XT-PBOX-250122001

PBOX Tight Coupling Navigation Receiver

User Manual

Description:

This document applies to the **PBOX** tight coupling navigation receiver.

Version: V1.0 **Date:** 2025.04.19

Copyright ©2013-2025, Archimedes Innovation Technology Co., Ltd. All rights reserved.

No part of this manual may be reproduced or transmitted in any form or by any means without prior written consent of Archimedes Innovation Technology Co., Ltd.

Disclaimer

This manual provides information about products of Archimedes Innovation Technology Co., Ltd. (hereinafter referred to as Archimedes Innovation). The manual does not transfer, by implication, tacit understanding or any other form, any rights or licenses under the patent, copyright, trademark, or other proprietary rights of the company or any third party. In addition to the responsibilities stated in the sales terms and agreements, the company shall not assume any other liability. Meanwhile, Archimedes Innovation does not make any express or implied warranties for the sale and use of its products, including but not limited to the suitability for a specific purpose, marketability, or intellectual property infringement liability for copyright, patent, and other rights, and shall not be liable for problems arising from non-compliance with the manual requirements for connection or operation. The software described in this manual is provided under a license agreement or a confidentiality agreement. The software may only be used or copied in accordance with the terms of the agreement. Reproduction of the software on any medium is illegal unless explicitly permitted by the license or confidentiality agreement. Archimedes Innovation may modify the product specifications and product descriptions as necessary without prior notice.

For any design defects or inappropriate aspects of our products that may exist, they will be improved and cause product version updates, and therefore may differ from the published specifications. If necessary, the latest product specifications can be provided.

REVISIONS

Version	Revision Notes	Revision Date
V1.0	1st Edition	2025.04.19

CONTENTS

REVISIONS 2

1 INTRODUCTION 1

2 MOUNTING 3

2.1 Package List 3

2.1.1 Power Cable 3

2.1.2 GNSS Antenna 4

2.1.3 RF Coaxial Cable 4

2.2 Connection 4

2.3 Installation of GNSS Antennas 4

2.4 Installation of the PBOX 5

2.5 Lever Arm and Rotation Angle to the User Coordinate System 6

2.6 Connection to Communication Devices 6

2.6.1 Serial Port 6

2.6.2 Ethernet 7

2.6.3 CAN/CAN FD 7

2.7 Connection to Synchronized Devices 7

2.8 Connection to the Odometer 7

2.9 Connection to the Power Supply 7

3 CONFIGURATION 8

3.1 Serial Port 8

3.1.1 Change Settings of the Serial Port 9

3.1.2 Communicate with Remote Terminals 9

3.2 Ethernet 10

3.2.1 Set the Static IP Address 10

3.2.2 Set the Dynamic IP Address 10

3.3 CAN/CAN FD 11

3.3.1 Configure the Bus 11

3.3.2 Set the CAN ID 11

3.4 Time Synchronization 12

4 HOW TO USE 13

4.1 Start Communication 13

4.2 Configure Parameters for the First Time 13

4.3 Transmit Differential Data 14

4.3.1 Transmit Differential Data via a Serial Port 14

4.3.2 Transmit Differential Data via Ethernet 14

4.3.3 Check the PBOX Status 15

4.4 Access Wheel Speed Signals **15**
4.5 Output Real-time Information **16**
4.5.1 Initialize the Combined Navigation System 16
4.5.2 Collect Data 16
4.6 Post-process Data **17**
4.7 Upgrade Firmware **17**
5 APPENDIX 1: TECHNICAL PARAMETERS **18**
5.1 Performance Parameters **18**
5.2 Mechanical Parameters and Navigation Center **19**
5.3 Physical and Electrical Parameters **19**
5.4 Connectors **20**
6 APPENDIX 2: COMMON COORDINATE SYSTEMS, ANTENNA LEVER ARM AND ROTATION PARAMETERS **21**
6.1 Common Coordinate Systems in Combined Navigation **21**
6.1.1 PBOX Coordinate System 21
6.1.2 Vehicle Body Coordinate System 22
6.1.3 User-defined Coordinate System 22
6.2 Antenna Lever Arm and Offset Configuration **23**
6.2.1 Lever Arm (GNSS Antenna) 23
6.2.2 Lever Arm (Vehicle Body Coordinate System) 23
6.2.3 PBOX Coordinate System 25
6.2.4 Rotation Angle to the User Coordinate System 26
6.2.5 Heading Offset and Pitch Offset 27

1 INTRODUCTION

Independently developed by A&I, the **PBOX tight coupling navigation receiver** (Hereinafter referred to as **PBOX**) is compact with dimension 150 mm * 123 mm * 310 mm and weight less than 450 g. It supports full constellations and full frequency bands.

