Hydro-Tech

Hydro-Tech MS400U
Multibeam Echo Sounder

User Manual

Beijing Hydro-Tech Marine Technology Co., Ltd.

Jul. 2024

Copyright

This manual including the products and software mentioned in it belong to copyright 2022 of Beijing Hydro-Tech Marine Technology Co., Ltd. Without the written permission of Hydro-Tech, the manual and its relevant parts shall not be copied or reprinted in any pattern.

Customer Supports

Welcome to contact us at any time. We would feedback in time and provide good service to you. Below is the contact information.

Beijing Hydro-Tech Marine Technology Co., Ltd.

Building 5, No. 33 Jingsheng South 2nd Street,

Tongzhou Dist., Beijing, China

Postcode: 101102

Tel: 010-5727 5310

Fax: 010-6787 0776

Website: www.hydro-techmarine.com

Table of Contents

1. Introduction

1.1. Product Introduction

MS400U is a compact multi-beam echosounder specially designed for the integration of small USV or other unmanned platforms. It has built-in surface sound velocity sensor and IMU & GNSS module similar to Applanix SurfMaster. It has excellent performance, such as small size, light weight and low power consumption.

Its functions are perfect for any hydrographic surveying requirements and other underwater exploration application.

MS400U Multi-beam echo sounder includes of two parts: Transducer working in underwater and Deck Unit (Or someone prefer to called it as Sonar Interface Module). The system block diagram of MS400U is shown in Figure 1.1.

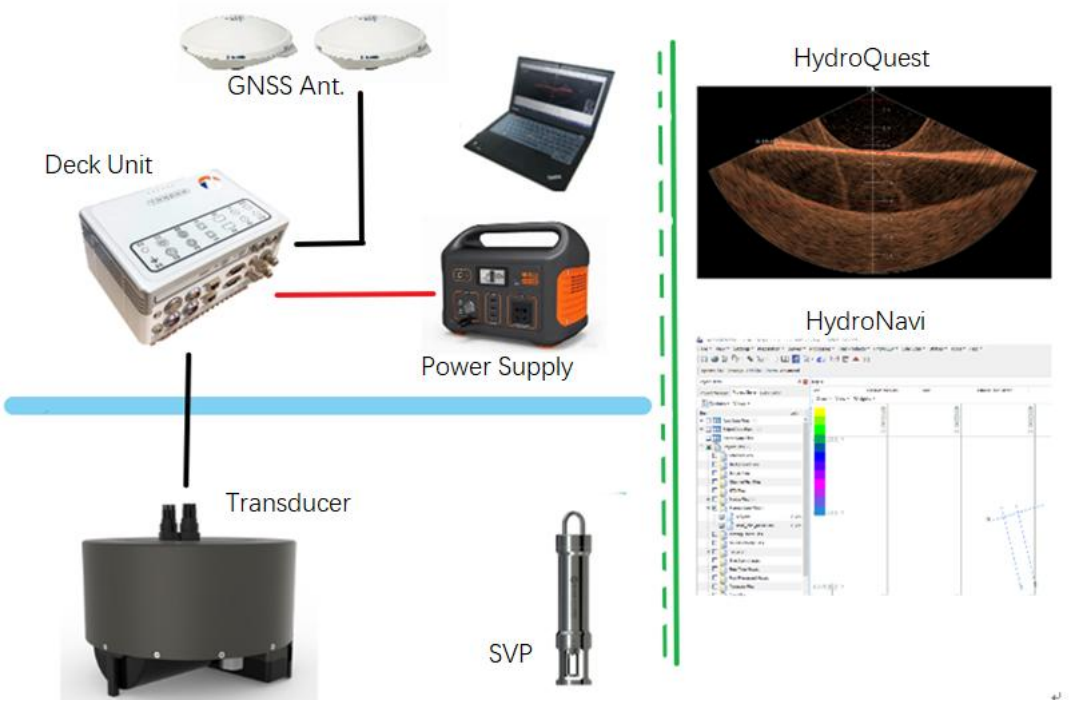


Figure 1.1 System Diagram

It works together with system software, including display and control software named “HydroQuest” and navigation & data acquisition software named “HydroNavi”.

1.2. How to Use This Manual

This manual introduces main technical specification, system framework, functions, installation, operation and safety precautions of MS400U multi beam echo sounder system. It is recommended that users had better read this manual carefully before installing or operating the equipment to avoid unnecessary injury to equipment and personnel.

(1) For the users who use MS400U for the first time, please read this manual Part 3. Safety to prevent any damage to equipment or injury to personnel during wrong operation;

(2) For the users who use MS400U for the first time, please refer to Part 6. System Installation and Configuration instructions. Furthermore, Appendix 1 and Appendix 2 show the product mechanical drawings and related installation mount & other components.

(3) If you have known or used MS400U multibeam echo sounder before, you can directly read the manual of Hydro-Quest to learn how to display and control MS400U.

2. System Specifications

2.1. System Specifications

Working Frequency	400kHz
Depth Resolution	0.75cm
No. of Beams	512
Beamforming	Equiangular or Equidistance
Across Track Beam Width	1°
Along Track Beam Width	2°
Max. Ping Rate	60kHz
Signal Type	CW or Chirp
Swath Sector	140°
Pulse Width	30us ~ 18ms (CW Signal)
Sounding Range	0.2~150m
Max. Working Depth	50m
Working Field Mode	Yes
Roll & Pitch Stabilization	Yes
Water Column	Yes
Positioning Accuracy	±1cm+1ppm (RTK)
Heading accuracy	0.06° (4m baseline)
Attitude accuracy	0.03° (Real-time) / 0.025° (Post-processing)
Heave accuracy	5cm or 5% Range / 2cm or 2% Range (Trueheave)

2.2. Physical Specifications

Transducer Size	φ220mm×181mm
Transducer Weight	~7.5kg
Sonar Interface Module Size	200mm × 145mm × 91mm
Sonar Interface Module Weight	~2.5Kg
Working Temperature	-2° ~ 40℃
Storage Temperature	-20℃ ~ 55℃

2.3. Electrical Specifications

Power Supply	DC10V-32V AC110V-240V
Power Consumption	70 - 90W
Data Interface Port	Gigabit Ethernet
Synchronization Output	5V TTL
Auxiliary Device Port	RS232
Deck Cable Length	3m or Customnized

2.4. ompatiable Software

- HydroQuest: Display and Control Software;
- HydroNavi: Navigation and Data Collection Software;
- Compatible with Hypack & BeamworX data collection software and Hypack, BeamworX & QPS post processing software.

2.5. Auxiliary Measuring Devices

- Sound Velocity Sensor: Standard built-in SVS1500
- Sound Velocity Profiler: Optional SVP1500
- INS: Standard internal and optional for external
- GNSS: Standard internal and optional for external

3. Safety

In order to ensures the personal and equipment safety during MS400U operation, please read the following details before operation.

