA/VTG/HDT data of the current test.

Select "**View**" - "**Table**" - "**Compass Calibration Table**" to view the bottom tracking course value, GGA course value, VTG course value, and course deviation value of each test.

Select one interface or table of the software, click "**Print Preview**" under "**File**", and select a suitable printer to print the currently selected interface.

FieldConfig: In real-time or playback mode, click the "**Field Config**" in the project information window to view the configuration parameters of this test.

PlaybackConfig: Playback function cannot be used in real-time mode. In playback mode, click "**Playback Config**" in the project information, and users can modify the configuration parameters. Click

"Finish", and the software will recalculate the number of tests and update the interface data according to the set configuration parameters. Refer to Chapter 4 "[Parameter Configuration](#)" for details.

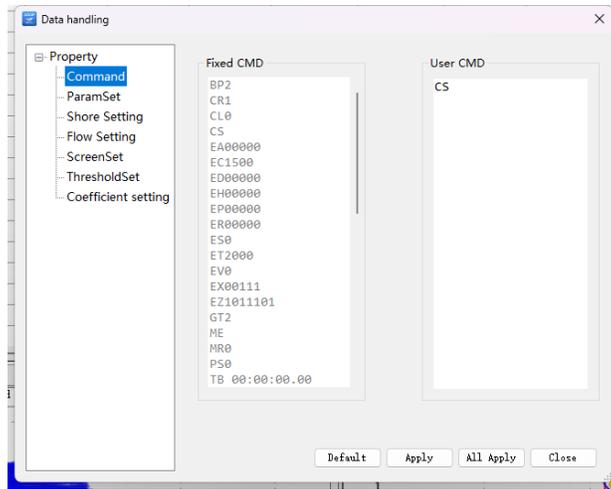


Figure 2-2-3 Parameter Configuration

When you right-click a test, the following interface will pop up. You can deselect, delete, segment, and save the current test.

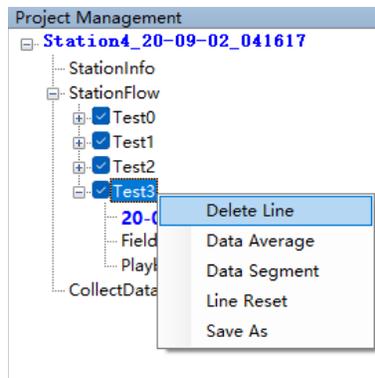


Figure 2-2-4 Test management menu

Delete Line: The current test can be deleted, but the source file is not deleted. It is mainly used for filtering error data.

Data Average: Average multiple ping data. Input the average number of pings of each group. According to the number of pings input, the software will average all pings of the whole test.

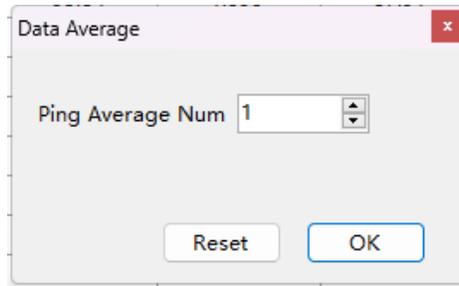


Figure 2-2-5 Data average interface

Data Segment: You can reselect the start and end ping numbers of the test. After clicking "OK", the software will automatically intercept the data and display the intercepted data on the interface. If you need to recover data, you can choose to use the original ping set number, and the software will recalculate the data and recover the original data.

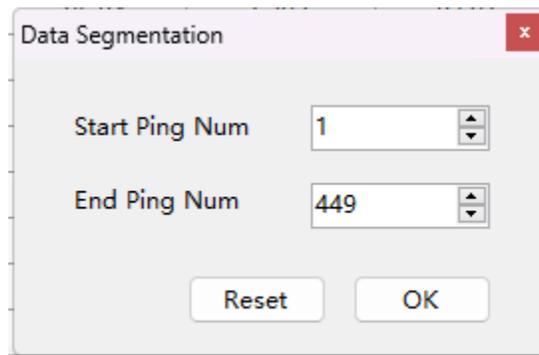


Figure 2-2-6 Data segmentation interface

Line Reset: Reset all test operations, clear the data average and data segmentation result data, and restore the test to the state when loading.

Save As: Save the segmented data as a .PDO file.

Right-click "**StationFlow**", and the following interface will pop up, where you can add Line.

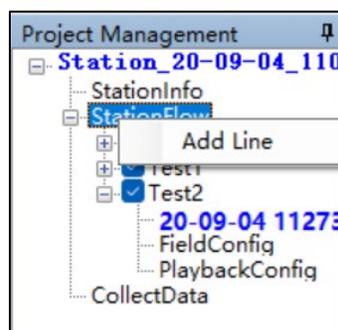


Figure 2-2-7 Add Line

In addition, you can also click the menu "File", select "Open test", select the corresponding test (.PD0) file, and then view the specific information of the data.

Double-click "**StationInfo**" to view the information about the measuring station, mainly including the description information of the measuring station. For missing information, you can fill in and supplement it afterward. Click the "**Save**" button to save the changes to the current project file. If you need to repeat tests at the same location multiple times, click "**As Template**" to export the information of the current project site. When creating a new project, you can directly import the saved template file.

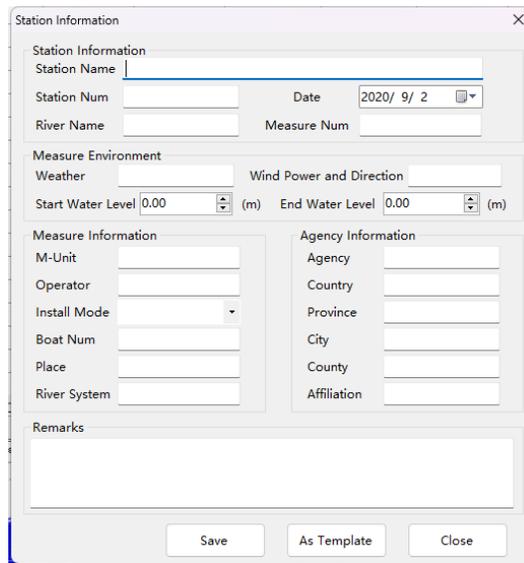


Figure 2-2-8 Station Information interface



Notice: It is strictly forbidden to lift the transducer out of the water when the equipment is working. If the equipment is operated in a water-free environment for a long time, it may cause irreversible damage to the equipment.

Chapter 3

Software Interface

This chapter contains:

- Menu Bar
- Tool Bar
- Status Bar
- Data Graphs and Tables
- Interface Configuration
- Auxiliary Operation

SLHydroFlow software provides users with a beautiful, simple, friendly, and easy-to-use software interface, which can be generally divided into a menu bar, toolbar, status bar, and display interface. The menu bar includes the basic functions of all user operations, the toolbar provides shortcuts for operations, the status bar indicates the current status of the software, and the display interface displays the flow rate and flows data details. The overall interface of the software is shown in the figure:

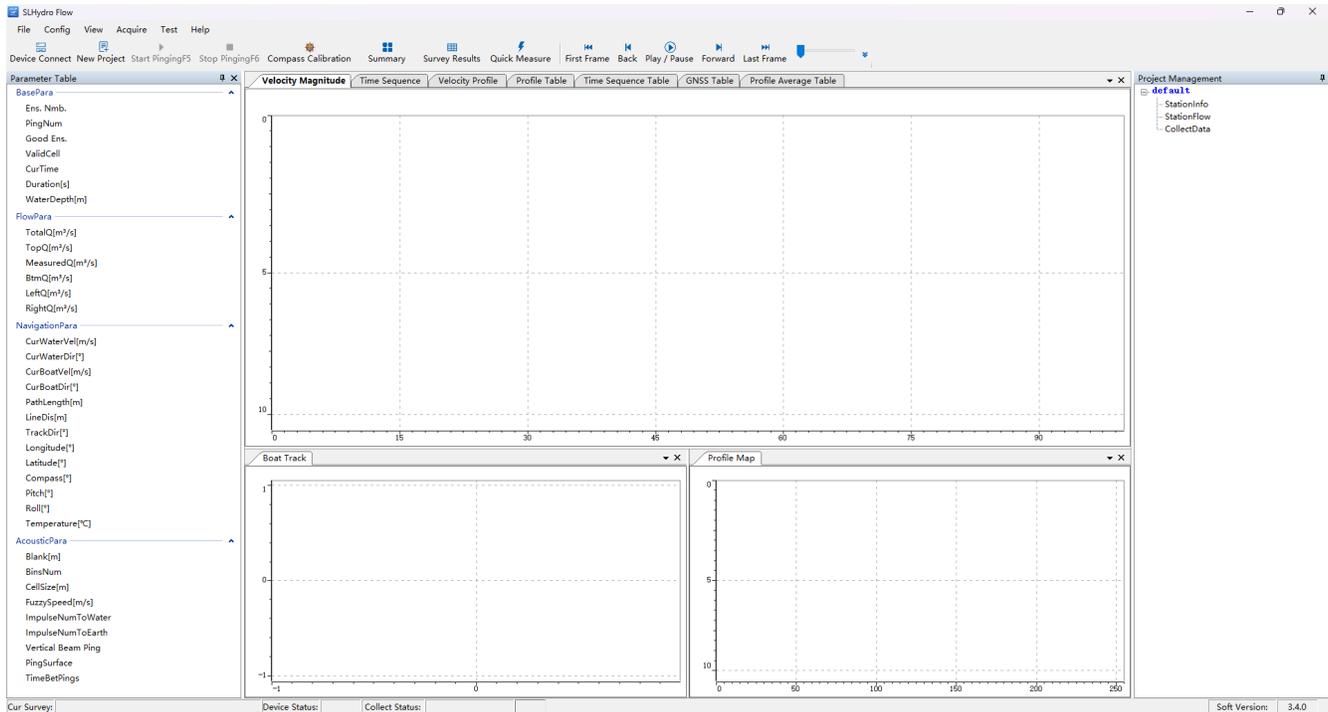


Figure 3-1 Main interface of the software

3.1 Menu Bar

3.1.1 File

New Measurement:

- Click "File" - "New Measurement", and then configure test options through the "Setup Dialog" interface to enable real-time testing.
- In the new test option, you need to configure the site information, flow measurement configuration, and flow configuration, save the configuration, and confirm the summary information.
- View the "[Parameter Setting](#)" to introduce the specific parameter settings.

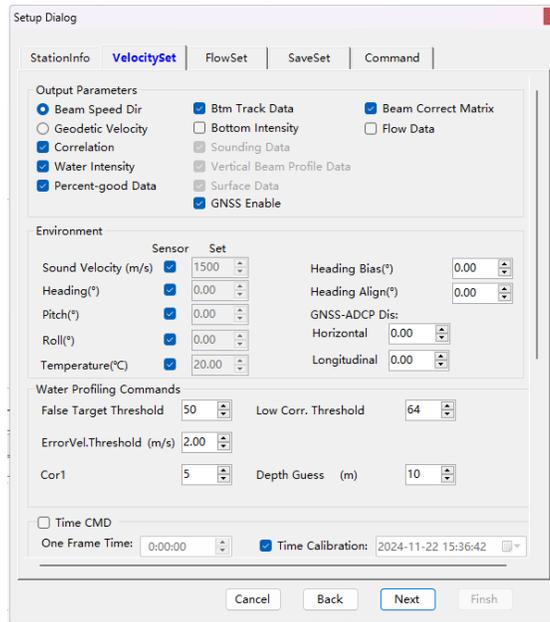


Figure 3-1-1 Setup Dialog interface

Open Measurement:

Click **"File"** - **"Open Measurement"** and select the file to open. Support. xpgm and pgm project format. Compatible with. mea of iFlow V2.1 and. mmt project format of WinRiverII software.

Print/Print Preview:

This option allows the user to print the software interface. Select the form and chart to be printed with the mouse to make the form or chart active. Click **"File"** - **"Print Preview"** to print out the form or chart results. Click **"File"** - **"Print Preview"** to allow users to preview the print effect. Click the print icon in the upper left corner of the print preview to continue printing.

Note: The printed page results depend not only on the print source but also on the **"Page Setup"**.

Page Setup:

Page Setup allows users to set printed pages, including setting margins, page directions, and paper styles. The margin determines the printable range of the total page, the page direction determines the printing direction of the content, and the paper style is used to set the paper in the printer.

Note: The specific form of the paper style depends on the format supported by the default printer of the system. If the printer does not support the selected paper style or there is no paper of this style, the printed paper will be blank or part of the content.

When printing forms, it is recommended to use the default A4 paper vertical, and when printing images, it is recommended to select horizontal.

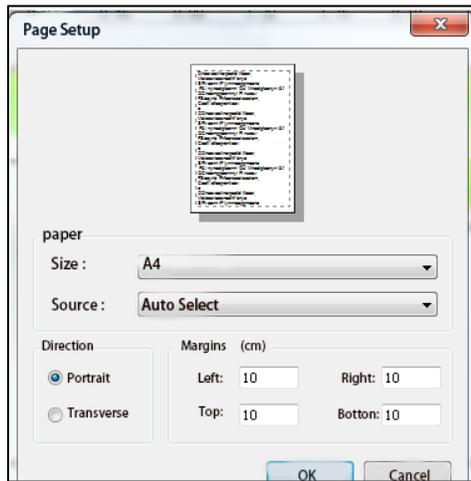


Figure 3-1-2 Page Setup

Flow Record Table:

The software provides a printout of the Flow Results Record Form specified in the Acoustic Doppler Flow Test Specification. Click **"File" - "Flow Record Table"** to open the flow record information interface, as shown in Figure 3-1-3. Click Save PDF to export the PDF format, click Print to enter the preview result, and click the printer icon to print.

SLHydroflow Record Table

Save PDF Print

Station		Station Name:	Processed By:	Gage Height: 0 m
Party:	Width: 268 m	Mean Velocity: 2.25 m/s	G. H. Change: 0 m	
Boat/Motor:	Area: 1800 m ²	Discharge: 4010 m ³ /s		
Station Num.:				

Config		ADCP Depth: 0.50 m	Index Vel.: —	Rating No.: —
Area Method: Mean Flow*	Shore Ens.: 10	Bottom Est: Power	Adj. Mean Vel.: —	Qm Rating: —
Nav. Method: GRS(GGA)	Top Est: Power	Control1: —	Rated Area: —	Diff: —
Mag/Var Method: —		Control2: —	Control3: —	
Depth: 6.94 m				
Power: 0.167				

Threshold		ADCP		
BT 3-Beam Solution: YES	Max. Vel.: 3.23 m/s	Serial #: 1146	Firmware: 2.14	
WT 3-Beam Solution: YES	Max. Depth: 11.1 m	Type/Freq.: RP1200K	Blank: 0.5 m	
BT Error Vel.: 0.2 m/s	Mean Depth: 6.94 m	Bin Size: 1 m	BT Pings: 0	
WT Error Vel.: 1.0668 m/s	Act. Meas.: 2750 m ³ /s	BT Mode: Wide-band	WT Pings: 3	
BT Up Vel.: 0.3048 m/s	Temp.: 20°C	WT Mode: Wide-band		
WT Up Vel.: 1 m/s		WV: 5 m/s		
Use Weighted Mean Depth: YES				

Performed Diag. Test: — Project Name: high sand content(600khz) Time: 9/2/2020

Performed Moving Bed Test: — Sorftware: — Location:

Performed Compass Calibration: —

Tr #	Start Shore	Edge Dist.		# Ens.	Discharge					Width	Area	Time		Velocity		% Ba	
		L	R		Top	Act. Meas.	Botto m	L	R			Total	Start	End	Boat		Water
1	Right	3.00	10.0	825	805	2860	234	36.4	5.89	3940	262	1790	15:48:44	16:02:28	0.32	2.30	1
2	Left	10.0	10.0	509	834	2890	252	20.4	36	4040	272	1800	16:03:01	16:11:30	0.51	2.21	1
3	Right	5.0	10.0	777	970	2570	385	15.1	11.2	3950	268	1830	15:46:22	15:59:19	0.34	2.23	1
4	Left	5.0	10.0	449	1010	2680	375	9.6	27.5	4100	268	1800	15:59:27	16:06:55	0.57	2.24	1

Figure 3-1-3 Print preview of record form

Survey Results Table:

The software provides the Survey Results Table specified in the Acoustic Doppler Flow Test Specification, and then the user sets the file name and saves the directory. When the file is generated, the prompt "**File converted successfully**" will pop up. For details, please refer to the introduction of "[Survey Results Table](#)" in Chapter 5.