Adopting an automotive-grade chip solution and ruggedized interfaces, the **PBOX** is more suitable for operations in harsh environments. With the unique measurements-free/self-calibration algorithm and the multi-strategy positioning algorithm engine, it can still output stable and reliable position and attitude information in challenging environments such as dense foliage obstruction and urban canyons.

The appearance of the **PBOX** is shown in Figure 1- 1:

Figure 1- 1 Appearance and interface

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

It owns the following advantages:

- Automotive-grade design

  The **PBOX** is equipped with an automotive-grade GNSS chip and IMU with ASIL B functional safety level. It uses automotive-grade connectors such as FAKRA, commonly used in vehicle front-end applications, which are safe, reliable and cost-effective.

- Rich peripheral interfaces

  The **PBOX** supports a variety of interfaces, including Ethernet, CAN, RS232, RS422, PPS, etc. It also supports PPS, GPTP, NTP time synchronization, enabling seamless integration with sensors, such as LiDAR, domain controllers, etc., for coordinated operation.

- Redundant backup algorithm engine

  The positioning engine integrates the advantages of various algorithms, such as PVT, RTK, loose-tight coupling navigation, etc., for multi-strategy redundancy backup, and establishes two sets of interference and abnormal signal detection algorithms for GNSS and IMU, which are used to enhance the positioning reliability and accuracy in harsh environments.

- Scene optimization

  Optimized for typical scenarios such as low-speed vehicle applications, ports, mines, etc., it can cope with complex scenarios, such as speed bumps, bumpy roads, viaducts, tunnel entrances and exits, etc., and provide continuous, stable and reliable real-time high-precision position and attitude information for all kinds of vehicle applications, including tracked and wheeled vehicles.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

2 MOUNTING

2.1 Package List

The package list of the **PBOX** is listed in Table 2- 1:

Table 2- 1 Package list

Name	Quantity	Standard /Optional	Description
PBOX	1	Standard	-
Power cable	1	Standard	To connect the **PBOX** to external power supply and communication devices.
GNSS antenna	2	Standard	To receive satellite signals.
RF coaxial cable	2	Standard	To connect the **PBOX** and the GNSS antenna. The end near the **PBOX** is FAKRA.
DC power supply	1	Optional	To output voltage +9V ~ +36V (output power no less than 10W).

2.1.1 Power Cable

The diagram of the power cable is shown in Figure 2- 1:

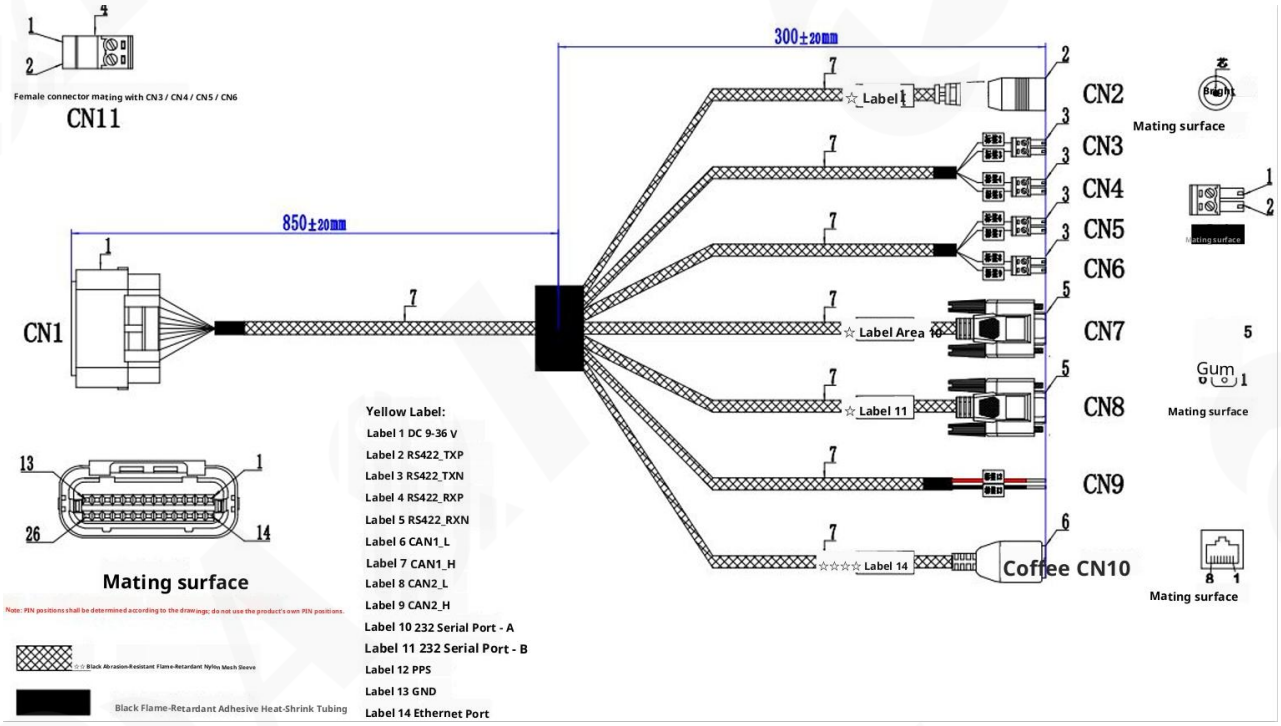

Figure 2- 1 Power cable diagram

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

2.1.2 GNSS Antenna

The **PBOX** shall use an active antenna. The **PBOX** can provide a 5V DC antenna feed and support up to 200mA current.

The following parameters for GNSS antenna are available for reference:

- Frequency band: GPS (L1/L2/L5), GLONASS (G1/G2), BDS (B1/B2) and Galileo (E1/E5a/E5b)
- Gain: 40 dB±5 dB
- Noise factor: less than 1.5
- Feed: +4.5V ~ +5.5V DC
- Phase center deviation: less than ±2 mm

2.1.3 RF Coaxial Cable

The RF coaxial cable shall have a characteristic impedance of 50Ω to ensure proper impedance matching between the GNSS antenna and the **PBOX**.

It is recommended that the cable attenuation is less than 10 dB.

2.2 Connection

The connection is shown in Figure 2- 2:

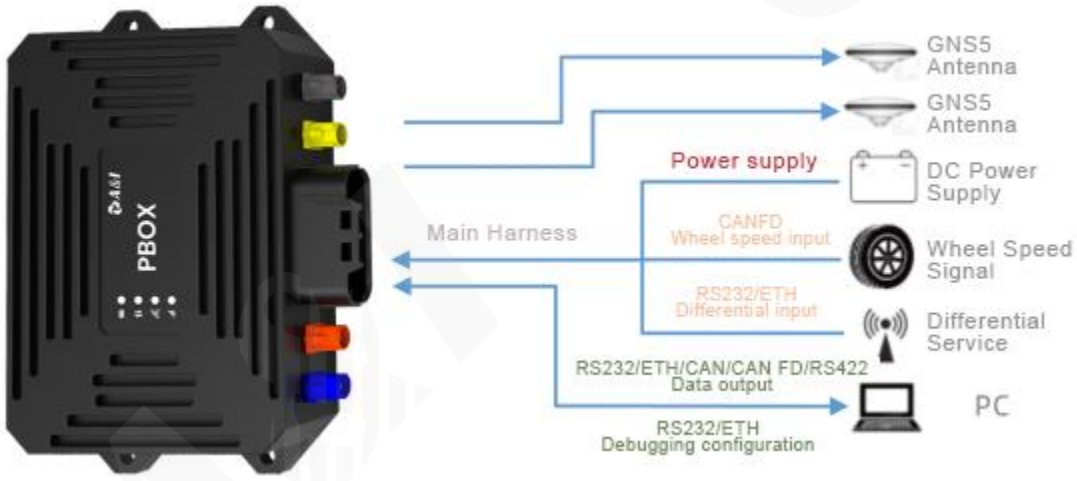

Figure 2- 2 Connection

2.3 Installation of GNSS Antennas

Please pay attention to the following when installing the GNSS antennas:

- Please install the GNSS antennas in an open and unobstructed environment.
- Please horizontally place the GNSS antennas. If they need to be tilted, the angle should not be greater than 15°.
- Please make sure that the GNSS antennas are rigidly attached to the carrier, and make sure that the antennas do not shift or wobble when the carrier is moving.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

2.4 Installation of the PBOX

The **PBOX** shall be firmly and reliably installed, and it shall be rigidly connected to the carrier, as so to make sure that the relative positions of the **PBOX**, the GNSS antenna and the carrier are fixed.