3.1. Equipment Safety

(1) During transportation, please pack the transport box properly and avoid any possible damage of vibration;

(2) Check whether the transportingcarton is damaged before unpacking

(3) Check whether each part of the system is damaged before installation;

(4) Main unit or transducer and other accessories shall not be dropped down;

(5) Please make sure the power supply working at stable voltage. If survey vessel, we suggest to connect to Uninterruptible Power Supply (UPS). If on USV, please connect to independent battery, separate with boat engine. Or there may be sudden voltage change that will affect the multibeam working status;

(6) It is forbidden to plug or unplug any connecting cable during equipment working operation;

(7) All plug-in or unplug cables of sonar interface module shall not be exposed to rain or water;

(8) The sonar interface module shall not be exposed to rain or water to prevent any damage to internal electrical components;

(9) When underwater transducer is not put into water, the whole sounding system shall not be powered on for testing or any other operation;

(10) It is forbidden to place the underwater transducer directly downward to the ground without protection, especially it is forbidden to scratch the surface of transducer part with hard or sharp objects;

(11) All cables of the system shall not be folded, pressed, squeezed, pulled, cut or other operations that may cause physical injury;

(12) Not exceed the operating and storage temperature limits;

3.2. Maintenance

When using or storing acoustic transducers, please adapt the following steps to protect it for better maintenance:

(1) Cleaning: clean with mild and clean fresh water, and soft brush the outside if needed.

(2) Wash the underwater transducer with fresh water after operation each time;

(3) It is forbidden to use any antifouling paint to coat the acoustic

transducer;

(4) It is forbidden to expose the surface of the transducer under the sun to prevent any damage to the transducer;

4. Transducer Operation

The appearance of MS400U transducer is shown in Figure 4.1

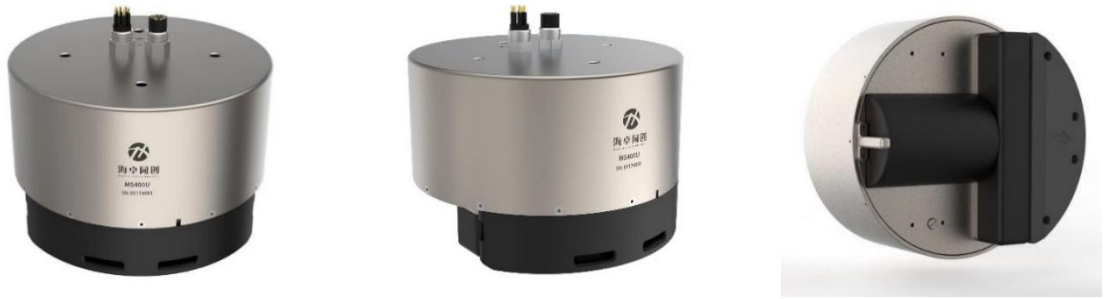


Figure 4.1 MS400U Transducer Round Version

The direction indicated by the arrow is the forward direction of sounding measurement. When installing the transducer, pay attention to its direction.

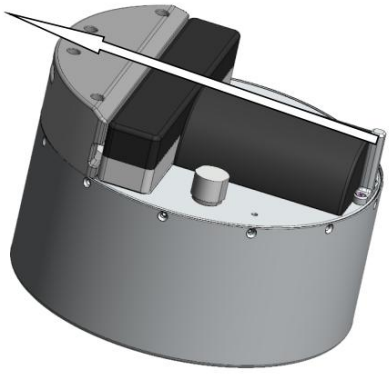


Figure 4.2 MS400U Transducer

The watertight cable is drawn from the center hole and passes through the connecting flange. Design the adapter flange and installation according to the actual situation of the surveying ship and the mechanical drawing of the acoustic transducer (See Appendix 1). Connect with the bracket to fix the acoustic transducer on the measuring boat or mounting pole.

5. Sonar Interface Module Operation

5.1. Sonar Interface Module Introduction

The Sonar Interface Module (Or we call it as Deck Unit) of MS400U is the data processing center of the multibeam echo sounding system, which mainly includes transducer interface to auxiliary device, display & control software, survey & data acquisition software and main control computer.

The appearance of sonar interface module is shown in Figure 5.1. See Appendix 2 for its mechanical drawing.

Figure 5.1 Sonar Interface Module (Deck Unit)

The main functions of the sonar interface module include the following aspects:

(1) The main control computer software sends commands to the auxiliary devices' information acquisition part and acoustic transducer through Ethernet interface;

(2) The sounding results and status of the acoustic transducer are transmitted to the data display and control computer through the Ethernet too;

(3) Auxiliary devices' information acquisition module establishes a local time system according to the time information provided by GNSS, and sends other auxiliary devices' information to the computer and acoustic transducer.

5.2. Sonar Interface Module Connecters and Indicators

5.2.1. Front Panel

The front panel of MS400U multibeam echo sounder consists of multiple indicator lights, as shown in the Figure 5.2 below.

The three indicators on the left represent PPS signal, synchronization signal and working status of the sound velocity sensor respectively. The three indicators on the right represent the GNSS differential signal, the attitude measurement equipment and the GNSS working status respectively.

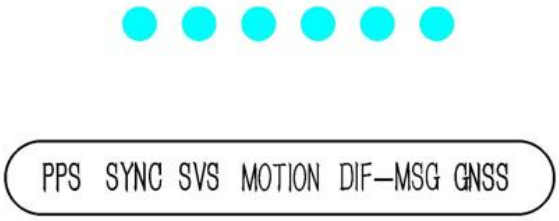


Figure 5.2 Sonar Interface Module Front Panel

Below is the indicator status introduction.

Indicator	Normal Status	Abnormal Status
PPS	Blinks every 1s	Off or abnormal blinking rate
SYNC	Blinks at the rate of PING rate	Off or abnormal blinking rate
SVS	Blinks at the rate of sound velocity output rate, default is 8Hz	Off
MOTION	Blinks at the rate of attitude output rate, default is 100Hz	Off
DIF-MSG	Blinks at the rate of GNSS differential signal, default is 1Hz	Off
GNSS	Blinks at the rate of GNSS output rate, default is 1Hz	Off

5.2.2. Back Panel

The back panel of the sonar interface module is mainly composed of power module, Ethernet connector, auxiliary device connectors, PPS connector, synchronization connector, GNSS antenna connectors, sound velocity sensor and sonar transducer watertight cable connector, as shown in Figure 5.3 and 5.4