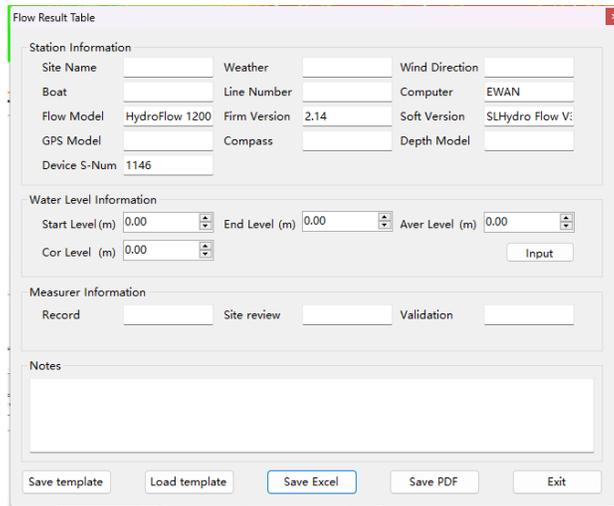


Figure 3-1-4 Survey Results Table

Data Output:

- Support .pgm file, .mea and .ADP files;
- Support user-defined output of Excel table contents, as shown in Figure 3-1-5;
- Support ASCII code data output and save the data as .TXT text.

Figure 3-1-5 Export result data to Excel

3.1.2 Config

Device Connection

- In the equipment connection interface, set the instrument serial port, baud rate, and instrument type. Data bit, stop bit, check bit, flow control and other parameters can be set in the serial port type. Generally, the default can be maintained.
- After parameter configuration, click "Connect" and wait for the connection. After the connection is successful, the interface will display the device serial number.
- The equipment connection interface can also connect GNSS equipment and MRU equipment. The ADCP generally uses GGA, VTG, and HDT.

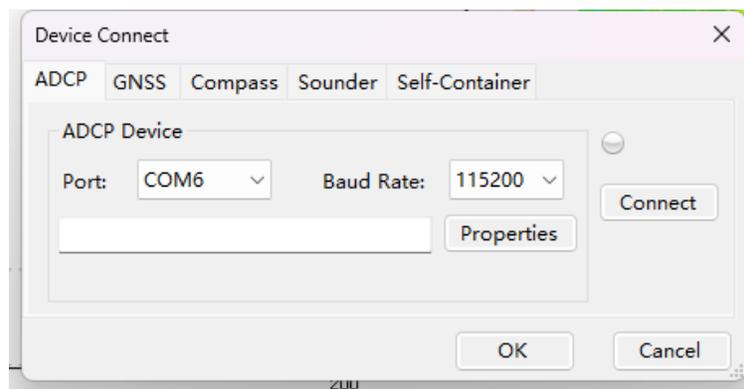


Figure 3-1-6 Device Connect

Quick Measure:

- When the device DSP version > 5.1, click Quick Measurement to enter the Quick Measurement page. Otherwise, go to the New Project screen.
- In the Quick Measurement interface, set the depth of water entry, current measurement mode, and bank parameters. Other parameters remain default, if you want to change other parameters, you can click Manual Project button to enter New Project interface.

Serial port forwarding

Serial port forwarding is the real-time forwarding of data using a serial port. The forwarding data includes layered flow rate data and GPS data. The layered flow rate data transmission formats are PD7 and PD8, and the GPS data mainly includes GGA and VTG data. In the configuration interface of serial port forwarding, as shown in Figure 3-1-8, select the serial port number and baud rate, click the "..." button to open the data selection interface, as shown in Figure 3-1-7, check the data type to be forwarded, click "OK" to take effect, check the check box before the serial port, and click "OK" to

close the serial port output interface. By connecting the computer to other devices with a serial cable, the third-party device can receive the data. For the specific format, please refer to the data format description in Chapter 5 "[Real time output](#)".

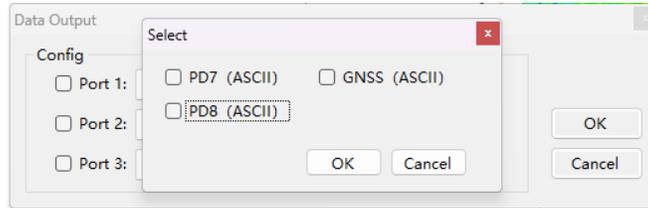


Figure 3-1-7 Forwarding data select

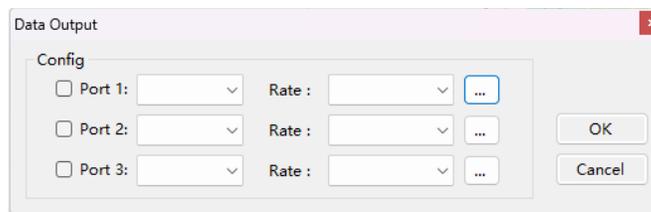


Figure 3-1-8 Serial port forwarding output setting



Notice: All data forwarded by the serial port are transmitted in ASCII format, please set the correct encoding format when parsing. If it is received locally, virtual serial port can be used and the corresponding data can be received through the serial port tool.

Unit Settings:

The unit settings include Imperial units, Metric units, and Custom units. Select the corresponding unit system to perform data unit conversion. Custom setting is to set the units of the main physical quantities in the software. The software starts in metric units by default and supports saving the last unit setting.

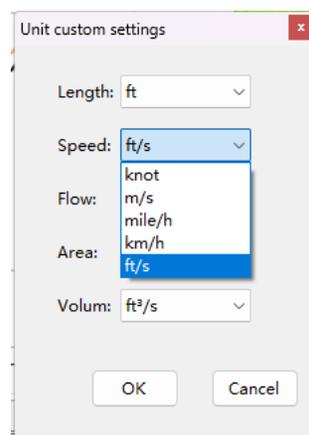


Figure 3-1-9 Unit custom settings

Coordinate Setting:

Coordinate parameter configuration includes Ellipsoid, Projection, Convert, RTK Tide, Plane grid, Height Fitting, Truck Point and other options. You can either enter the parameters manually or import a saved parameter file. For common configurations, they can be saved as .dam files.

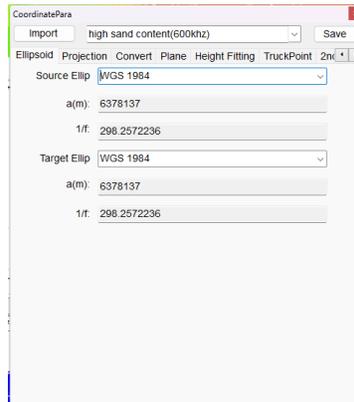


Figure 3-1-10 Coordinate Setting

The configuration of coordinate conversion parameters will affect the functions of DXF base map import, planned line editing, and GPS navigation. Therefore, it is necessary to ensure that the base map and planned line match the coordinate system.

Base Map Setup:

The base map function supports importing DXF (Drawing Exchange Format) format of channel charts or nautical charts, bathymetry points, etc.

The Base Map Setup supports the import of multiple data. The Base Map will be saved in a specific folder under the running directory of the software. The import, deletion, and visibility of files can be controlled on this interface.

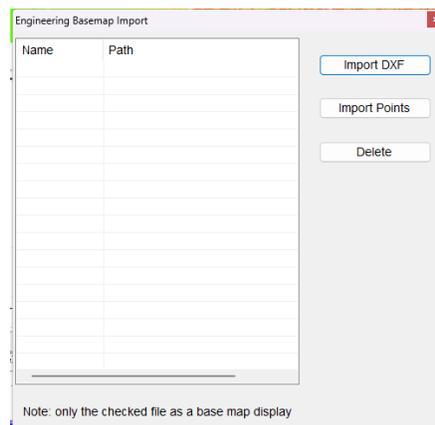


Figure 3-1-11 Base map configuration Interface

3.1.3 View

You can control whether the corresponding view is displayed on the page by checking the check box in front of each item in the "View" menu. Views include **Command Log**, **Default Layout**, **Summary Table**, **Pictures/Tables**, **Secondary Windows**, and **Language Setting**.

Command Log: The Command Log interface mainly displays the commands that the user has used to communicate with the device after the software has been started, such as connect the device, create a new project, collect data, stop transmitting, and other communications.

Default layout: The Default Layout function is used to restore the disturbed software interface and provide the customer with a default layout, as shown in the following figure:

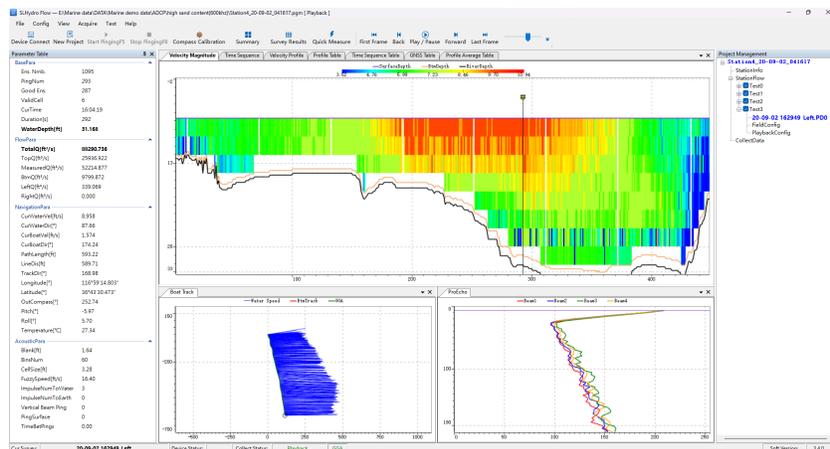


Figure 3-1-12 Software Default layout

Summary Table:

In real-time mode and playback mode, you can select and click "View" - "Summary Table F10" or the shortcut key "Summary" in the menu bar to view the summary information of all tests in the current project. Check the checkbox according to the data quality, check the corresponding test data for data adjustment calculation, and select the shortcut tool in the window to save the data, as shown in Figure 3-1-13.

ALL	MeasureName	Start Bank	End Nbr	StartTime	Total Discharge(ft ³ /s)	RelativeError(%)	Total Area(ft ²)	AverageDischarge(ft/s)	Water Speed(ft/s)	WaterDirection(°)
<input checked="" type="checkbox"/>	20-09-02 164930_RiGht	RiGht	825	2020-09-02 15:48:44	139064.600	-97.2	19233.520	7.230	7.552	91.50
<input checked="" type="checkbox"/>	20-09-02 160347_LeFt	LeFt	509	2020-09-02 16:03:01	142565.100	-97.1	19407.100	7.346	7.252	88.92
<input checked="" type="checkbox"/>	20-09-02 161645_RiGht	RiGht	777	2020-09-02 15:46:22	139649.100	-97.2	19671.550	7.099	7.321	86.52
<input checked="" type="checkbox"/>	20-09-02 162949_LeFt	LeFt	449	2020-09-02 15:59:27	144557.800	-97.1	19394.320	7.469	7.346	85.74
	Average				141534.148		19426.62	7.206	7.368	
	Standard Deviation				2693.309		181.39	0.158	0.129	
	Standard Deviation / Average				0.019		0.01	0.022	0.018	

Figure 3-1-13 Summary interface

Pictures/Tables:

- The Pictures/Tables option includes the user interface that displays the test results in the form of a graph or table. Please refer to the "[Data Graphs and Tables](#)" section for details.

Secondary Window - Navigation

PlanLine Design:

The PlanLine can be drawn and managed on this interface. The drawing methods of PlanLines include "**Simple**" and "**Complete**", in which "**Simple**" refers to directly selecting points on the grid diagram through mouse interaction, and the drawing process is simple; In "**Complete**", the drawing process is more accurate by manually entering coordinate points or selecting the coordinate points previously imported into the coordinate library to connect lines.

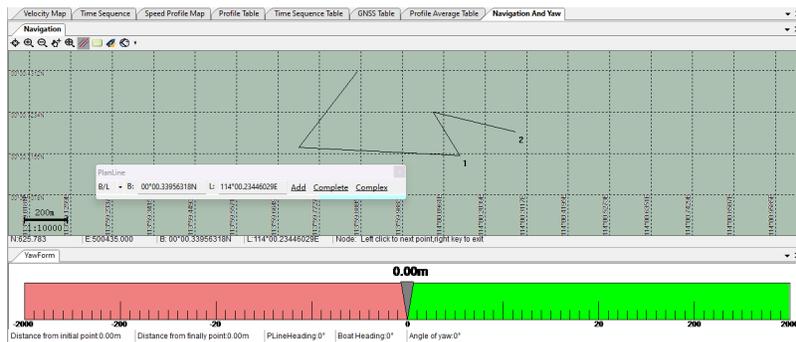


Figure 3-1-14 Planline design interface

The forms of drawing planned lines are divided into "**Channel**", "**Area**", "**Parallel**", "**Vertical**", "**Sector**", and "**Semi**", which can be selected according to specific needs.

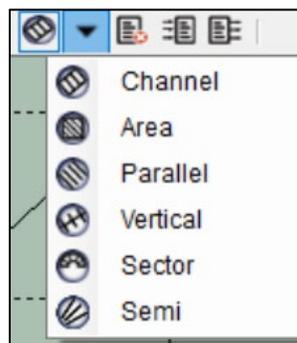


Figure 3-1-15 Routing Selection Menu

In addition, you can export the drawn plan lines as .DXF, .pln, .plx format file for the next import. In this interface, you can also select, edit, delete, zoom in, zoom out, pan, full view, line selection mode, etc. for the existing planned lines. The interface can also switch between day mode and night mode.

Navigation:

Navigation means accessing RTK's positioning data for real-time navigation on the grid. Among them, the simplified boat model represents the location of the current navigation equipment, which can be referenced by the imported DXF base map, water depth points, and planning lines.

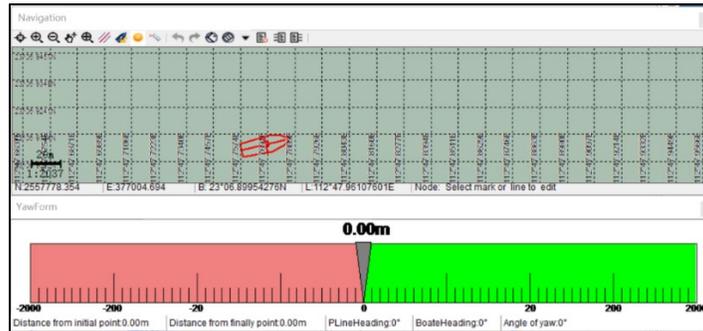


Figure 3-1-16 Navigation interface

The north needle of the grid chart is always up, indicating true north. The boat model will move in the grid according to the coordinate changes calculated by GNSS positioning information. When the boat model moves outside the interface, the boundary coordinates of the grid will be automatically updated and the model will be re-included. The scale will also change dynamically as the interface zooms in and out. The boat's track line can be displayed when the boat is traveling.