Please pay attention to the following when installing the **PBOX**:

- Please mount the PBOX on a rigid structural surface, which is required to have a flatness of less than 1°.
  Flatness: the pitch and roll angle between the rigid structural surface and the horizontal plane.
- Please make sure that the heating temperature of the interfering units around the **PBOX** is less than 85°C.
- Please make sure that there should not be any vibration interfering units within 50 cm around the **PBOX**, and keep the **PBOX** away from vibration sources such as engine, subwoofer and other positions where strong vibration may exist. The frequency bands that the IMU should avoid are 15.8 kHz - 17.8 kHz, 28 kHz - 35.6 kHz, 44 kHz, 18.3 kHz - 20.3kHz, and 1.9 kHz - 2.1 kHz.
- Please keep the **PBOX** as far away as possible from the location of the complex electromagnetic environment, such as LiDAR, dashboard, etc.

Please use the following recommended installation method to install the **PBOX**:

- Please horizontally mount the **PBOX** with a horizontal angle of less than 5°. The smaller the better.
- The Y-axis of the **PBOX** points toward the forward direction of the carrier, the X-axis is perpendicular to the forward direction of the carrier and points to the right side, and the Z-axis points upward.
- The Y-axis of the **PBOX** is parallel to the longitudinal center axis of the vehicle body and the distance between them is less than 70 cm.
- The PBOX is mounted at or near the center of the carrier's rear wheel axle.

If the orientation of the **PBOX** does not meet the above installation requirements, alternatively, it is possible to adopt a horizontal deflection arrangement, it is suggested that the deflection angle is an integral multiple of 90° (e.g., 90°, 180°, 270°). In this case, additional configuration is required.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

2.5 Lever Arm and Rotation Angle to the User Coordinate System

After the initial installation of the **PBOX**, the default output is the positioning results of the primary GNSS antenna. If output of other designated location is required, for example, the lever arm, it is recommended to use professional surveying and mapping equipment, such as a total station or laser rangefinder, and configure the values of lever arm via commands or web UI.

In vehicle mode and low-speed vehicle mode, the **PBOX** outputs attitude information in the vehicle body coordinate system. In all other modes, it outputs attitude information in the **PBOX** (machine) coordinate system. If you need to output the attitude information in other user coordinate systems, you need to configure rotation angle to the user coordinate system via the command.

When installing the GNSS antennas, you need to configure the offsets of heading angle and pitch angle via the command.

For details on coordinate system conversions, lever arm and offsets of heading and pitch angles, please refer to APPENDIX 2: COMMON COORDINATE SYSTEMS, ANTENNA LEVER ARM AND ROTATION PARAMETERS.

2.6 Connection to Communication Devices

The **PBOX** can communicate with external devices by one of the following ways:

- Serial port
- Ethernet
- CAN/CAN FD bus

2.6.1 Serial Port

The **PBOX** is equipped with two RS232 serial ports and one RS422 serial port, both of which can be configured for output.

The serial protocols are listed in Table 2- 2:

Table 2- 2 Serial protocols

Port	Protocol	Note
RS232-A	RS232	IN/OUT
RS232-B	RS232	IN/OUT
RS422	RS422	Reserved

To connect the serial port, do the following:

1. Insert the connector of the power cable into the data port of the **PBOX**.
2. Connect the DB9 connector at the other end of the cable to a computer or other communication device.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

2.6.2 Ethernet

The **PBOX** is equipped with an Ethernet port for communication with external Ethernet devices.

The Ethernet port supports IPv4 network layer, TCP/IP protocols and can be used for remote commissioning, receiving differential data, outputting position and attitude information or upgrading firmware.

To connect to the Ethernet, do the following:

1. Insert the connector of the power cable into the data port of the **PBOX**.
2. Connect the RJ45 network connector at the other end of the cable to a computer or other Ethernet communication device.

2.6.3 CAN/CAN FD

The **PBOX** is equipped with two CAN bus ports with a data rate of up to 5 Mbps. The CAN FD port is designated for wheel speed signal input.

To connect to the CAN/CAN FD bus:

1. Insert the connector of the power cable into the data port of the **PBOX**.
2. Connect the bare wire at the other end of the cable to the external CAN/CAN FD bus via an adapter.

2.7 Connection to Synchronized Devices

The **PBOX** provides a PPS signal for time synchronization, and supports configurable protocols such as NTP and GPTP. Please select the appropriate protocol based on your actual demands.

To connect to synchronization signals, do the following:

1. Insert the connector of the power cable into the data port of the **PBOX**.

2. Connect the bare wires at the other end of the cable to your synchronization device.

: *Please make sure the GND signal is connected to the ground line of your device*.

2.8 Connection to the Odometer

The **PBOX** can be connected to an odometer. Wheel speed information can be transmitted to the **PBOX** via the common DBC protocol. This integration enhances positioning accuracy when satellite signals are lost. Please select it based on your actual demands.

2.9 Connection to the Power Supply

Please use an appropriate power adapter or other DC power source (9-36V DC).