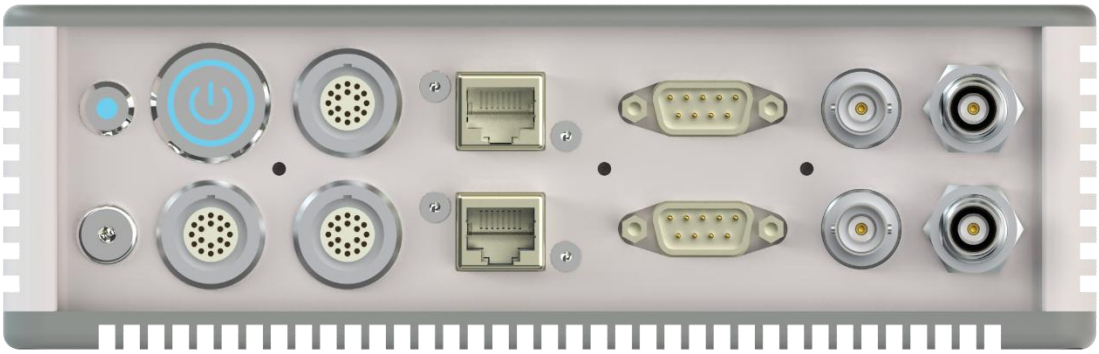


Figure 5.3 Sonar Interface Module Back Panel

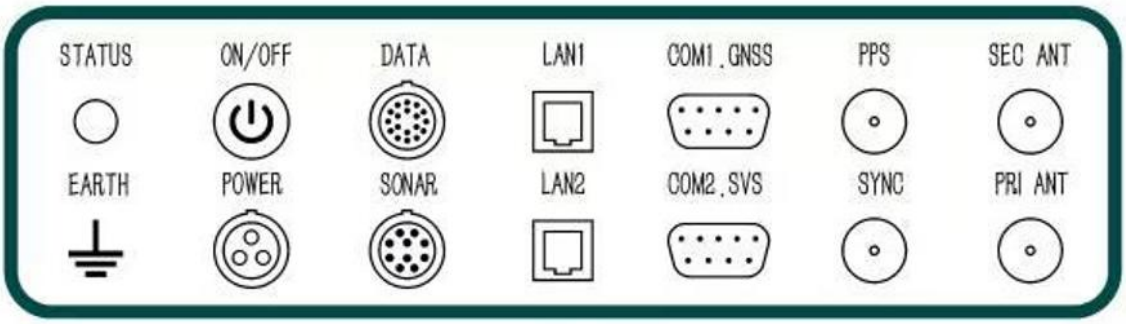


Figure 5.4 Sonar Interface Module Back Panel

The exact usage of each connector is listed as below.

Indication & Connectors	**Function**
Status	Indicator of the device status
Earth	Connect the device with earth
On/Off	Power switch of the device
Power	Connect with DC or AC power supply
Data	Data input / output connector
Sonar	Connect with transducer
LAN1	Ethernet port to connect with display and control or navigation PC
LAN2	Ethernet port to connect with display and control or navigation PC
GNSS COM1	Connect with external GNSS Receiver
SVS COM2	Connect with sound velocity sensor SVS1500 for power supply and input sound velocity data
PPS	PPS signal input or output
SYNC	Synchronization signal input or output
SEC ANT	Connect with the front GNSS antenna for heading
PRI ANT	Connect with the primary GNSS antenna for position

Below is the introduction of the status indicators and data extending ports.

Indicator and Connectors	**Status and Function Introduction**
Status	Red: Sonar Interface Module is not connected or mis-connected.
	Yellow: The device is in preparation.
	Green: The device is normal and ready to start up operation.
COM1 (GNSS COM)	External GNSS input, 9600 ~ 115200bps auto adaptive
COM2 (SVS COM)	Sound Velocity Sensor data input, 9600 ~ 115200bps auto adaptive
COM3 (Extended data cable connecting out)	External RS232 data input, 9600 ~ 115200bps auto adaptive
COM4 (Extended data cable connecting out)	External RS232 data input, 9600 ~ 115200bps auto adaptive
COM5 (Extended data cable connecting out)	Default is position output, including NMEA GPGGA sentence and time GPZDA output, which corresponds to the COM2 interface of the built-in SurfMaster (AP+ Version).
COM6 (Extended data cable connecting out)	Default is the attitude and motion PASHR output, which corresponds to the COM3 interface of the built-in SurfMaster (AP+ Version).

6. System Installation and Configuration

MS400U multibeam echo sounder consists of underwater acoustic transducer and sonar interface module. Below we will introduce the composition of the whole system and explain the system installation involving underwater parts and above-water units respectively.

The components of MS400U system are put into two layers in the carrying case. Figure 6.1 shows the top 1st layer and Figure 6.2 shows the second layer storing units and accessories.

Figure 6.1 MS400U Multibeam Echo Sounder Carrying Case 1st Layer

Figure 6.2 MS400U Multibeam Echo Sounder Carrying Case 2nd Layer

6.1. Underwater Transducer Installation

Underwater parts include acoustic transducer with build-in sound velocity sensor, transducer cable, SVS cable, which have been assembled in factory. Users do not need to fix by themselves. The underwater parts look like Figure 6.3.

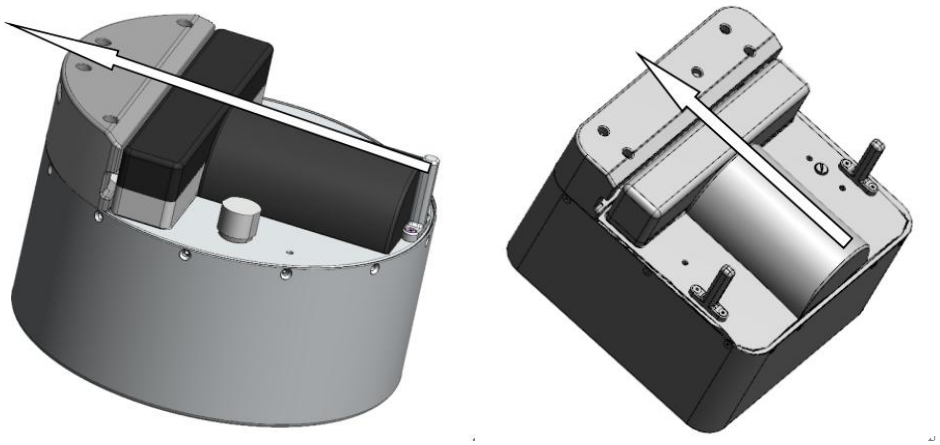


Figure 6.3 Underwater Transducer Unit

The direction pointed by the arrow in Figure 6.3 is the forward direction of survey vessel sailing. Pay attention to the installation direction of the transduction during installation. The watertight cable is led out from the middle of back side and passes through the connecting flange.

Please design the adapter flange and Install the bracket to fix the transducer according to the actual situation of the survey vessel and the mechanical drawing of the transducer (Appendix 1),

6.1.1. Underwater Transducer Installation

The installation of sonar transducer is matched with external support of USV. The specific installation methods are as follows:

(1) The sonar transducer is fixedly connected with customized adapter flange;
(2) Pass connecting cables through adapter flange and make necessary anti cutting protection;
(3) Fix adapter flange on USV bottom to avoid shaking of transducer and sonar interface module during sounding measurement;

6.1.2. Underwater Installation Precautions

(1) When selecting installation position of sonar head, the safety of equipment shall be considered. Avoid possible collision of sonar transducer to obstacles in water,

such as wharf wall and shoal;

(2) When choosing installing location of the acoustic transducer, consider the influence of surrounding objects on the measurement. Make sure away from propeller, water outlet and select right installation depth to avoid vessel bottom shielding.