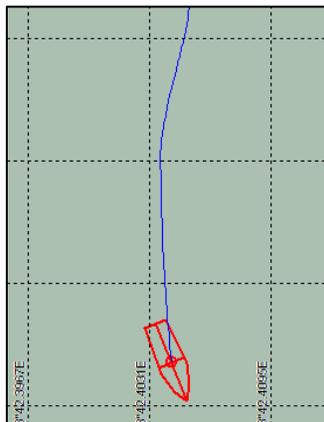


Figure 3-1-17 Route trajectory

Secondary Window – Real Time Camera Image

During field operation, click "**View**" - "**Secondary window**" - "**RtCameraImage**" to open the real-time image viewing interface, as shown in Figure 3-1-18. Connect the camera equipment on the unmanned boat through network communication, view the test site image in real-time, input the IP address, terminal number, user name, and password information, and click Login to see the screen information on the unmanned boat. In the right operation panel, adjust the left and right angle of view of the lens,

video recording and other operations, and store the snapshots and videos in the project folder for later viewing of the on-site test environment.



Figure 3-1-18 Real time camera image interface

3.1.4 Acquire

Start Pinging: start surveying.

Stop Pinging: stop receiving data and the interface will stop displaying.

3.1.5 Inspection

Digital Self Checking: Detect the status information of each component in the hardware device. The interface is as follows:

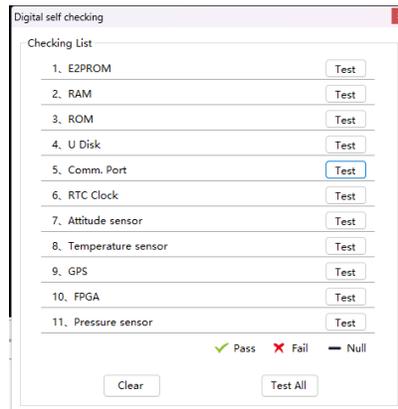


Figure 3-1-19 Digital self checking

After the upper computer connects the equipment successfully, click "**Test**" -> "**Digital Self Checking**" to enter the equipment self-test interface, select the corresponding detection module, click the corresponding "Self Test" button, and obtain the status information of the module hardware. The status information includes three states, namely, "Pass", "Fail", and "Null". "Pass" indicates that the module works normally, and "Fail" indicates that the module is abnormal and cannot work normally, "Null" means the module is installed or does not exist; Click " Test All " and the software will inspect each module one by one.



Notice: The device detection function requires DSP 4.0 and above firmware, please check the current firmware version information before use.

Field Calibrate Compass: it can be used to calibrate the heading, pitch, and roll values. The interface is as follows:

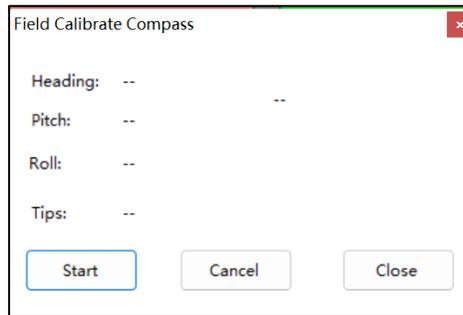


Figure 3-1-20 Field Calibrate Compass

Field Calibrate Compass method: after the upper computer connects the equipment successfully, click "Test" -> "Field Calibrate Compass" to enter the attitude calibration interface. First place the ADCP on a level surface smoothly. Click "Start", and then rotate the ADCP horizontally counterclockwise or clockwise (during calibration, the rotation direction cannot be changed). The rotation speed needs to be greater than the 30s/circle, but it should not be too fast. When the interface prompts the number to 6, raise the ADCP head, that is, the arrow is upward, and the pitch angle is greater than 30 degrees. Then continue to rotate, with the rotation direction unchanged. When the interface prompts 12, lower the ADCP head, that is, the arrow is downward, and the pitch angle is less than - 30 degrees. Continue to rotate to the number prompt 18. If the calibration is successful, the interface will prompt "Calibration succeeded".

Device Serial Number: View the firmware version and serial number information of the device. The interface is as follows:

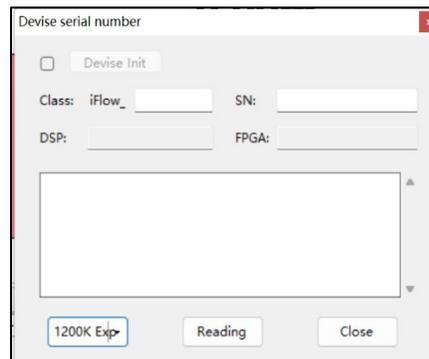


Figure 3-1-21 Device Serial Number Interface

After the upper computer connects the device successfully, click "**Test**" -> "**Device Serial Number**" to enter the device serial number viewing interface, and click "Read" to query the device serial number, DSP version, FPGA version, and other information.

DSP Upgrade:

- Click "**Test**" - "**DSP Upgrade**" in real-time mode, and the main interface will pop up to display the window of "DSP Upgrade".
- You need to connect the ADCP device first in the device connection before you can upgrade the firmware of ADCP. DSP upgrade can help users upgrade or improve the whole ADCP system without returning to the factory when the equipment fails. Users can contact the corresponding technical department of Satlab to obtain the latest DSP software. Click "**Browse**" in the window to find the acquired DSP software (.ais or .bin file), and then click "**Start**". The ADCP system will automatically upgrade the DSP software. At this time, please do not do any operation until the progress bar is completed and the text box displays "**Burn-in successful, please re-power**". The ADCP device can be disconnected and powered on again to restart the surveying.

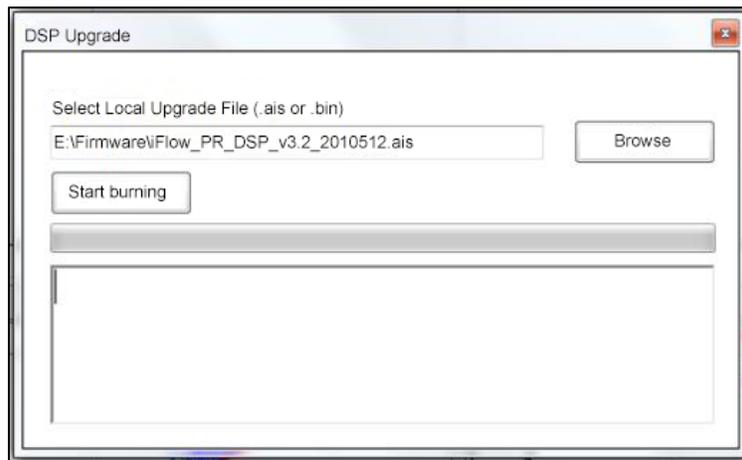


Figure 3-1-22 DSP Firmware Upgrade

FPGA Upgrade:

- Click "**Test**" - "**FPGA Upgrade**" under "Real-time mode", and the main interface will pop up to display the "FPGA Upgrade" window.
- You need to connect the ADCP device first in the device connection before you can upgrade the FPGA firmware of ADCP. FPGA upgrade can help users upgrade or improve the entire ADCP system without returning to the factory when the equipment fails. Users can contact the corresponding technical department of Satlab to obtain the latest FPGA firmware. Click "**Browse**" in the window to find the acquired FPGA firmware (.bit file), and then click "**Start**". The ADCP system will automatically upgrade the FPGA firmware. At this time, please do not do any

operation until the progress bar is finished and the text box displays " **Burn-in successful, please re-power** ". The surveying can be restarted after the ADCP device is disconnected and powered on again.

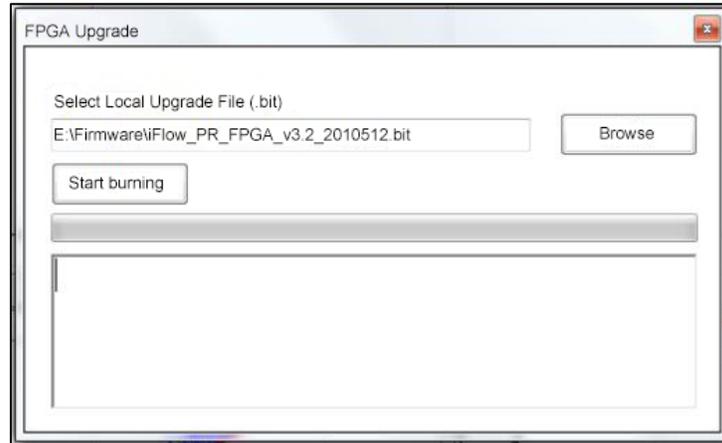


Figure 3-1-23 FPGA Firmware Upgrade

Working Mode:

- Click "**Test**" - "**Working Mode**" under "Real time Mode", and the window of "Working Mode" will pop up in the main interface.
- The computer needs to open the communication port in the equipment connection to connect the ADCP equipment, and then can switch the working mode. The ADCP working mode is mainly divided into walk-on mode, self-contained mode, and self-start mode. The walk-on mode mainly deals with the river section flow observation, the self-contained mode mainly deals with the monitoring of the flow and flow rate at the fixed point of the river, and self-start mode mainly deals with the automatic test configuration of equipment under the self-contained mode.

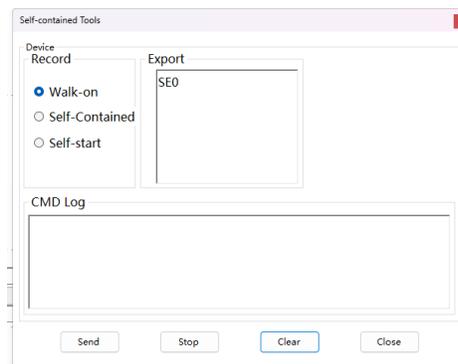


Figure 3-1-24 Working Mode

Disk Management:

Disk Management is used to manage the storage space in the ADCP device, mainly including the export and deletion of storage files, as well as the query and cleaning of storage space. The operation interface is shown in Figure 3-1-25.

- On the toolbar at the top of the interface, there is the Query Remaining Space button, Export All Files button, Clear All Stored Files button, and select the default path for file export. There are two ways to export a single file in the center of the interface, namely, file name export and file creation time export.
- FileName export, that is, by clicking the "**Search**" button, query the file name list of historical test storage in the ADCP storage unit. By checking the corresponding file name and clicking the "**Export**" button, you can export the corresponding data files, you can also select multiple files at a time to export.
- Time export, input the start time of file storage, click the "**Export**" button, and export all the data files stored at this time.

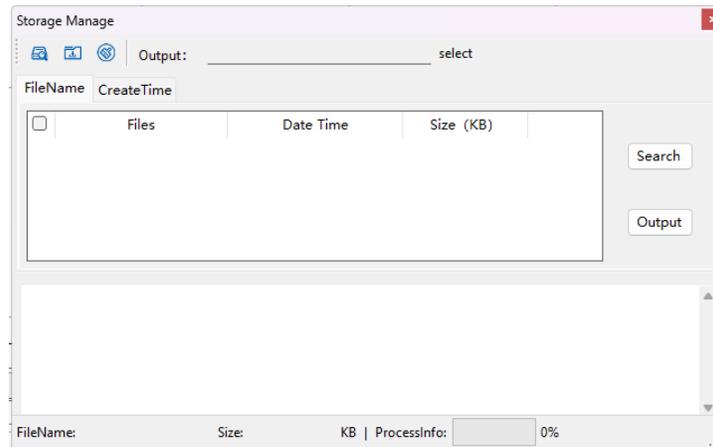


Figure 3-1-25 Storage data export



Notice: When exporting by file name, if there is a file with the same name under the folder, the new file will be stored as a copy; when exporting by time, if there is a file with the same name under the folder, the new file will directly overwrite the file with the same name.

3.1.6 Help

Help Information: provide help documents to help users use the software. It includes software overview, system overview, software interface, parameter configuration, and data output.

Version Information: display software version, company address, phone, E-mail, website, and other information. The interface is as follows:



Figure 3-1-26 Version information

Updates Checking: check whether the current software is the latest version. You can download and upgrade the latest software online, or upgrade locally through the upgrade package.

3.2 Tool Bar

The toolbar is mainly divided into two parts. On the left is the shortcut button for common software operations, and on the right is the data playback button, as shown in the following figure.

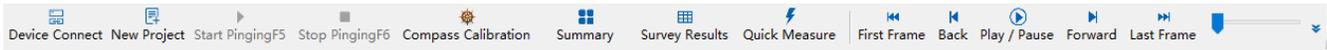


Figure 3-2-1 Toolbar icon

The toolbar contains shortcut options for common items of menu bar options. The toolbar icons of the current version are explained in the following table:

Surface 3-1 Toolbar icon explanation

Icon	Meaning	Icon	Meaning
	Device Connect		New Project
	Start Ping		Start shore setting
	Stop shore setting		Stop Ping
	Survey Results		Summary
	Compass Calibration		First Frame
	Last Frame		Back
	Forward		Playback
	Pause Playback		More

The play button is mainly used to control the position and status of data playback. Please refer to the specific content of "**Playback Operation**" in Section 3.6 "[Auxiliary Operation](#)" for the specific operation method and logic.

3.3 Status Bar

The Status Bar provides prompt information on the status of the software.

When SLHydroFlow is in "real-time mode", the Status Bar from left to right is the Current Test Times, Device Status, Acquisition Status (playback, acquisition), current test reference system (BTM, GGA, VTG, NONE), and software version.

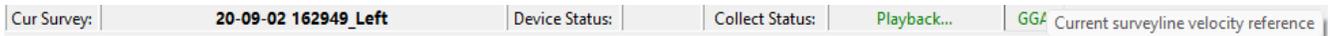


Figure 3-3-1 Software Status Bar

3.4 Data Graphs and Tables

The image interface has the function of zooming in and out. When you click a point, you can scroll the mouse wheel to zoom in and out. The point is always displayed in the center of the interface.

3.4.1 Velocity Magnitude

The user can visually view the river bottom depth information and the changing trend of selected parameters through the velocity map.

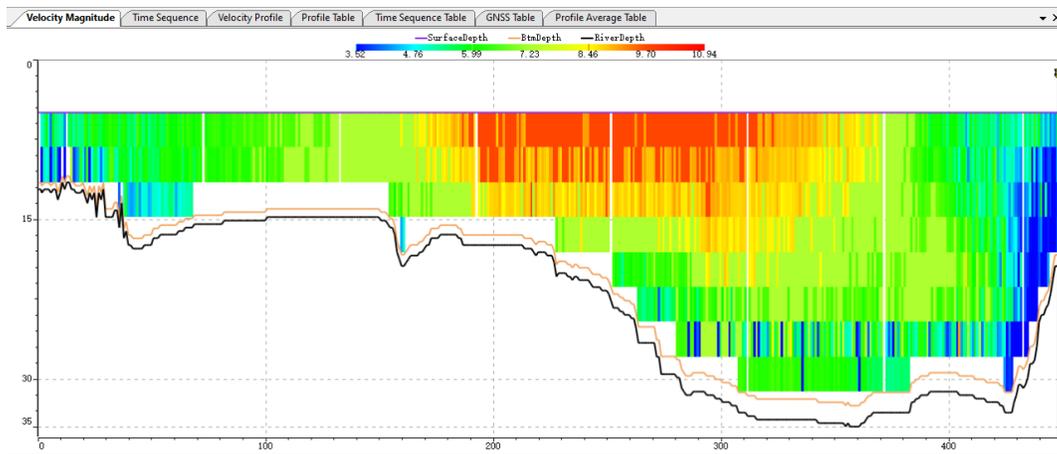


Figure 3-4-1 Velocity Graph

In Figure 3-4-2, the black vertical line is the cursor. The cursor is only displayed in the playback mode. The cursor position represents the position of the current ping in the playback state. Click other positions of the velocity map or drag the cursor to switch the display of the current ping.

The top icon of the cursor represents the ADCP, and the lower position of the icon represents the depth of entry of the ADCP. Click "**Playback Config**" in the project window to open the parameter setting interface, and you can select "**System Config**" to modify it.