(3) During the installation process, correspondingly protect the surface of the transducer to prevent scratching by hard objects;

(4) It is not suitable for sounding operations in areas where the water is not deep enough to prevent damage to the transducer;

(5) It is not suitable for sounding operations when there are too many objects, such as twigs, fishing nets, in water to prevent damage to transducer;

(6) The underwater transducer installation shall ensure solid, avoid vibration, shaking, shock or deformation;

(7) For other precautions, please refer to the Part 3. Safety in this manual;

6.2. Sonar Interface Module Installation

Sonar Interface Module need connect with underwater transducer, display & control computer and other accessories if there are.

6.2.1. Sonar Interface Module Introduction

(1) Sonar Interface Module:

Its connectors are shown as Figure 6.4. For details, please refer to the Part 5. Sonar Interface Module Operation in this manual.

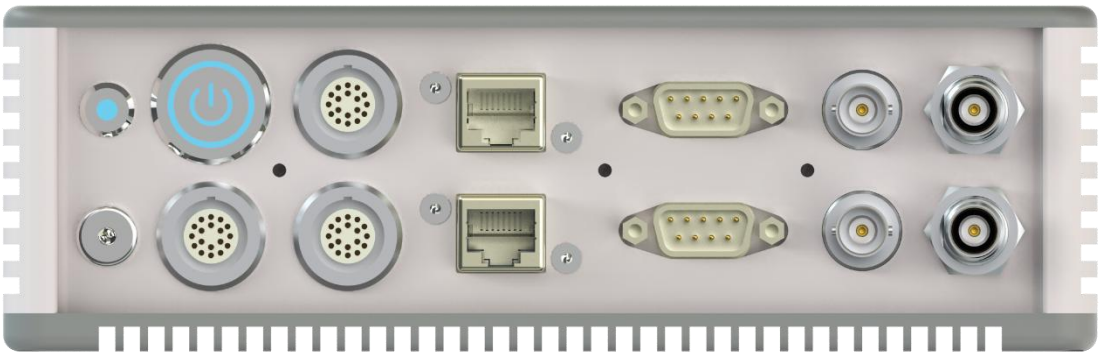


Figure 6.4 Sonar Interface Module Back Panel

(2) GNSS antenna:

Two GNSS antennas are used for attitude and heading measurement, they are as shown in Figure 6.5.

Figure 6.5 GNSS Positioning & Heading Antenna

GNSS antenna need install on magnetic mounting pole as shown in Figure 6.6.

Figure 6.6 GNSS Antenna and Magnetic Mounting Pole

(3) Display and Control Computer (Not included in MS400U):

It is used to collect the data of sounding result and control echo sounder working modes. On USV, it will usually use an industry computer as shown in Figure 6.7.

Figure 6.7 Display & Control Computer (Not Included in MS400U Package)

In some project, user will just select a laptop for this function.

Figure 6.8 Laptop for Display & Control (Not Included in MS400U Package)

(4) GNSS Antenna cable:

It is used to connect GNSS antenna and Sonar Interface Module as shown in Figure 6.9.

Figure 6.9 GNSS Antenna Cable

(5) Power Cable:

It is used to connect sonar interface module with DC power supply as shown in the Figure 6.10.

Figure 6.10 24V DC Power Cable

User can select to connect to AC power supply via AC power adapter too. Its picture is as shown in the Figure 6.11.

Figure 6.11 AC Power Adapter

(6) Type 7 Dual Shielding Ethernet Cable:

Used to connect Sonar Interface Module with display & control PC, which is same as show in Figure 6.12.

Figure 6.12 Type 7 Dual Shielding Ethernet Cable

(7) Sonar Wet Cable:

Used to connect Sonar transducer, sound velocity sensor & internal IMU with deck unit, which is same as show in Figure 6.13. Standard is 3m.

Figure 6.13 Sonar Wet Cables

(8) Grounding Wire:

Used to ground the multibeam echo sounder system which is same as show in Figure 6.14.

Figure 6.14 Grounding Wire

6.2.1. Sonar Interface Module Installation

(1) Fix sonar interface module in a suitable area in the USV to prevent slipping during operation;

(2) Connect the watertight cables of underwater transducer and sound velocity sensor to the corresponding connectors of sonar interface module through the reserved waterproof hole of the USV;

(3) Insert the power supply of USV to power connector of sonar interface module;

(4) Connect sonar interface module with the control computer in the USV by Ethernet cable;

(5) Use the remote control software to connect the control computer in the USV, and run the corresponding software for measurement.

Notice: For the corresponding connector information, please refer to Part 5.2.2 Back Panel.

7. HydroQuest Software Setting

Run the display and control software of HydroQuest. Switch to "Port Settings" in the “Device Settings” and select "Automatic" for the configuration. The default configuration is shown in Figure 7.1.

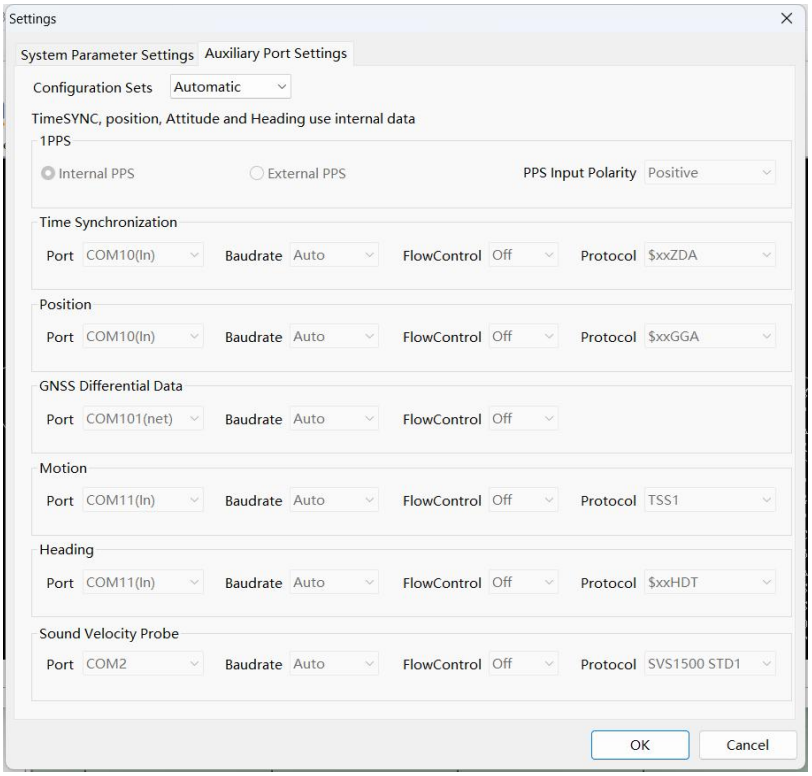


Figure 7.1 HydroQuest Port Setting

It is recommended to use our factory default setting. While we also list the corresponding relationship between the MS400U multibeam Sonar Interface Module (Or called deck unit) and the built-in SurfMaster (AP+ version) port as shown in the following Table.