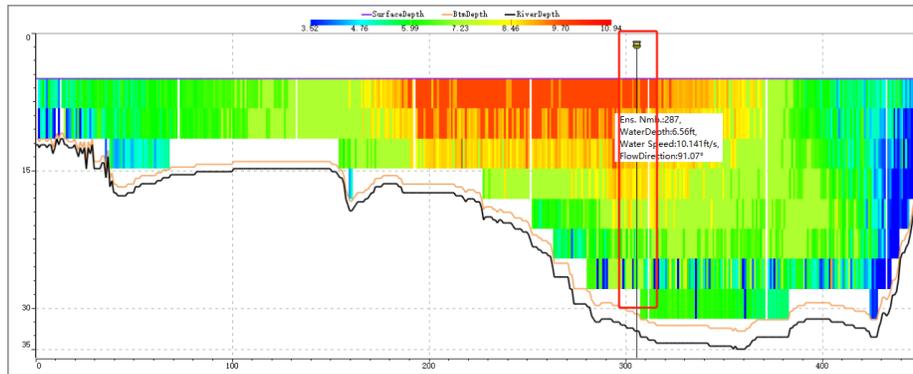


Figure 3-4-2 ADCP icon position on cursor

Right-click the "**Attribute**" function in the velocity map interface, mainly including Y axis scale, X axis scale, and gradient range. Y axis scale and X axis scale are mainly used to set the maximum and minimum values of the Y axis and X axis. The Gradient Range Sets the maximum and minimum values of the gradient color bar, which you can change according to your needs.

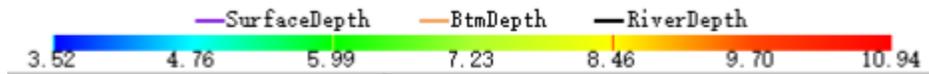


Figure 3-4-3 Color card of flow rate contour map

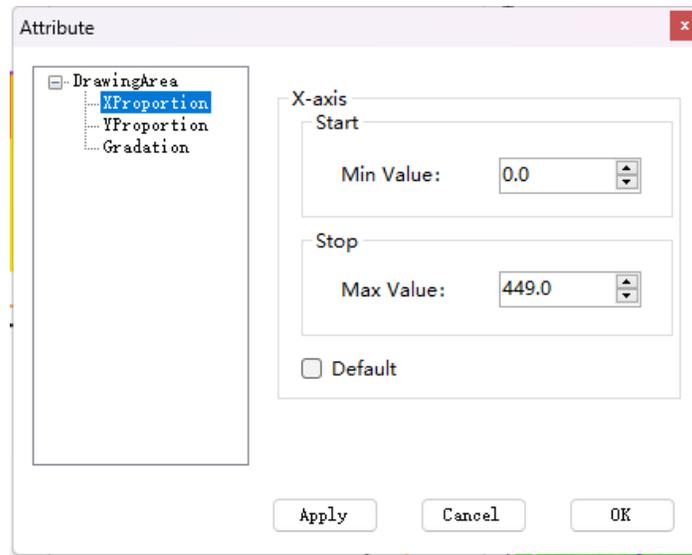


Figure 3-4-4 Gradient attribute modification interface

3.4.2 Time Sequence

- Users can view ADCP heading, water speed and boat speed, pitch and roll, and flow information through the time sequence diagram.
- The coordinates of the mouse point will be displayed when the mouse hovers over the graph.

- Right-click to switch the abscissa to data group serial number or linear distance.

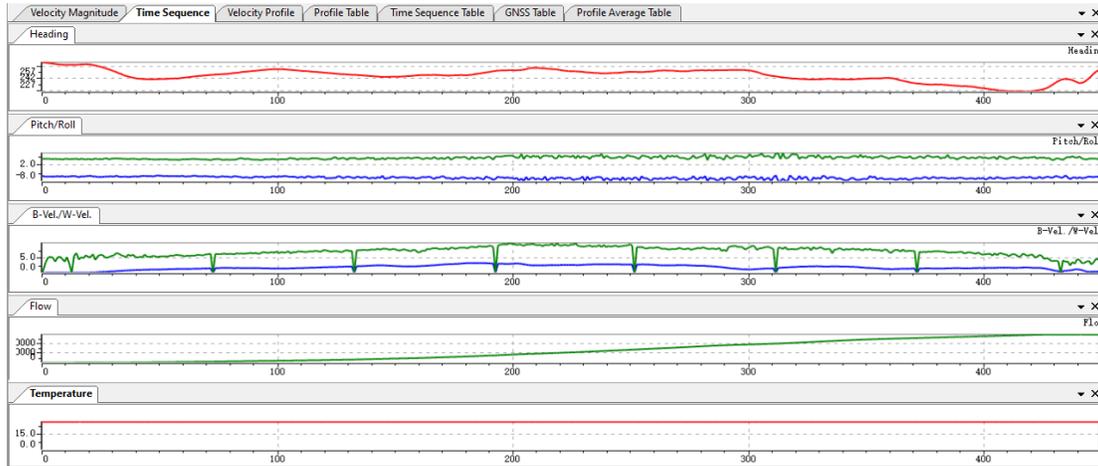


Figure 3-4-5 Time Sequence

3.4.3 Profile Table

- The table shows the values of each parameter on the current depth profile of the ping, and the user can right-click to select the parameters to be displayed. Optional parameters include beam velocity, relative velocity, earth velocity, speed value, speed direct, correlation, echo strength, and other information, Where the symbol "-" indicates an abnormal value.
- The first row of the profile table shows information about the bottom of the water, and the second row onwards shows information about each cell layer of the water.
- Right mouse click to bring up the column selection menu, you can freely select the data you want to display.
- "/" in the figure is a placeholder, indicating a parameter without practical significance;

Cell	Depth	ReNorthSpeed	ReEastSpeed	ReVerSpeed	ReErrorSpeed	North Velocity	East Velocity	Up Velocity	Error Velocity	SpeedValue	SpeedDir	Correlation1	Correlation2	Correlation3	Correlation4	ic
BtmTrack	32.4...	/	/	/	/	-1.444	0.027	0.000	0.000	1.444	178.917	0	0	0	0	
1	6.56	-2.870	-9.917	-0.364	0.102	1.426	9.944	0.364	0.102	10.046	81.84	214	217	221	221	
2	9.84	-2.365	-9.397	-0.141	-0.046	0.921	9.424	0.141	-0.046	9.469	84.42	233	230	219	234	
3	13.12	-2.191	-8.941	-0.292	0.052	0.747	8.969	0.292	0.052	9.000	85.24	223	214	230	227	
4	16.40	-2.397	-8.907	-0.443	0.030	0.953	8.934	0.443	0.030	8.985	83.91	238	236	228	216	
5	19.69	-2.045	-7.958	-0.522	-0.151	0.601	7.985	0.522	-0.151	8.008	85.69	239	204	235	218	
6	22.97	-2.716	-7.515	-0.650	-0.151	1.272	7.542	0.650	-0.151	7.649	80.42	167	91	189	129	
7	26.25	-0.243	-5.226	-0.686	0.906	-1.201	5.254	0.686	0.906	5.389	102.88	48	55	95	51	
8	29.53	-	-	-	-	-	-	-	-	-	-	22	36	69	45	
9	32.81	-	-	-	-	-	-	-	-	-	-	40	22	79	36	
10	36.09	-	-	-	-	-	-	-	-	-	-	38	39	47	75	
11	39.37	-	-	-	-	-	-	-	-	-	-	34	96	72	128	
12	42.65	-0.182	-1.086	-1.663	0.279	-1.262	1.114	1.663	0.279	-	-	100	113	139	130	
13	45.93	-0.148	-0.176	-1.801	-0.072	-1.296	0.204	1.801	-0.072	-	-	105	123	173	117	
14	49.21	0.508	-0.794	-1.834	-0.161	-1.952	0.821	1.834	-0.161	-	-	112	69	171	75	
15	52.49	0.517	-1.623	-1.640	0.174	-1.961	1.650	1.640	0.174	-	-	69	68	153	91	
16	55.77	0.258	0.509	-1.722	-	-1.703	-0.482	1.722	-	-	-	70	47	94	75	
17	59.06	0.018	-0.399	-2.238	-0.909	-1.462	0.426	2.238	-0.909	-	-	71	95	115	123	
18	62.34	0.653	0.135	-1.818	0.095	-2.097	-0.108	1.818	0.095	-	-	63	118	124	159	
19	65.62	0.106	-0.030	-2.211	0.174	-1.550	0.057	2.211	0.174	-	-	112	135	136	128	

Figure 3-4-6 Profile table and its function menu

3.4.4 Time Sequence Table

- This table displays the time, water depth, navigation information, flow information, and other parameter values of the current test from the initial ping to all pings in the current ping. Right-click to display or hide the corresponding parameters.
- Right-click to pop up the column selection menu. Select the corresponding column to display the table data selectively.

PingNum	Time	Duration	WaterDepth	ValidCellNum	urWaterSpeed	CurWaterDir	MeanWaterVel	MeanWaterDir	CurBoatVel	CurBoatDir	MeanBoatVel	MeanBoatDir	TrackLength	LineDis
1	15:59:27	0	12.14	0	---	---	0.000	0.00	---	---	---	---	0.00	0.00
2	15:59:28	1	12.47	2	3.680	85.74	3.680	85.74	0.111	274.09	0.111	274.09	0.11	0.11
3	15:59:29	2	12.14	2	5.243	96.76	4.441	92.22	---	---	---	---	0.21	0.21
4	15:59:30	3	12.14	2	5.432	85.53	4.764	89.68	---	---	---	---	0.29	0.29
5	15:59:31	4	12.14	2	5.216	72.86	4.836	85.20	---	---	---	---	0.39	0.37
6	15:59:32	5	12.47	2	3.794	85.42	4.628	85.24	---	---	---	---	0.49	0.44
7	15:59:33	6	12.14	2	5.266	97.83	4.717	87.56	---	---	---	---	0.61	0.52
8	15:59:34	7	12.14	2	5.497	84.85	4.828	87.12	---	---	---	---	0.72	0.60
9	15:59:35	8	13.12	2	4.764	86.36	4.820	87.03	---	---	---	---	0.85	0.70
10	15:59:36	9	12.47	2	3.801	93.62	4.704	87.62	---	---	---	---	0.96	0.79
11	15:59:37	10	11.48	1	5.330	83.63	4.736	87.38	---	---	---	---	1.07	0.89
12	15:59:38	11	12.14	2	3.027	95.84	4.570	87.91	---	---	---	---	1.18	0.98
13	15:59:39	12	11.48	0	---	---	4.570	87.91	---	---	---	---	1.18	0.98
14	15:59:40	13	11.48	1	5.801	79.58	4.624	87.44	---	---	---	---	1.42	1.19
15	15:59:41	14	12.14	2	6.728	71.23	4.779	85.56	---	---	---	---	1.54	1.29
16	15:59:42	15	12.14	2	4.527	78.27	4.757	85.03	---	---	---	---	1.66	1.40
17	15:59:43	16	12.47	2	5.294	86.54	4.795	85.31	---	---	---	---	1.77	1.49
18	15:59:44	17	12.47	2	5.003	90.05	4.808	85.64	---	---	---	---	1.89	1.59
19	15:59:45	18	12.47	2	5.996	86.22	4.882	85.68	---	---	---	---	2.00	1.68
20	15:59:46	19	12.14	2	5.350	81.34	4.909	85.40	---	---	---	---	2.13	1.80

Figure 3-4-7 Time Sequence table and its function menu

3.4.5 Profile Average Table

- The table shows the depth, average velocity, average velocity direction, and effective number ping of each unit layer in the current test. The calculation range is from the initial ping to all pings in the current ping, where the symbol "-" represents numerical outliers.
- Right-click the mouse to pop up the function menu for exporting to Excel. Click the "Save as Excel" button to pop up the file path selection dialog box. Select the location to save the file. After clicking "OK", the data in the profile average table will be saved to the file. When the "Export completed" dialog box pops up, the file is successfully exported.

Cell	Depth(m)	Average Velocity(m/s)	AverSpeedDir (°)	Good Ens.
1	6.56	8.164	90.60	300
2	9.84	7.854	90.59	298
3	13.12	8.034	91.75	182
4	16.40	8.068	89.53	80
5	19.69	7.119	83.95	43
6	22.97	6.293	81.93	8
7	26.25	3.094	106.34	8
8	29.53	-	-	0
9	32.81	-	-	0
10	36.09	-	-	0
11	39.37	-	-	0
12	42.65	-	-	0
13	45.93	-	-	0
14	49.21	-	-	0
15	52.49	-	-	0
16	55.77	-	-	0
17	59.06	-	-	0
18	62.34	-	-	0
19	65.62	-	-	0
20	68.90	-	-	0
21	72.18	-	-	0

Figure 3-4-8 Profile average table and its function menu

3.4.6 GNSS Table

- The table displays the UTC, longitude, latitude, number of satellites, solution state, altitude, ground speed, and heading value in the current Flow test, where the symbol "-" represents the numerical abnormal value.
- Right-click to pop up the function menu of exporting to Excel. Click the "Save as Excel" menu button to pop up the file path selection dialog box. Select the location to save the file. Click "OK" to save the data in the profile average table to the file. When the dialog box "Export completed" pops up, the file is exported successfully.

PingNum	UTC Time	Longitude	Latitude	Number of satellites	GNSSQuality	Altitude	GNDSpeed_In	GNDSpeed_kmh	Heading
1	8:29:48 AM	116:59:13.415	36:43:36.194	30	G_Q_Dif_co...	31.77	0.068	0.126	262.02
2	8:29:49 AM	116:59:13.414	36:43:36.194	30	G_Q_Dif_co...	31.77	0.0		1.72
3	8:29:50 AM	116:59:13.413	36:43:36.194	30	G_Q_Dif_co...	31.77	0.0		1.34
4	8:29:51 AM	116:59:13.412	36:43:36.194	30	G_Q_Dif_co...	31.77	0.0		0.92
5	8:29:52 AM	116:59:13.411	36:43:36.193	30	G_Q_Dif_co...	31.78	0.0		0.52
6	8:29:53 AM	116:59:13.410	36:43:36.192	30	G_Q_Dif_co...	31.78	0.0		0.11
7	8:29:54 AM	116:59:13.410	36:43:36.191	30	G_Q_Dif_co...	31.77	0.0		0.70
8	8:29:55 AM	116:59:13.410	36:43:36.190	30	G_Q_Dif_co...	31.77	0.0		0.45
9	8:29:56 AM	116:59:13.410	36:43:36.189	30	G_Q_Dif_co...	31.77	0.0		0.12
10	8:29:57 AM	116:59:13.410	36:43:36.188	30	G_Q_Dif_co...	31.77	0.0		0.04
11	8:29:58 AM	116:59:13.410	36:43:36.186	30	G_Q_Dif_co...	31.78	0.0		0.11
12	8:29:59 AM	116:59:13.410	36:43:36.185	30	G_Q_Dif_co...	31.77	0.0		0.07
13	8:30:00 AM	116:59:13.410	36:43:36.184	30	G_Q_Dif_co...	31.78	0.092	0.171	259.04
14	8:30:01 AM	116:59:13.410	36:43:36.183	30	G_Q_Dif_co...	31.78	0.067	0.124	259.11
15	8:30:02 AM	116:59:13.411	36:43:36.182	30	G_Q_Dif_co...	31.77	0.073	0.135	259.12
16	8:30:04 AM	116:59:13.411	36:43:36.180	30	G_Q_Dif_co...	31.78	0.068	0.126	259.25
17	8:30:04 AM	116:59:13.411	36:43:36.179	30	G_Q_Dif_co...	31.77	0.065	0.120	259.46
18	8:30:05 AM	116:59:13.412	36:43:36.178	30	G_Q_Dif_co...	31.78	0.072	0.132	259.56
19	8:30:06 AM	116:59:13.413	36:43:36.177	30	G_Q_Dif_co...	31.78	0.071	0.132	259.81
20	8:30:07 AM	116:59:13.413	36:43:36.176	30	G_Q_Dif_co...	31.78	0.083	0.154	259.67

Figure 3-4-9 GNSS table

3.4.7 Profile Echo Intensity Graph

The user can view the current ping set parameters versus depth curve through the profile echo intensity graph. Right-click to select echo intensity, correlation, beam velocity, bottom filtration, and other information displays.

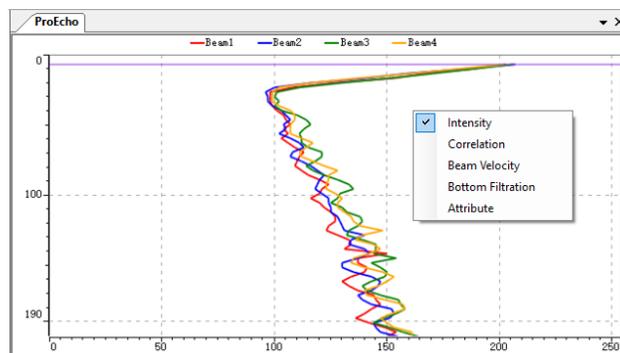


Figure 3-4-10 Profile Intensity Graph

3.4.8 Profile Correlation Graph

The user can view the echo signal quality of different unit layers of each beam of the current device through the correlation graph, and determine the credibility of the beam speed and other data

according to the correlation. The computers have screened the data, and the data that can be displayed in the software meet the required data quality requirements.

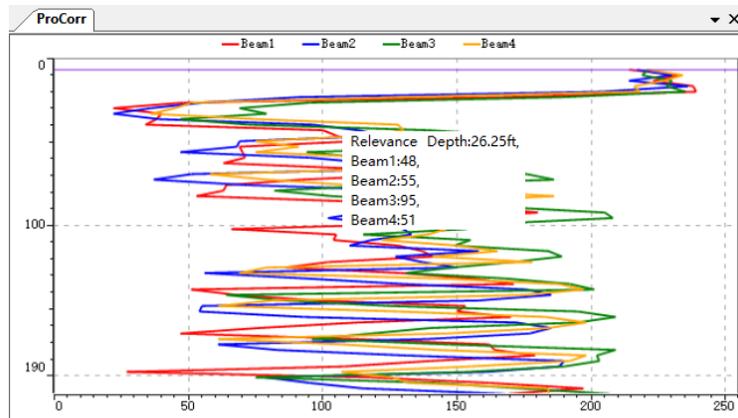


Figure 3-4-11 Profile Correlation graph

3.4.9 Profile Speed Graph

Users can view the current ping set parameter and depth curve through the profile speed chart, which displays the parameters as average and instantaneous water speed.

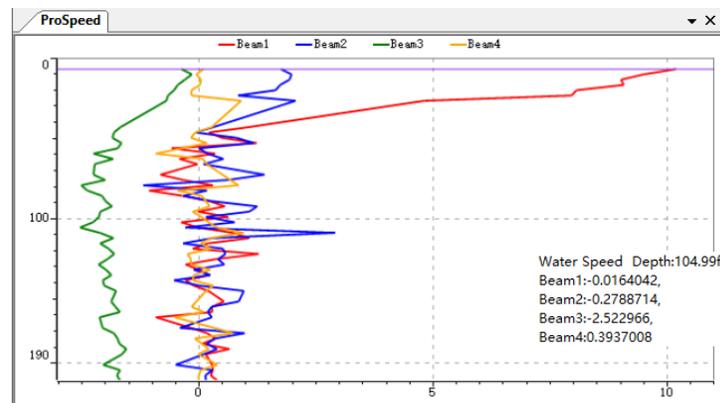


Figure 3-4-12 Profile velocity graph

3.4.10 Boat Track Graph

On the left side of the navigation map, the user can view the navigation track from the beginning of the ping to the current ping, and the average flow direction corresponding to each ping. The bottom tracking, GGA, and VTG track lines can be selected and displayed at the same time in the track map, which can be checked and displayed through the right-click menu. In the right-click function menu, the track tracking is mainly used to lock the perspective of track points during real-time acquisition and playback, and refresh and display the flow velocity vector status of the current track position in real-time.

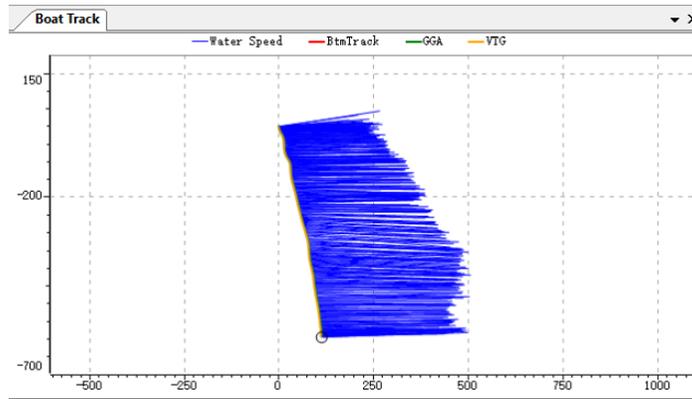


Figure 3-4-13 Boat Track Graph

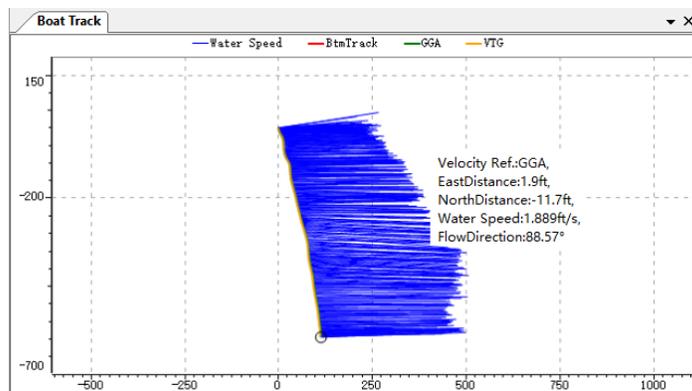


Figure 3-4-14 Real-time track tracking perspective

3.4.11 GNSS Data Table

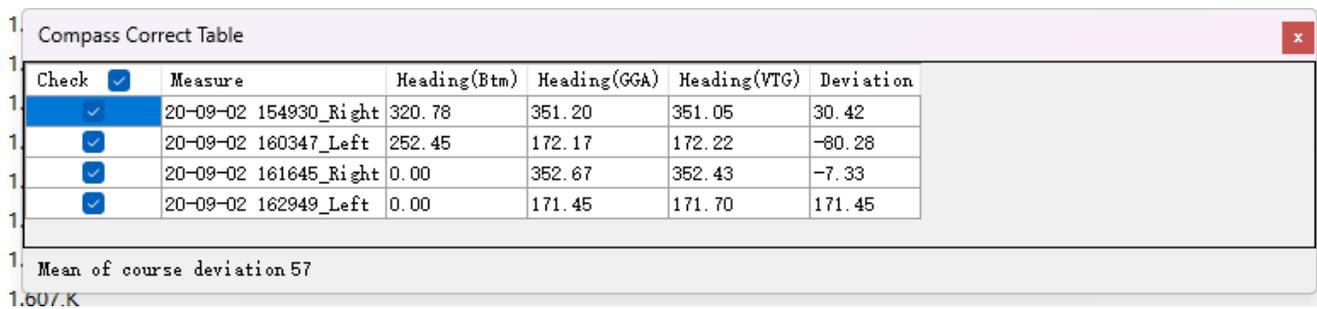
The user can click the menu "**View**" - "**Tables**" - "**GNSS Data Table**" to open the GNSS Data Table interface, as shown in the figure below, which displays the current device's GNSS raw data, including GPGLGA, GPVTG, and GPHDT data.



Figure 3-4-15 GNSS Data Table

3.4.12 Compass Correct Table

The user can click the menu "View" - "Table" - "Compass Calibration Table" to open the Compass Calibration table interface, as shown in the figure below, which displays Heading (Btm), the bottom tracking heading value, Heading (GGA), the GGA heading value, Heading (VTG), VTG heading value and heading deviation value of all current tests. The deviation value is the difference between the Heading (GGA) and the Heading (Btm), and the value range is $-180^{\circ} \sim 180^{\circ}$. If the difference between the Heading (GGA) and the Heading (Btm) is less than -180° , the difference shall be $+360^{\circ}$ processed. If the difference is greater than 180° , the difference shall be treated at -180° to ensure that the difference range is between $-180^{\circ} \sim 180^{\circ}$.



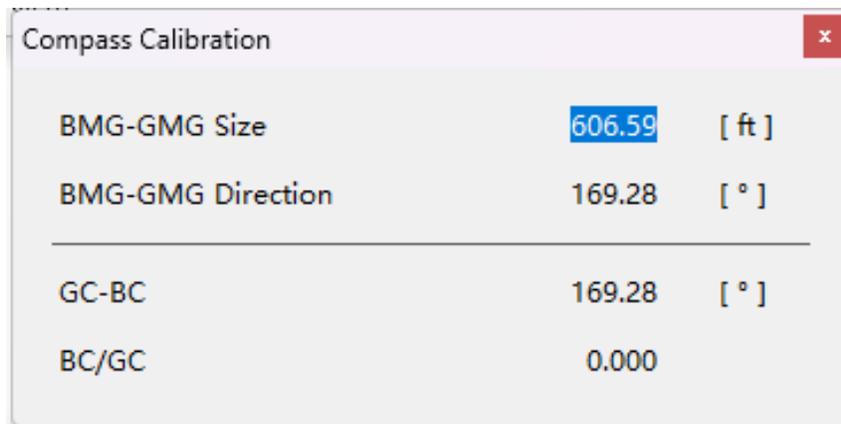
Check	Measure	Heading(Btm)	Heading(GGA)	Heading(VTG)	Deviation
<input checked="" type="checkbox"/>	20-09-02 154930_Right	320.78	351.20	351.05	30.42
<input checked="" type="checkbox"/>	20-09-02 160347_Left	252.45	172.17	172.22	-80.28
<input checked="" type="checkbox"/>	20-09-02 161645_Right	0.00	352.67	352.43	-7.33
<input checked="" type="checkbox"/>	20-09-02 162949_Left	0.00	171.45	171.70	171.45

Mean of course deviation 57
1.607.K

Figure 3-4-16 Compass Calibration Table

3.4.13 Compass Calibration

Click the  icon button in the toolbar to open the real-time heading calibration interface, as shown in Figure 3-4-17. The interface mainly displays the comparison results between the current test status position and the bottom tracking current test position under the reference of other velocities, which is used to display the heading error result value in real-time. The specific meaning of the name can be displayed by moving the mouse to the top of the label name.



BMG-GMG Size	606.59	[ft]
BMG-GMG Direction	169.28	[°]
GC-BC	169.28	[°]
BC/GC	0.000	

Figure 3-4-17 Compass Calibration Display

3.4.14 Parameter Table

The parameter table is arranged on the left side of the main window interface by default. The user can view the basic information, heading information, flow rate information, and navigation information of the current ping set in the parameter table. In addition, acoustic parameters and other information are added. To display, right-click on the parameter table, select "**Configure**" and choose the parameter to be displayed.

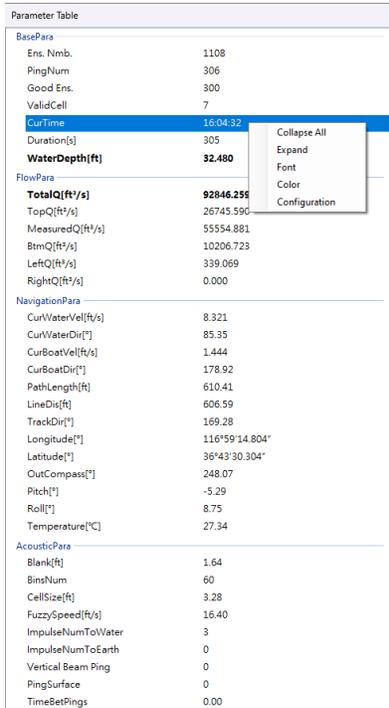


Figure 3-4-18 Parameter Information Interface

In the configuration interface, left-click the options in the left box to select them, and then click the button to add them to the parameter window for display. Left-click the options in the right box to select them, and then click the button to remove the parameter display in the parameter window.

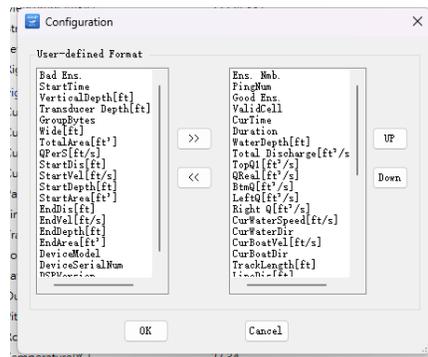


Figure 3-4-19 Parameter configuration interface

3.4.15 Project Information

The Project Information page is arranged on the right side of the main window interface by default. Users can view the basic information and configuration information of each test in the project in the project information.

Click the "**Field Config**" node to view the parameter information set during real-time acquisition. Click the "**Playback Config**" node to modify the data parameters, recalculate the data, and playback the data.

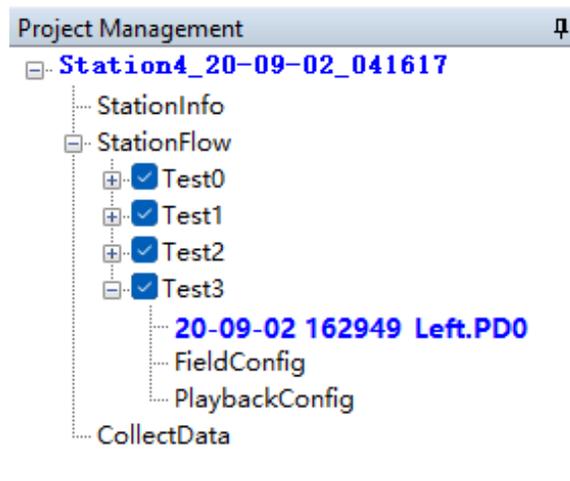


Figure 3-4-20 Project Information Page

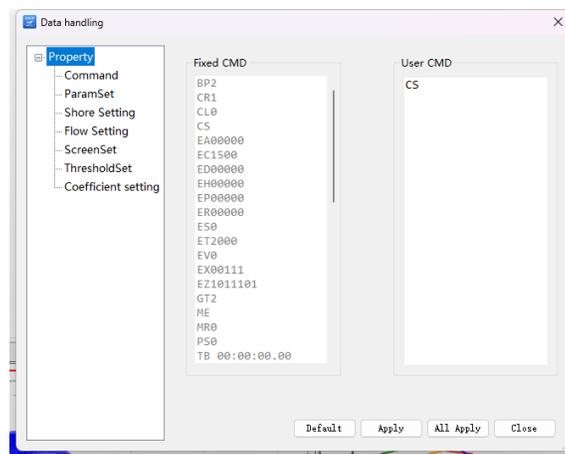


Figure 3-4-21 Playback configuration parameter setting page

Right-click on the test number to bring up the test operation menu, and to delete, average, segment, reset, and save as other files.

3.5 Interface Configuration

3.5.1 Coordinate Settings

The axes of each chart in the software are adjustable. Taking the track map as an example, right-click to pop up a menu to display the list, and click the "**Attribute**" item to open the attribute setting interface. The attribute setting page includes the function of setting the maximum and minimum values of the X axis and Y axis. Click "X-axis scale" to display the maximum and minimum value setting page of the X axis, fill in the preset value, the same as Y axis. Click "**Apply**" to complete the coordinate value setting, or click "**OK**" directly to take effect and close the setting.

Check "**Default**" and click "**OK**" to restore the default setting of the track map.