HydroQuest Port		AP+ Port	Explanation
COM10	To	COM2	Position: GPGGA Time: GPZDA
COM11	To	COM3	PASHR
COM101	To	COM1	Reserve for RTCM input (RTK)

At the same time, the data port of the multi-beam deck unit can be connected to an extension line to output position, time and attitude information to other devices. Below is the picture for the extension cable.

Figure 7.2 Extension COM Cable

Below is the introduction to each port:

Extension Cable		AP+ Port	Explanation
COM5	To	COM2	Position: GPGGA Time: GPZDA
COM6	To	COM3	PASHR

8. INS Setting

8.1. Reference Axis Relationship

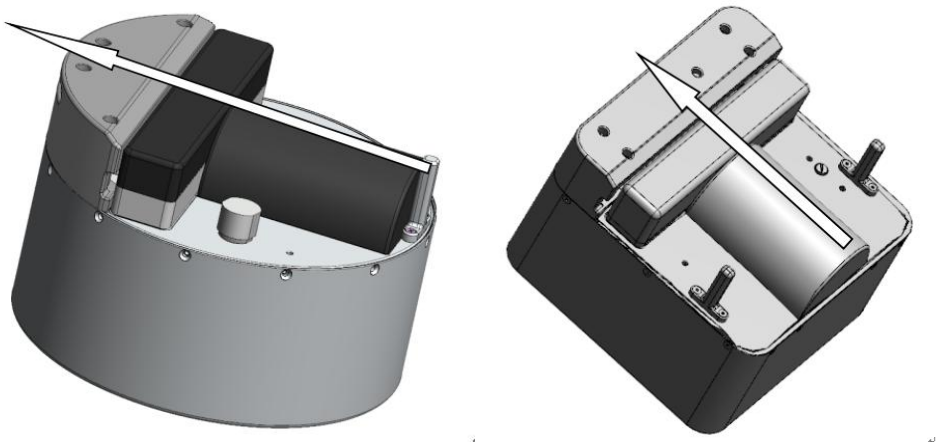


Figure 8.1 Extension COM Cable

The direction pointed by the arrow shown above in Figure 8.1 is the forward direction of survey vessel sailing. Pay attention to the installation direction of the transduction during operation.

Below is the axis relationship:

Bow forward direction is X+ (Positive)

Starboard direction is Y+ (Positive)

Bottom direction is Z+ (Positive)

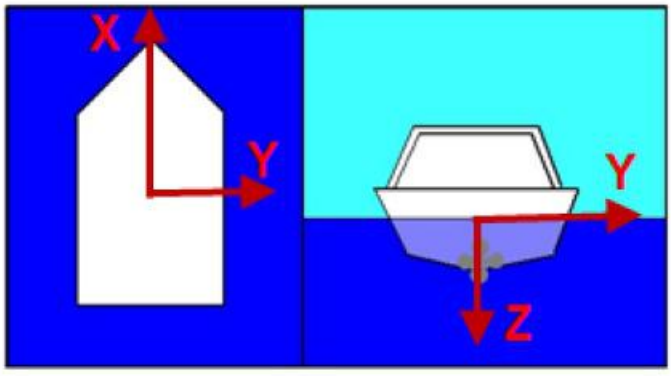


Figure 8.2 Reference Axis Relationship

8.2. Reference to IMU Lever Arm

Click the menu "Receiver Configuration" and select "INS Remote" – “IMU Remote”. Enter the position relationship between the reference point to the IMU Target point in the "IMU Remote". The reference point is the origin of measurement and the axis relationship is consistent with "8.1 Reference Axis Relationship". If the measurement point on the upper shell of the IMU is selected as the reference point, then X, Y, and Z here are fixed values (X=0, Y=0, Z=0.049).

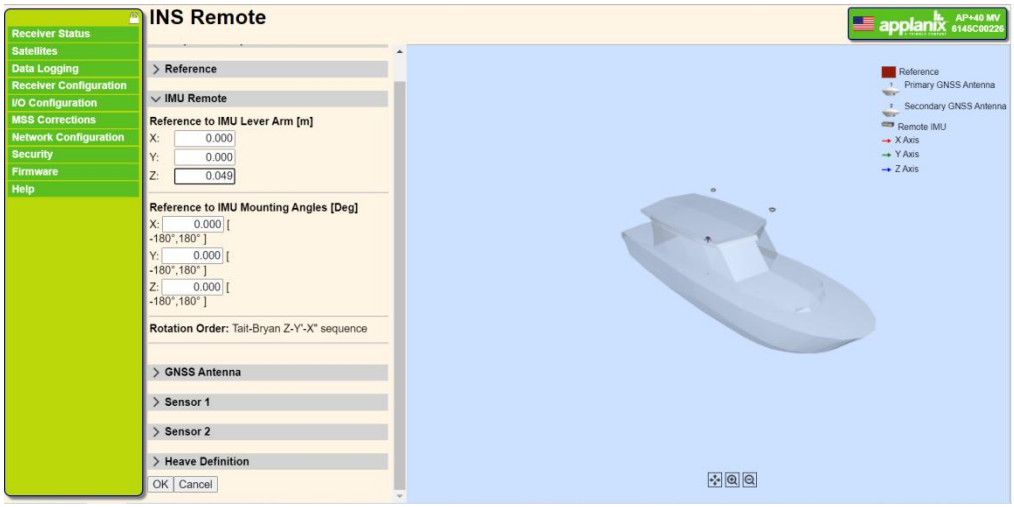


Figure 8.3 Reference to IMU Lever Arm

8.3. Reference to Primary GNSS Lever Arm

Click the menu of "Receiver Configuration" and select "INS Remote" – “GNSS Antenna”. Enter the position relationship between the reference point and the primary antenna in the "GNSS Antenna" area. The reference point is the origin of the measurement and its axis relationship is consistent with Part 8.1 “Reference Axis Relationship”. 1-σ is the position measuring accuracy.

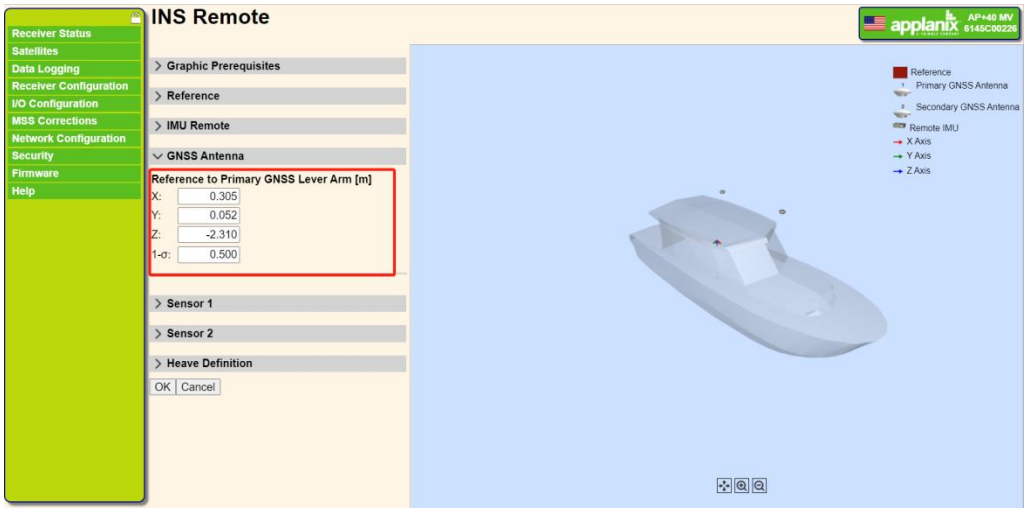


Figure 8.4 IMU Reference to Primary GNSS Lever Arm

8.4. Primary to Secondary GNSS Baseline Vector (GAMS)

Click the menu of “Receiver Configuration” and choose “Navigation Controls”.