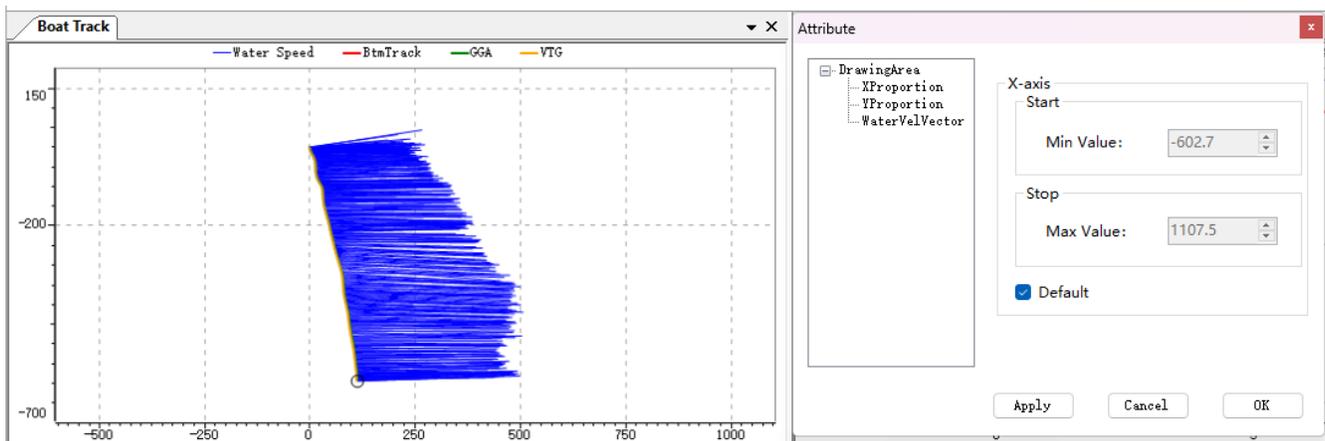


Figure 3-5-1 Coordinate Settings

3.5.2 Velocity Vector

In the Track Map, right-click to pop up the function menu, click "**WaterVelVector**" to select the display and hiding of velocity vector, click "**Attribute**" to open the attribute setting interface, select the "**WaterVelVector**" node, switch to the attribute setting page of the velocity vector, and set the display scale and color of the velocity vector. The default value of line scale is 1. A display scale between 0 and 1 is reduced, and a display scale between 1 and 10 is enlarged.

Click the "**Color**" drop-down box to select the color of vector lines, and click "**Apply**" to make the modified results effective.

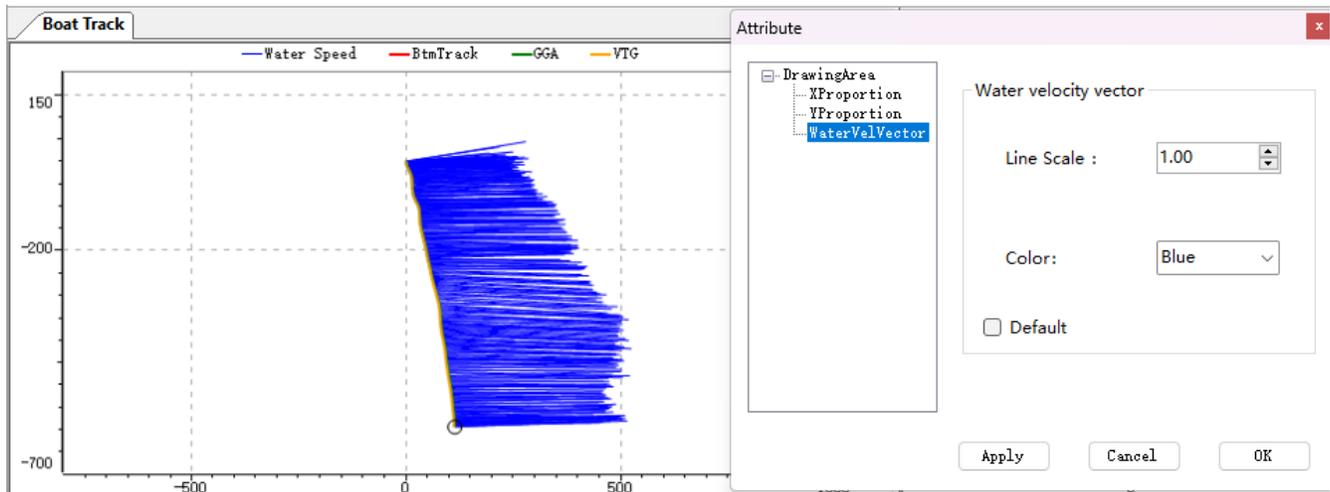


Figure 3-5-2 Velocity Vector Custom Display Settings

Check "**Default**" and click "**OK**" to restore the default coordinate value display.

3.5.3 Parameter Style

On the parameter information interface on the left side of the main page, right-click to display the configuration information menu, which includes: collapse all, expand all, font, color, configuration, and other functions. Folding and expanding can be used to adjust the expansion, display, folding, and hiding of parameter classification names, and font and color are used to highlight parameters of interest to the user.

In the real-time acquisition process, the current water velocity, current water direction, current boat speed, current boat direction, path length, track direction, linear distance, and other parameters in the acoustic parameters and navigation information have been added with the red error warning function, so the user-defined parameter font color will be forced to become invalid.

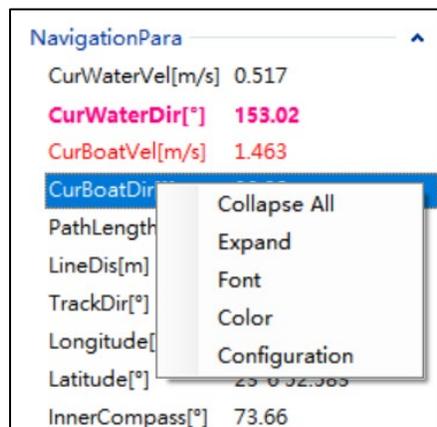


Figure 3-5-3 Navigation parameters Font color custom settings

3.6 Auxiliary Operation

3.6.1 Software shortcut key

Users can quickly call some of the commonly used functions through shortcut keys. The specific operation instructions are shown in the following table:

Table 3 -2 Operating Instructions for Common Shortcut Keys

Shortcut key	Effect	Shortcut key	Effect
F1	Open User Manual	Ctrl+B	Switch the water speed reference to bottom tracking
F5	Start Pinging	Ctrl+G	Switch the water speed reference to GGA
F6	Start Pinging	Ctrl+N	No water speed reference
F10	Open Summary Table	Ctrl+P	Print the currently chart form
Ctrl+V	Switch the flow rate reference to VTG		

3.6.2 Playback Control

On the right side of the toolbar are the playback buttons. Click  the button to place the cursor at the initial position of the first frame, and then click  the play button to play the data frame by frame.

The user can drag the cursor  to adjust the position of the playback, or directly select the current ping data to be viewed in the velocity map.

Click  the icon on the right side of the toolbar to pop up more playback function, as shown in Figure 3-6-1. Set the value of the current ping, click the "Jump" button, and the playback data will switch to the specified location, fill in the playback interval, and then the real-time playback data will automatically play.



Figure 3-6-1 Playback expansion function

Chapter 4

Parameter Configuration

This chapter contains:

- Station Information
- Velocity Set
- Flow Set
- Save Set
- Command

4.1 Station Information

Station configuration includes site information, agency information, and remarks. Station information includes site location information, site environment, measurement time, and other information. Agency information records the detailed information of agencies. Notes indicate the information that is not within the scope of site information and agency information. The initial value of the date is the system date.

The station configuration is the first step of the setup dialog when creating a new measurement. After the configuration is completed, the site information will be loaded into the "**Flow Results Table**". For the document format, refer to the introduction of "[Flow Results Table](#)" in Chapter 5.

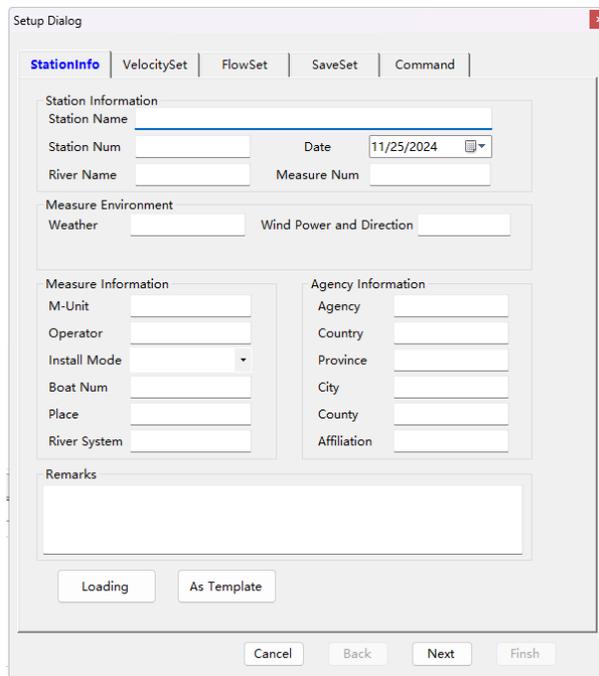


Figure4-1-1 Station Information

4.2 Velocity Set

"**VelocitySet**" can be used to configure flow commands, output parameters and environmental parameters. These configurations will be uniformly distributed to the ADCP after the transmission signal is measured, and these configurations cannot be changed after the ping is started. Among them, the flow commands will control the type of sound signal type, and affect the data accuracy and the number of effective cells. Therefore, it is necessary to reasonably select and configure this parameter.

Flow commands:

- **Blinking dis:** vertical depth when ADCP does not provide valid data due to aftershocks around the transducer. The blinking distance is 0.125m, 0.25m, 0.5m, 1m, 2m and 4m. Generally, the blinking distance is consistent with the thickness of cells.
- **Bin Size:** the smaller the cells, the higher the depth resolution, and the finer the stratification; The thickness of cells is 0.125m, 0.25m, 0.5m, 1m, 2m and 4m.
- **Number of Bins:** the maximum number of measurable cells, and the range is adjustable from 1 to 256; The product of the bins number and bins size plus blinking distance shall be greater than the maximum water depth.
- **Blur speed:** refers to the maximum measurable water speed. The user should set it according to the maximum water speed on-site. Blurring speed can be selected as follows 1m/s, 2m/s, 5m/s, 10m/s and 20m/s.
- **Water Pulse Num:** number of pulses measured to water.
- **Earth Pulse Num:** the pulse number measured on the river bottom.
- **Vertical Beam Ping:** number of beams measured by vertical distance.
- **Surface Pings:** pulse number measured for surface layer water.
- **Time Bet Ping(s):** the interval time between the two pulses.
- **Data Group time(s):** the output time interval of two data groups.

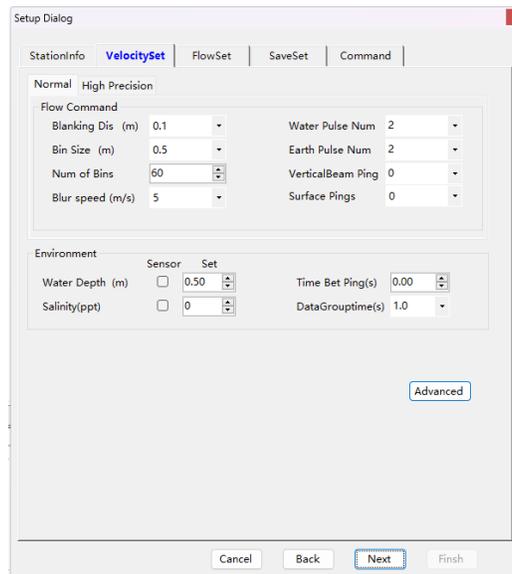


Figure 4-2-1 Basic configuration of Velocity set

Advanced flow configuration:

Click the "**Advanced**" button at the bottom right to filter unreasonable data by setting the flow rate error threshold, false target threshold, and low correlation threshold.

- **ErrorVel.Threshold(m/s):** velocity error reflects the consistency of velocity. When the velocity error is greater than the threshold, the velocity of this layer is considered as bad.
- **False Target Threshold:** The false target threshold is used to reduce the impact of underwater fish. When the difference between the maximum echo and the minimum echo or the second small echo intensity of four beams is greater than the threshold, the small echo beam is considered bad.
- **Low Corr. Threshold:** the correlation reflects the validity and credibility of the data. When the correlation value is less than the threshold, the speed of the beam is considered bad.
- **One Frame Time:** set the time length of one frame data.
- **Intra-frame Count:** set the number of groups of the array in a frame.

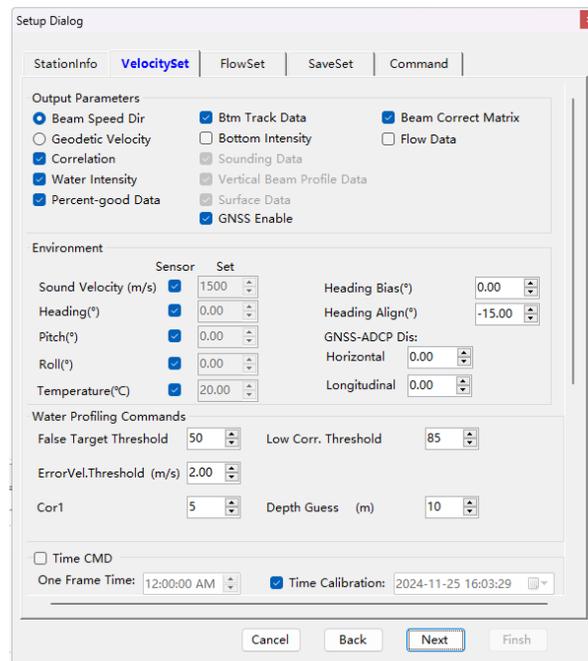


Figure 4-2-2 Advanced configuration of flow test

4.3 Flow Set

- **Velocity Ref:** when converting the water velocity measured by ADCP water tracking to the absolute velocity relative to the earth, the water velocity should be subtracted from the reference velocity. SLHydroFlow provides four options: "Bottom Tracking", "GPS (GGA)", "GPS (VTG)" and "none".
 - Bottom Tracking: select ADCP bottom tracking speed as the boat speed reference (the default option).
 - GNSS (GGA): Select the speed of GPS's GPGGA data as the boat speed. Select this option when there is a good GPS environment.
 - GNSS (VTG): Select the speed of GPVTG data of GPS as the boat speed. Select this option when there is a good GPS environment.
 - No Reference: Set the boat speed to 0, and directly use the water speed as the absolute speed to check the water speed.
- **Heading Offset:** the heading offset represents the deviation angle between the compass and the heading.
- **Top/Btm Dis Method:** means that the top/bottom blind discharges can be estimated using the corresponding estimation methods. Power, 3-pt Slope and constant methods can be used for top discharges, power and no-slip methods can be used for bottom discharges.
- **Power Curve:** When the " Top/Btm Dis Method " selects the power function or NoSlip method, the value set by the power function index is used, and the standard value is 0.1667.

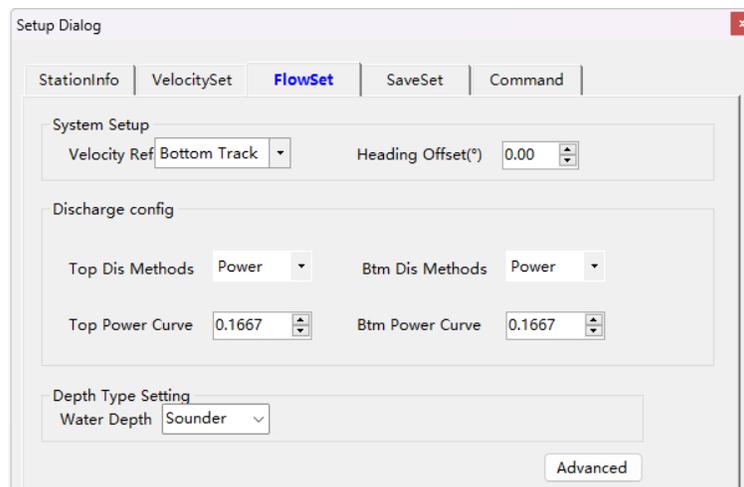


Figure 4-3-1 Basic traffic configuration

Advanced Flow Config:

Flow Config:

- Cut Top/Btm bins: you can choose to delete some additional bins from the top or bottom, which are not used for discharge calculation in the measured area.
- Projection Angle: When "**Cross Sectional Area**" checks "**Perpendicular to Mean Flow**", The input values are used to show the river width and cross-sectional area projected at a user-given angle.
- Cross Sectional Area: Perpendicular to Mean Flow represents the true river width and cross-sectional area; Perpendicular to Proj. Angle calculates the projected river width and cross-sectional area using the angle given by the user; Parallel to Average Course provides the widest river width and area.

Data Screening:

- Data Display: Including three boxes: "**BtmQDepth**", "**RiverQDepth**" and "**MaxQDepth**". The software will mark the data below this boundary as bad, but this item only affects the data display, not the discharge calculation.
- Depth Screening: Including three checkboxes of "**Weighted depth**", "**Screen Depth**" and "**Screen Btm Track**". After the weighted depth is checked, the software will use the weighted average depth of four beams as the water depth; Screen depth is used to filter bad depth data with a large internal difference of four beams, and use previous ping data to judge whether the current depth data is a bad point; After the Screen Btm Track is checked, if the bottom tracking speed is bad, the software thinks that the depth data is also bad.
- Three beams: including the "**Bottom tracking**" and "**Water tracking**" checkboxes. Checking this option means that when one beam in the ping set exceeds the threshold, the remaining three beams are allowed to be used to estimate the speed.

- Estimate Ping: If "Yes" is checked, the velocity profile of the main interface will be estimated with the data of effective Ping and filled in the blank of invalid Ping, if "No" is checked, it will remain unchanged. Note: When there are too many invalid items in the measured data, the software will not be able to estimate the value, so it will not be able to fill in the blank.

Threshold setting:

- Bottom Track Error Vel: when the bottom-track error velocity is greater than this value, the given cell depth is considered bad.
- Bottom Track Up Vel: when upwards velocity is greater than this value, the given cell depth is considered bad.
- Water Track Error Vel: when the error velocity of a cell is greater than this value, the given cell depth is considered bad.
- Water Track Up Vel: when upwards velocity is greater than this value, the given cell depth is considered bad.
- Fish Intensity: The ADCP uses this parameter to screen water-track data for false targets. If the difference between the maximum and minimum echo intensity or the sub-minimum echo intensity is greater than this value, it is considered that the beam value of the small data is bad.

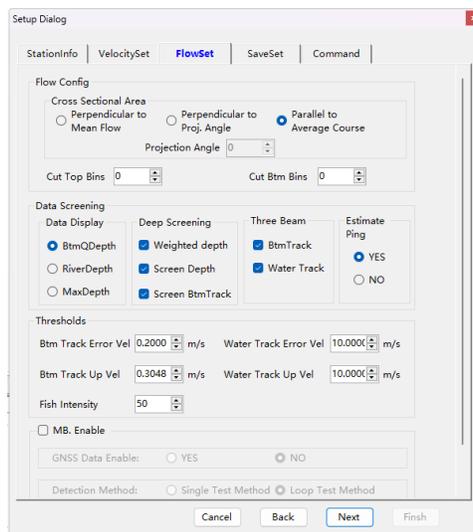


Figure 4-3-2 Advanced traffic configuration

4.4 Save Set

- File name: the project name. When the "**Measure Number**" option is checked, this item will be added in front of the saved project file name.
- File name option: supplement the file name, including Measure number, Order number, Section Number, etc. The file name is in the form of "**file item name_ measure number_ order number_ time date**". Select whether to add the corresponding content to the file name by checking the file name option. You can check whether to use a section number between file names, and the separator can be customized.
- Preview: The preview option can be used to determine whether the saved file name meets the user's requirements.

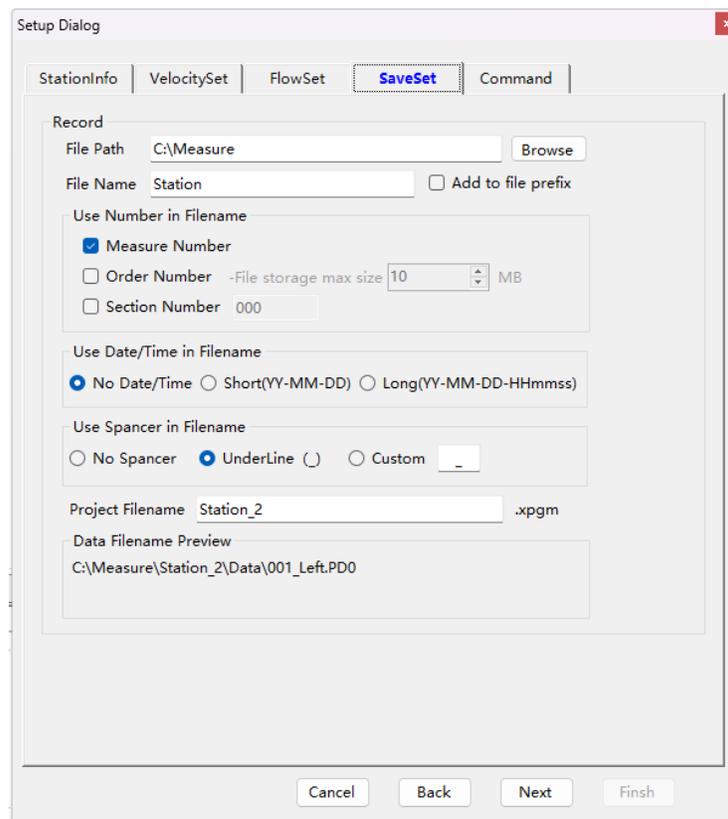


Figure 4-4-1 Save Configuration

4.5 Command

- Default command: It displays a set of default parameter commands saved by the software. When the user does not make any changes, the default parameters will be issued for use.
- User command: Displays the modified configuration parameters compared with the default parameters. User commands can be modified.

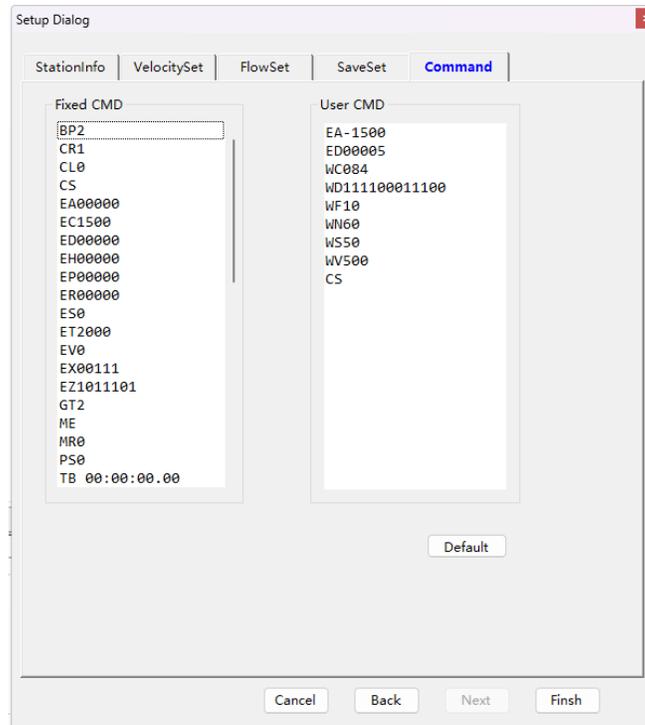


Figure 4-5-1 Command



Notice: It is recommended that you do not modify the user commands here at will. The wrong command format will lead to the failure of parameter setting. If you need to manually configure special commands, please contact the relevant technical personnel, and add them manually after confirmation.

Chapter 5

Data Output

This chapter contains:

- Velocity File
- Discharge Record Forms
- Summary Table
- Results Printing
- Table Output
- Real Time Output

5.1 Velocity File

The velocity file records the ADCP velocity results and saves in "**PD0**" format. It is stored in the file directory where the option settings are saved. The velocity file is saved in binary mode, including velocity data, echo intensity data, correlation data, good data percentage data, and depth data. The table shows the data saving format of PD0 data.

Table 5-1 PD0 Data Format

Fixed Output	HEADER (6byte+ [2×Number of data types])
	Fixed LEADER (59byte)
	Variable LEADER (66byte)
Surface Profile Data	Superficial Velocity Leader (7byte)
	Earth/Beam Speed (2byte+ 8byte×Depth unit layer (5))
	Correlation Of Water Velocity (2byte+ 4byte×Depth unit layer (5))
	Water Echo Intensity (2byte+ 4byte×Depth unit layer (5))
	Water Quality Data Percentage (2byte+ 4byte×Depth unit layer (5))
Profile Data (Cell layer weight and number of layers change dynamically)	Beam Speed (2byte+ 8byte×Depth unit layer)
	Ground Velocity (2byte+ 8byte×Depth unit layer)
	Correlation Of Water Speed (2byte+ 4byte×Depth unit layer)
	Water Echo Intensity (2byte+ 4byte×Depth unit layer)
	Water Quality Data Percentage (2byte+ 4byte×Depth unit layer)
	Sampling Data Of Water Drop (2byte+knbyte)
Bottom Tracking	Bottom Tracking Data(89byte)
	Ground Drop Sampling Data (2byte+knbyte)
Vertical Beam Ranging	Vertical Beam Ranging(9byte)
	Vertical Drop Sampling data (2byte+1020byte)
NMEA Information	NMEA GPS Information(15+nbyte)
Beam Correction Information	Beam Correction (2byte+16×2byte)
Fixed Output	Reserved Bit(2byte)
	Correction Bit(2byte)

5.2 Flow Results Table

SLHydroFlow software provides Excel report output of Discharge Record Table specified in Acoustic Doppler Flow Test Specification. Click **"File"** - **"Flow Result Table"** or directly click  in the toolbar to pop up the result information setting interface. Click **"Input"** to import a level template. Select the water level in a fixed format to input the document. Then, you can automatically set the start water level, end water level, average water level, and corresponding water level according to the start time and end time of the water level in the document.

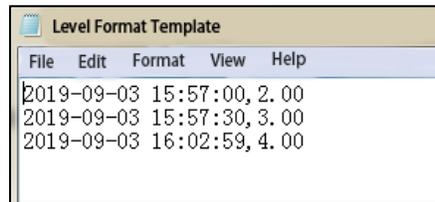


Figure 5-2-1 Water level format

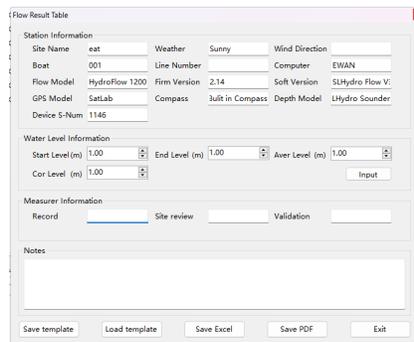


Figure 5-2-2 Fill in the flow result table information

The flow results table supports the export of Excel and PDF formats. At the same time, after the export is successful, the software will automatically open the corresponding file.

Acoustic Doppler Current Profiler Discharge Record Form									
Date:	0903	Year:	2020	Weather:	Sunny	Wind power and direction:			
Measurement Time:	15:02	Survey Boat:	16:00	Computer Name:	EYAN				
Start Time:	15:02	End Time:	16:00	Survey Date:	15:02				
ADCP Model:	HydroFlow 1200 1146	Firmware Version:	2.14	Software Version:	SLHydro Flow V1				
ADCP Model:		Compass Model:		Echo Sounder:					
Data File Path:	G:\Home\work\Compass\meas\data\CPG\meas\meas\090303\			Configuration File Name:	High Lead Content (GMAH):				
Transducer depth:	0.00	Shoaling Distance:	0.50	Depth Bin Size:	1.00	Depth Bin Number:	60		
Salinity:	0	Water tracking ping number:	3	Bottom tracking ping number:	0	Power Curve Coeff:	0.1887		
Measurement Round	Course	Shore Distance (m)	Data File Name	Half round Q (m/s)	Average Q of one whole round (m/s)	Remarks			
1	Right	3.00	20-09-03_154900_Right	4320	2960				
	Left	10.0	20-09-03_160310_Left	2730					
2	Right	8.0	20-09-03_161830_Right	2850					
	Left	8.0	20-09-03_162940_Left	4100					
Measurement Results									
Measurement Item	Measuring Round 1		Measuring Round 2		Measuring Round 3		Average of Round		
	Forward measurement	Back measurement	Forward measurement	Back measurement	Forward measurement	Back measurement	Forward measurement	Back measurement	
Profile Q (m/s)	4320	2730	2960	4100	2960				
Profile Area (m ²)	1010	1000	1020	1000	1010				
Average Velocity (m/s)	2.10	2.10	2.16	2.10	2.10				
Maximum Velocity (m/s)	2.31	2.09	2.46	2.09	2.31				
Average Water Depth (m)	6.8	6.9	6.5	6.7	6.7				
Maximum Water Depth (m)	11.1	11.0	10.7	10.9	11.1				
Water Surface Width (m)	200	211	200	200	200				
Start Water Level:	0.00	End Water Level:	0.00	Average Water Level:	0.00	Corresponding Water Level:	0.00		
Remarks:									
Operation Record:			On Site Review:			Approved:			

Figure 5-2-3 Discharge Record Form

5.3 Summary Table

The software provides a flow summary table. In the real-time mode, after a test is collected, or in the playback mode, you can click "**Summary Table**" under "**View**" or "**Summary Table**" in the shortcut key to view.

In the flow summary table, you can select multiple groups of tests to calculate the average, standard deviation, and average/standard deviation. If the average value/standard deviation value of the total flow of the selected test is greater than 0.05, calculate the selected test times separately, subtract the total flow of each test time from the average value of the total flow, and then make a ratio with the average flow. If the result is still less than 0.05, the data of this test time will be displayed in red. If the average value/standard deviation of the total flow is less than 0.05, the test times will be displayed in black.

MeasureName	Start Bank	End Mb	StartTime	Total Discharge(m ³ /s)	RelativeError[%]	Total Area(m ²)	AverageDischarge(m/s)	Water Speed(m/s)	WaterDirection(°)
20-09-02 154930_Right	Right	825	2020-09-02 15:49:44	4120.028	3.30	1809.356	2.277	2.386	76.47
20-09-02 160347_Left	Left	509	2020-09-02 16:03:01	3777.425	-5.29	1796.430	2.103	2.088	73.79
20-09-02 161645_Right	Right	777	2020-09-02 15:46:22	3954.423	-0.85	1827.547	2.164	2.231	86.52
20-09-02 162949_Left	Left	449	2020-09-02 15:59:27	4101.916	2.84	1801.791	2.277	2.239	86.74
Average				3988.448		1808.79	2.205	2.236	
Standard Deviation				159.035		13.59	0.087	0.121	
Standard Deviation / Average				0.040		0.01	0.039	0.054	

Figure 5-3-1 Summary of test Calculation of Each test

5.4 Results Printing

The software provides the function of printing data results. During playback or collection, users can first click to select the chart, then open the "**File**" menu, select "**Print Preview**", print the selected chart form information, and select the size of the print file by selecting "**Page Setup**". Currently, direct printing of non-chart form interfaces is not supported. If misuse occurs, a pop-up window will alert you that "Printing of ** forms is not supported at this time".