1) Choose to use “Remote IMU Enable” and “Remote IMU Nav Solution”, tick the box after “GAMS”, please refer to the red square 1 as shown in Figure 8.5.

2) Input the position relationship from primary antenna to secondary antenna. Regard the primary antenna as origin, measure the X, Y and Z value from secondary antenna to primary antenna. The coordinate system relationship shall be the same as what described in Part 8.1 “Reference Axis Relationship”. 1-σ is the position measuring accuracy.

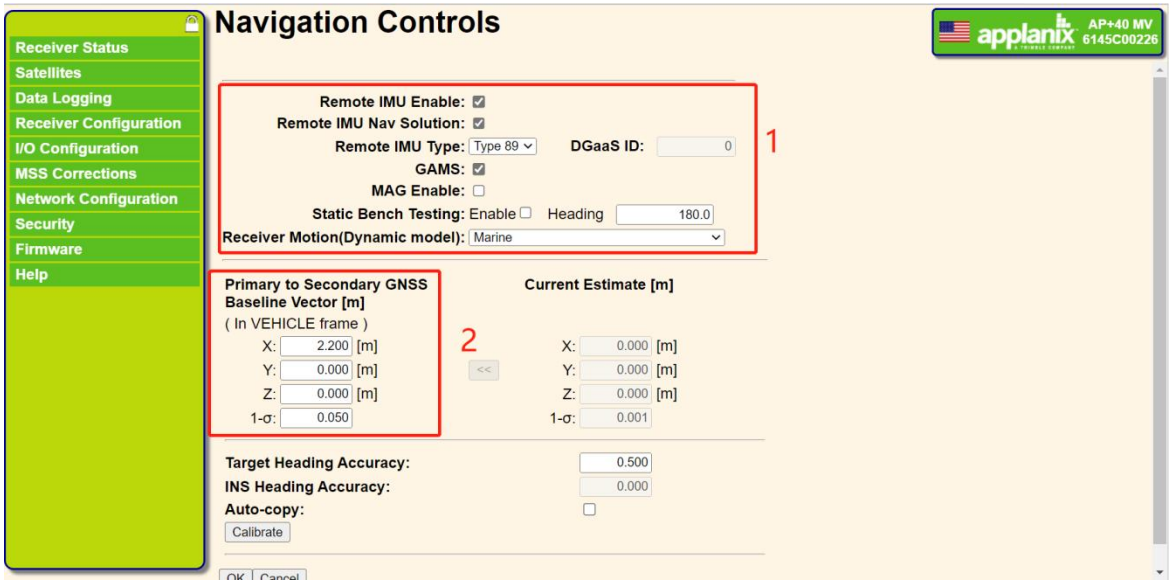


Figure 8.5 Primary to Secondary GNSS Baseline Vector

Remarks: MAG Enable is not available in the AP+ Firmware 8.0.

9. RTK Mode

In HydroQuest software configuration, GNSS differential RTCM IN must select COM101 (network), the user can follow the steps below:

1) Connect the computer to the hotspot of the mobile phone, so that the computer can access the Internet normally. Then open the virtual serial port software.

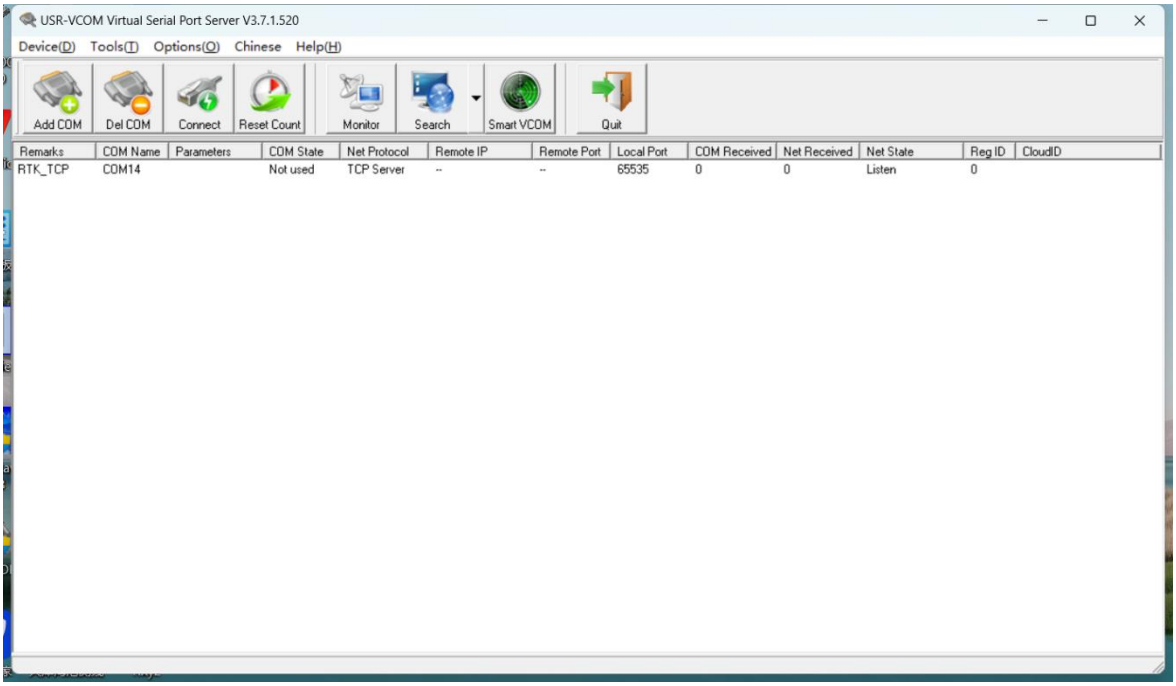


Figure 9.1 Virtual Serial Port

2) Click “Add a Virtual Serial Port” and set it as shown in the figure 9.2, change the network protocol to TCP Server and set the local port to 5003:

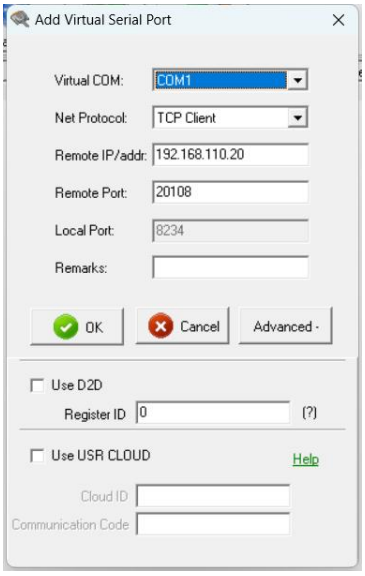


Figure 9.2 Virtual Serial Port Setting

3) Open NTRIP software. Click “Edit” button beside the Serial Port and revise it as the same as what set in Virtual Serial Port software.

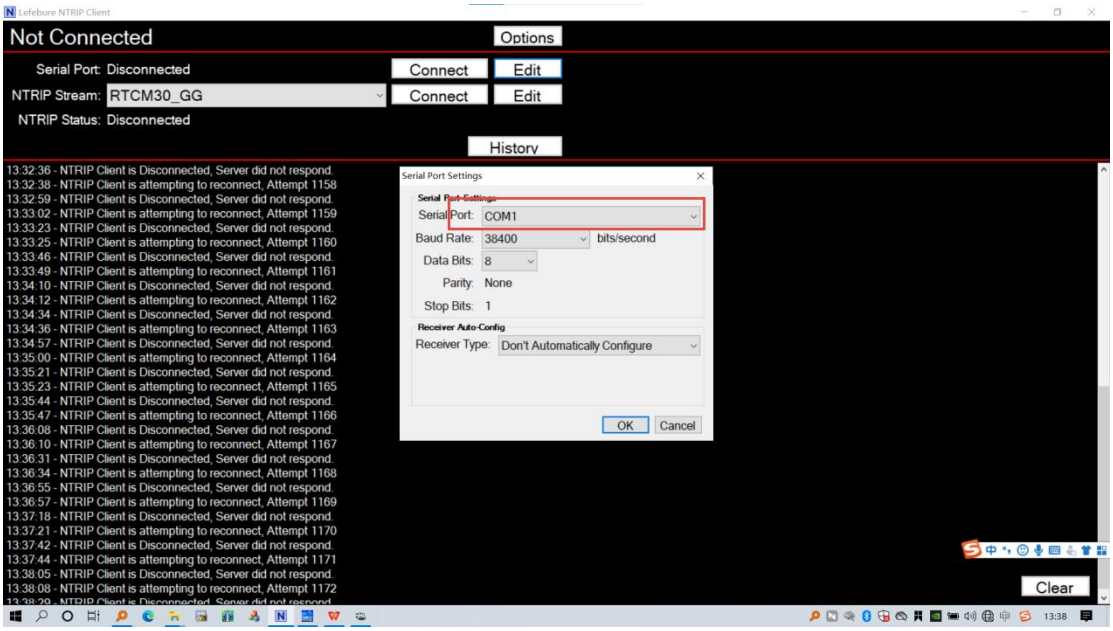


Figure 9.3 NTRIP Port Setting

4) Click “Edit” button beside the NTRIP Stream and input the IP Address, Port, User Name, Password, local Latitude and Longitude.

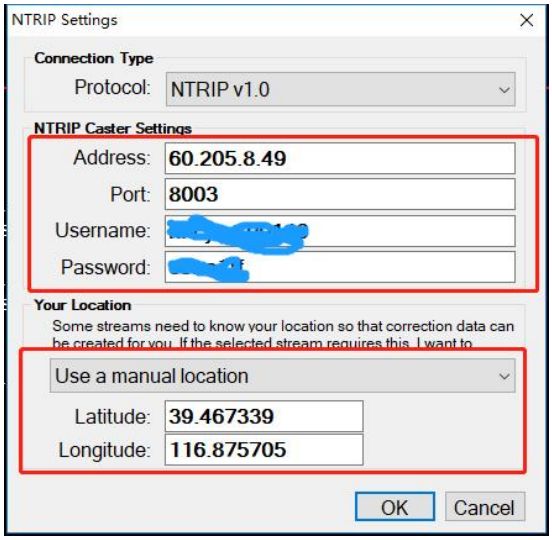


Figure 9.3 NTRIP Setting

5) After these 2 software setting, click “Connect” button in NTRIP software. Then it will return position data.