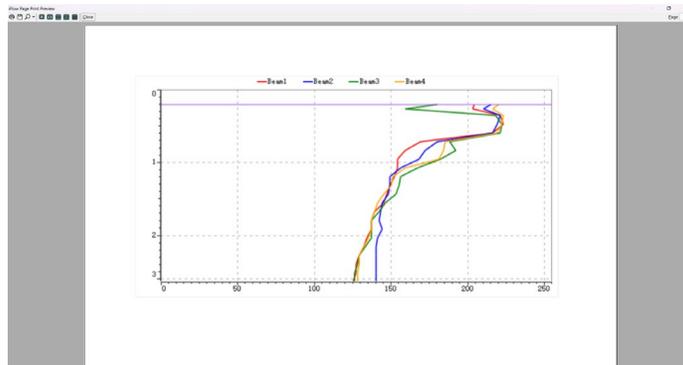


Figure 5-4-1 Print preview of software interface chart

In addition, click "File" and select "Flow Record Table" to print the flow test record information of the project.

5.5 Table Export

The software provides the table data export function. During playback or acquisition, the user can select to open the corresponding data table. Right-click the mouse to pop up the export menu. After selecting the column to export, click "Export to Excel" to pop up the path selection dialog box. Select the location to save. Click OK to save to the Excel file. After the export is completed, there will be a reminder of "Export succeeded", as shown in Figure 5-5-1.

Time	Time	Duration	WaterDepth	ValidCellNum	CurWaterVel	CurWaterDir	MeanWaterVel	MeanWaterDir	CurWaterVel	CurWaterDir	MeanWaterVel	MeanWaterDir	TotalLength	LineID
1	11:27:32	0	16.85	13	0.267	325.91	0.267	325.91	0.241	72.62	0.241	72.62	0.60	0.00
2	11:27:33	1	16.84	13	0.314	319.40	0.290	322.39	0.215	65.22	0.215	65.22	0.21	0.21
3	11:27:34	2	16.92	13	0.306	303.89	0.292	316.03	0.177	49.57	0.196	68.15	0.39	0.39
4	11:27:35	3	17.08	13	0.245	325.89	0.280	315.96	0.249	68.89	0.214	62.30	0.64	0.63
5	11:27:36	4	17.25	13	0.202	323.76	0.294	317.16	0.400	79.73	0.260	69.13	1.05	1.03
6	11:27:37	5	17.50	13	0.188	319.96	0.293	317.51	0.402	95.35	0.306	14.27	1.53	1.50
7	11:27:38	6	17.59	13	0.243	329.05	0.290	317.72	0.404	86.34	0.301	77.06	1.99	1.95
8	11:27:39	7	17.60	14	0.256	310.29	0.245	316.05	0.490	95.27	0.356	78.73	2.48	2.44
9	11:27:40	8	17.75	14	0.270	300.99	0.249	316.09	0.491	86.83	0.372	89.42	2.97	2.93
10	11:27:41	9	17.92	14	0.296	300	0.249	316.83	0.432	76.79	0.378	89.21	3.45	3.38
11	11:27:42	10	18.06	14	0.297	312	0.249	316.35	0.349	77.08	0.376	79.82	3.78	3.71
12	11:27:43	11	18.37	14	0.186	321	0.249	316.69	0.300	79.00	0.376	79.83	4.15	4.10
13	11:27:44	12	18.57	14	0.191	315	0.249	316.66	0.444	83.93	0.383	89.23	4.49	4.45
14	11:27:45	13	18.78	14	0.136	328	0.249	317.07	0.541	85.76	0.395	89.30	5.14	5.09
15	11:27:46	14	18.89	14	0.136	340	0.249	317.87	0.490	86.41	0.414	81.67	5.79	5.73
16	11:27:47	15	18.93	15	0.148	330	0.249	318.49	0.476	89.33	0.408	85.99	6.57	6.50
17	11:27:48	16	19.27	15	0.136	304	0.249	317.10	0.873	93.74	0.445	83.90	7.44	7.36
18	11:27:49	17	19.84	15	0.289	300	0.249	315.05	0.996	93.91	0.496	85.09	8.43	8.34
19	11:27:50	18	20.16	15	0.283	293	0.249	314.17	1.957	95.39	0.527	86.24	9.49	9.39
20	11:27:51	19	20.61	16	0.284	296	0.249	312.95	1.321	97.74	0.509	87.46	10.43	10.40
21	11:27:52	20	21.18	16	0.334	292	0.249	311.29	1.917	99.42	0.504	89.06	11.89	11.84
22	11:27:53	21	21.58	16	0.304	305	0.249	310.66	1.303	91.45	0.499	89.33	12.79	12.84
23	11:27:54	22	22.00	17	0.224	306	0.249	310.59	1.583	95.08	0.494	89.90	13.96	13.91
24	11:27:55	23	22.30	17	0.352	307.35	0.229	310.34	1.113	92.73	0.465	89.19	15.07	14.95
25	11:27:56	24	22.76	17	0.256	324.27	0.230	311.06	1.192	91.39	0.478	89.35	16.26	16.11
26	11:27:57	25	23.16	18	0.193	307.37	0.230	310.91	1.106	98.36	0.497	89.75	17.47	17.31

Figure 5-5-1 Timeline data export

Time	Time	Duration	WaterDepth	ValidCellNum	CurWaterVel	CurWaterDir	MeanWaterVel	MeanWaterDir	TotalDischarge	Save as Excel
1	11:27:32	0	16.85	13	0.267	325.91	0.267	325.91	0.241	0.241
2	11:27:33	1	16.84	13	0.314	319.40	0.290	322.39	0.215	0.215
3	11:27:34	2	16.92	13	0.306	303.89	0.292	316.03	0.177	0.177
4	11:27:35	3	17.08	13	0.245	325.89	0.280	315.96	0.249	0.249
5	11:27:36	4	17.25	13	0.202	323.76	0.294	317.16	0.400	0.400
6	11:27:37	5	17.50	13	0.188	319.96	0.293	317.51	0.402	0.402
7	11:27:38	6	17.59	13	0.243	329.05	0.290	317.72	0.404	0.404
8	11:27:39	7	17.60	14	0.256	310.29	0.245	316.05	0.490	0.490
9	11:27:40	8	17.75	14	0.270	300.99	0.249	316.09	0.491	0.491
10	11:27:41	9	17.92	14	0.296	300	0.249	316.83	0.432	0.432
11	11:27:42	10	18.06	14	0.207	312.83	0.249	316.33	0.249	0.249
12	11:27:43	11	18.37	14	0.186	321.71	0.243	316.69	0.398	0.398
13	11:27:44	12	18.57	14	0.191	315.99	0.232	316.66	0.444	0.444
14	11:27:45	13	18.78	14	0.106	328.44	0.222	317.07	0.541	0.541
15	11:27:46	14	18.89	14	0.106	340.99	0.214	317.87	0.490	0.490
16	11:27:47	15	18.93	15	0.148	330.68	0.209	318.49	0.476	0.476
17	11:27:48	16	19.27	15	0.135	284.10	0.203	317.10	0.873	0.873
18	11:27:49	17	19.84	15	0.259	300.44	0.205	315.05	0.996	0.996
19	11:27:50	18	20.16	15	0.283	293.60	0.209	314.17	1.957	1.957
20	11:27:51	19	20.61	16	0.284	296.63	0.212	312.95	1.321	1.321
21	11:27:52	20	21.18	16	0.334	293.72	0.218	311.29	1.917	1.917
22	11:27:53	21	21.58	16	0.304	305.25	0.222	310.66	1.303	1.303
23	11:27:54	22	22.00	17	0.224	305.56	0.222	310.59	1.583	1.583
24	11:27:55	23	22.30	17	0.352	307.35	0.229	310.34	1.113	1.113
25	11:27:56	24	22.76	17	0.256	324.27	0.230	311.06	1.192	1.192

Figure 5-5-2 Data exported to Excel

5.6 Real-Time Output

The software provides the real-time forwarding function of flow rate data. During the acquisition process, the user can open the data forwarding setting interface and forward the layered flow rate data to other devices or platforms through the serial port. For the specific setting method, please refer to the relevant content in Chapter 3 "Config" of this document. The data forwarded by the serial port mainly includes two types, namely, layered flow rate data PD7, PD8, and GPS data GGA, VTG.

The specific format of PD7 data of stratified flow rate data is shown in Figure 5-6-1. Compared with PD7 data, PD8 data cancels the last two lines of bottom tracking data. The data format is described as follows:

Line 1: Year/Month/Day Hour: Minute: Second Equipment Serial Number Layer One Distance Unit Layer Thickness Unit Layer Number;

Line 2: Hdg (current compass value) Pitch (current pitch value) Roll (current roll value)

Line 3: Temp (current temperature), SoS (current sound velocity), Bit (identifier, not used)

Line 4: Bin (unit layer serial number), Dir (current unit layer velocity direction), Mag (current unit layer velocity size), E/W (current unit layer east velocity), N/S (current unit layer north velocity), Vert (current unit layer vertical velocity), Err (current unit layer error velocity), Echo1~Echo4 (current unit layer echo intensity 1~echo intensity 4) of each unit layer

Line (5+unit layers): boat speed, boat direction, northeast vertical error speed, four beam echo intensity corresponding to Bot (bottom tracking)

Line (6+unit layers): the four data after the Bot Range are the four beam depths of the current device, not the east/north/vertical/error velocity

In the data, the unit of temperature is Celsius (), the unit of distance is meter (m), and the unit of velocity is meter/second (m/s)

1	2020/09/04 11:05:39 1146 1.25 1.00 10										
2	Hdg: 269.22 Pitch: -0.39 Roll: -0.39										
3	Temp: 31.2 SoS: 1512 Bit: 00										
4	Bin	Dir	Mag	E/W	N/S	Vert	Err	Echo1	Echo2	Echo3	Echo4
5	1	304.97	0.386	0.221	-0.316	0.099	-0.058	178	170	191	178
6	2	296.10	0.439	0.193	-0.394	0.046	-0.085	175	174	180	187
7	3	304.39	0.319	0.180	-0.263	0.000	-0.192	168	174	177	205
8	4	313.40	0.178	0.122	-0.129	0.061	-0.071	171	172	176	175
9	5	212.90	0.300	-0.252	-0.163	0.063	-32768	191	174	174	167
10	6	234.97	0.462	-0.265	-0.378	0.095	-0.078	170	177	215	172
11	7	312.47	0.176	0.119	-0.130	0.059	-0.038	178	170	177	181
12	8	304.94	0.368	0.211	-0.302	0.048	-0.054	170	169	171	193
13	9	293.35	0.454	0.180	-0.417	0.026	-0.066	169	171	172	186
14	10	284.69	0.572	0.145	-0.553	-0.053	-0.013	172	186	173	194
15	11	-32768	-32768	-0.093	-0.258	0.040	-0.007	222	184	178	210
16	12	-32768	-32768	0.128	0.337	0.128	-0.157	206	203	231	228
17	13	-32768	-32768	-32768	-32768	-32768	-32768	141	238	198	158
18	14	-32768	-32768	0.187	-0.135	0.188	0.061	125	173	132	136
19	15	-32768	-32768	-32768	-32768	-32768	-32768	120	133	121	129
20	16	-32768	-32768	-32768	-32768	-32768	-32768	119	125	121	126
21	17	-32768	-32768	-32768	-32768	-32768	-32768	124	121	122	127
22	18	-32768	-32768	-32768	-32768	-32768	-32768	125	120	125	128
23	19	-32768	-32768	-32768	-32768	-32768	-32768	124	122	126	129
24	20	-32768	-32768	-32768	-32768	-32768	-32768	122	122	125	129
25	Bot	298.02	0.477	0.224	-0.421	0.000	0.003	193	185	182	197
26	Bot Range			11.59	13.33	12.68	11.82				

Figure 5-6-1 Example of PD7 Data Output Format

The GPS data adopts the NMEA 0183 universal data format, which mainly forwards the GPS data accessed by the software one by one. The specific data content is shown in Figure 5-6-2, and the specific message format is described as follows:

\$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,M,<10>,M,<11>,<12>*xx<CR><LF>

- \$GPGGA: description of starting guide character and statement format (this sentence is GPS positioning data);
- <1> UTC in hhmmss.sss format;
- <2>Latitude, in the format of ddmm.mmmm (the first digit is zero and will also be transmitted);
- <3>Latitude hemisphere, N or S (northern latitude or southern latitude)
- <4>Longitude, in the format of dddmm.mmmm (the first zero will also be transmitted);
- <5>Longitude hemisphere, E or W (east longitude or west longitude);
- <6>GPS status, 0 initialization, 1 single point positioning, 2 difference, 3 invalid PPS, 4 fixed solution, 5 floating point solution, 6 estimations, 7 manual input of fixed value, 8 simulation mode, 9 WAAS difference
- <7>Number of satellites used, from 00 to 12 (the first zero will also be transmitted)
- <8>HDOP - horizontal precision factor, 0.5 to 99.9. It is generally believed that the smaller the HDOP, the better the quality;
- <9>Altitude: - 9999.9 to 9999.9 meters;
- M refers to the unit meter;
- <10>Abnormal difference of geoid height, - 9999.9 to 9999.9 meters;
- M refers to the unit meter;
- <11>Differential GPS data period (RTCM SC-104), and finally set the number of seconds transmitted by RTCM. If it is not differential positioning, it is blank;
- <12>Differential reference base station label, from 0000 to 1023 (the first 0 will also be transmitted);
- Statement end flag;
- xx XOR check of all ASCII codes from \$ to *;

- <CR>carriage return, end mark;
- <LF>newline character, end mark;
- \$GPVTG,<1>,T,<2>,M,<3>,N,<4>,K,<5>*hh<CR><LF>
- <1>Ground heading with true north as the reference datum (000~359 degrees, the front 0 will also be transmitted)
- <2>Ground heading with magnetic north as the reference datum (000~359 degrees, the previous 0 will also be transmitted)
- <3>Ground speed (000.0~999.9 knots, the previous 0 will also be transmitted)
- <4>Ground speed (0000.0~1851.8 km/h, the previous 0 will also be transmitted)
- <5>mode indication (only NMEA0183 version 3.00 output, A=autonomous positioning, D=differential, E=estimation, N=invalid data)
- <CR>carriage return, end mark;
- <LF>newline character, end mark;

```

1 $GPGGA,082059.424,8346.3140,N,17928.9920,W,1,08,1.5,1.7,M,56.4,M,,*4F
2 $GPVTG,148.3,T,287.4,M,146.5,N,079.1,K,A*2D
3 $GPGGA,082100.440,1305.5620,N,03808.4300,W,1,11,1.5,-3.3,M,37.4,M,,*6E
4 $GPVTG,291.9,T,211.8,M,052.2,N,028.2,K,A*27
5 $GPGGA,082101.452,8516.9440,N,07313.0620,W,1,13,0.7,-3.3,M,87.6,M,,*67
6 $GPVTG,089.8,T,237.7,M,098.7,N,053.3,K,A*28
7 $GPGGA,082102.466,2309.4320,S,01508.9280,E,1,01,0.0,8.9,M,2.1,M,,*7D
8 $GPVTG,023.3,T,100.5,M,088.9,N,048.0,K,A*20
9 $GPGGA,082103.480,3417.9160,S,10008.8920,E,1,03,0.1,-7.3,M,75.4,M,,*6D
10 $GPVTG,191.8,T,170.3,M,090.4,N,048.8,K,A*2E
11 $GPGGA,082104.494,1005.2440,N,14752.4880,W,1,15,2.7,6.8,M,0.3,M,,*73
12 $GPVTG,199.8,T,168.6,M,081.1,N,043.8,K,A*24
13 $GPGGA,082105.508,7752.0620,N,08226.7900,W,1,09,0.7,-3.7,M,19.2,M,,*63
14 $GPVTG,217.9,T,328.9,M,081.3,N,043.9,K,A*2A
15 $GPGGA,082106.522,3147.7420,S,03048.4500,W,1,13,2.3,9.7,M,92.5,M,,*56
16 $GPVTG,131.2,T,291.0,M,174.1,N,094.0,K,A*26

```

Figure 5-6-2 Example of GPS data output content



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