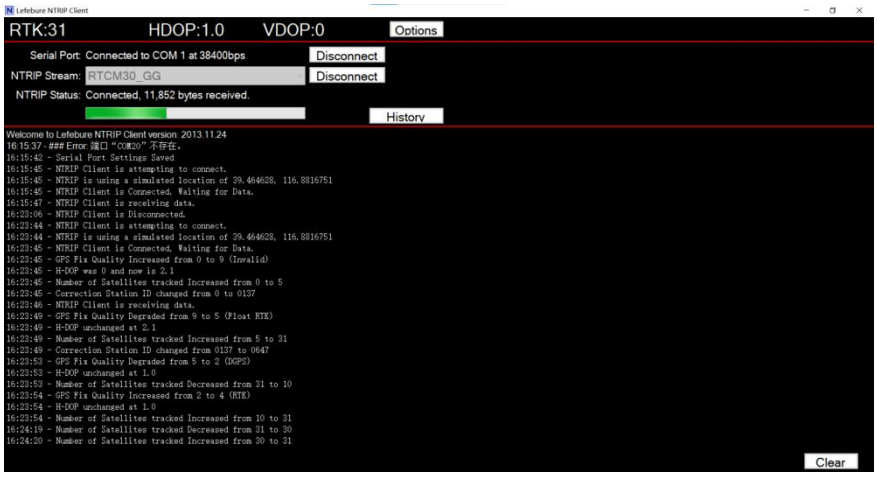
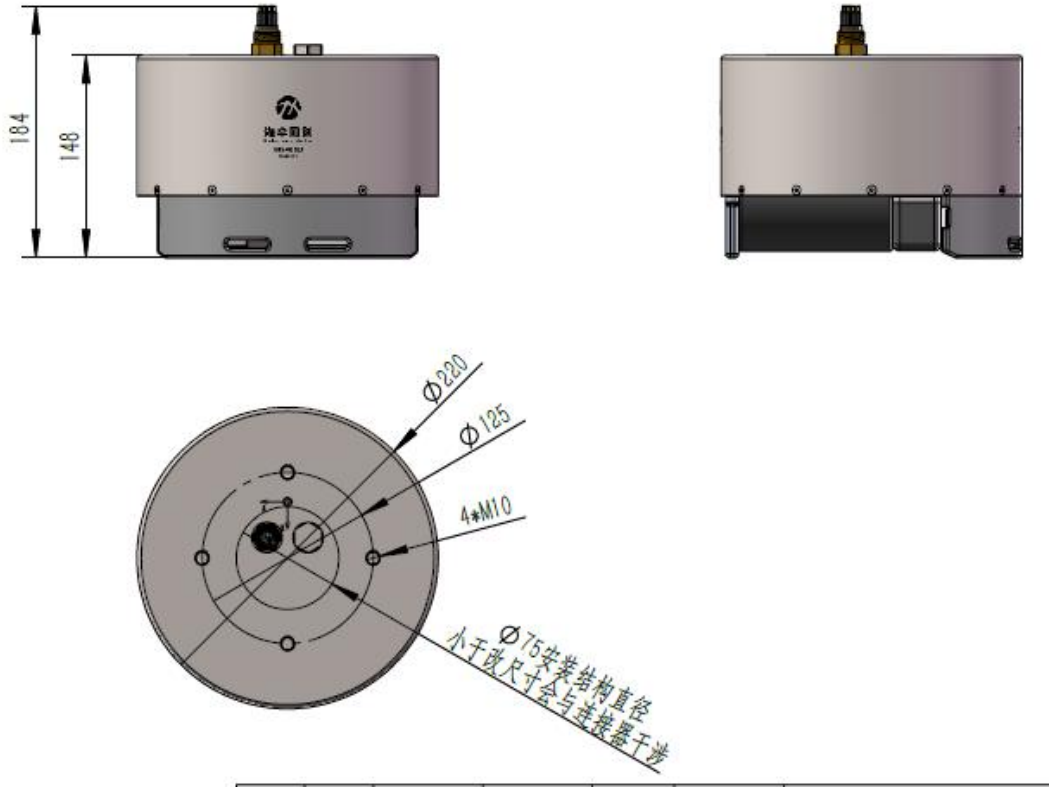
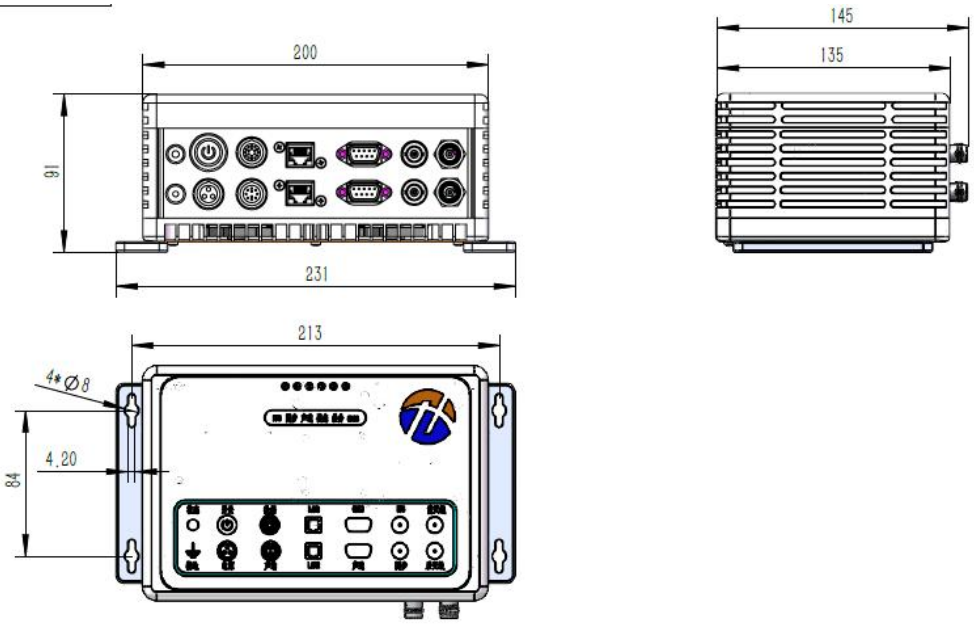


Figure 9.3 NTRIP Position Data

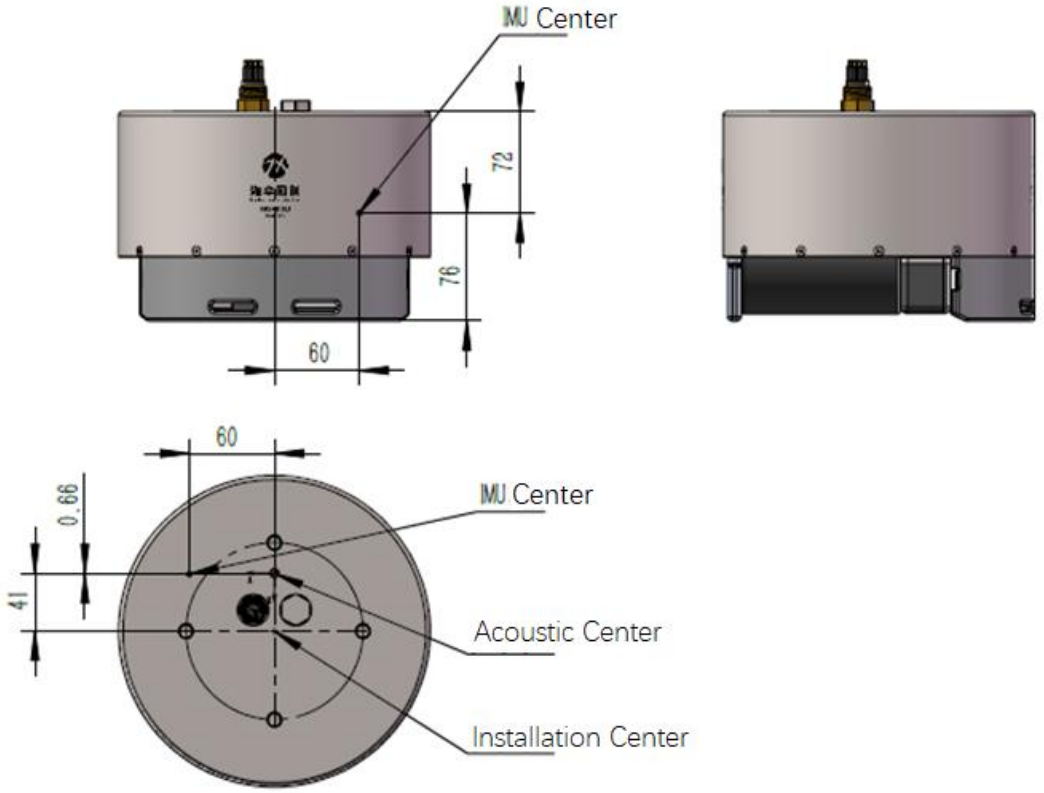
Appendix 1 Underwater Transducer Drawing



Appendix 2 Sonar Interface Module Drawing



Appendix 3 Transducer Center vs IMU Center



Appendix 4 IMU & SVS Wet Cable Definition

A End	Q'ty	Cable Length / Cable Specification	B End	Q'ty
MCIL8M (Connector Tail 20 ± 2cm)	1	3m / 10-core cable	FGG.2B.316 .CLAD82	1
Pin	**Color**	**Waterproof Core Color**	**Pin**	**Signal**
1	Black	Black	1	Ground
		Blue	Empty	
2	White	Red	2	Power
		Brown	Empty	
3	Red	Red White	3	ETH TX-
4	Green	Thin Red	4	ETH TX+
5	Orange	Green White	5	ETH RX-
6	Blue	Thin Green	6	ETH RX+
7	Yellow / Grey	Blue White	7	RS485B
8	Brown	Thin Blue	8	RS485A
		Shielding	9	Shielding GND
			10 (Empty)	

Remarks：

(1) A End need to be vulcanized after welding;

(2) After B End is welded, it is necessary to apply thread glue and be encapsulated for waterproof.

MCIL8M Connector