To connect to the power supply, do the following:

1. Insert the connector of the power cable into the data port of the **PBOX**.
2. Connect the DC power supply at the other end of the cable to an external power supply.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

3 CONFIGURATION

3.1 Serial Port

The **PBOX** can communicate with computers and other devices via a serial port.

Before establishing communication via the two devices, please make sure that the serial port parameters are properly configured.

The default configuration of the serial port is as follows:

- Baud rate: 115200 bps
- Parity: None
- Data bits: 8 bits
- Stop bits: 1 bit

You can enter the config command in the Serial Assistant to read the network information of the **PBOX** as shown in Figure 3- 1, and use the network port to access the web UI of the **PBOX**.

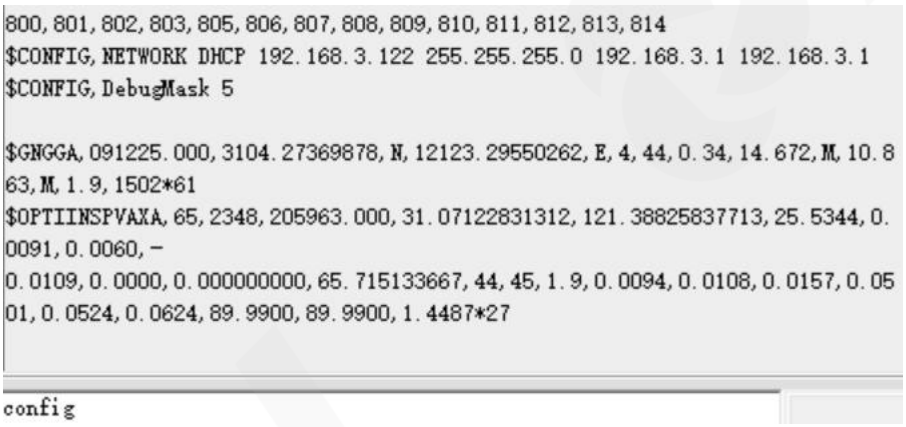

Figure 3- 1 Network info in serial assistant

To access the web UI of the **PBOX**, do the following:

1. Connect to the network port, open the browser, enter 192.168.3.122 in the address bar. The login interface shows.
2. Input the following information:
   - Account: admin
   - Password: password

Archimedes Innovation Technology Co., Ltd.
Email: sales@archi-inn.com
https://archi-inn.com

3.1.1 Change Settings of the Serial Port

To change settings of the serial port, do the following:

1. After logging in to the web UI, to enter the **I/O Setting** interface, click **I/O Setting**.
2. Select the serial port that needs to be output (e.g. COM1), click **Set.** The interface is shown in Figure 3- 2:

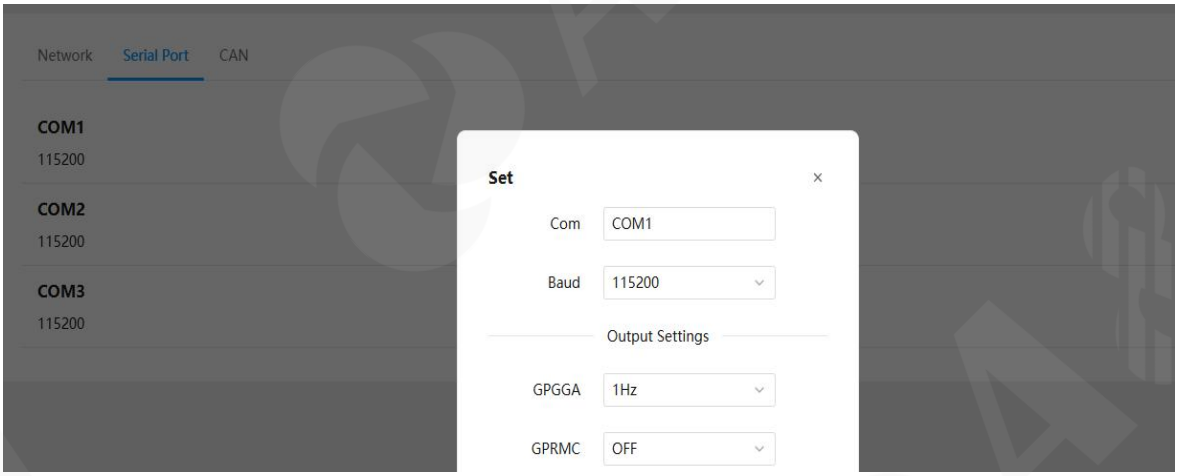

Figure 3- 2 Web UI setting-serial port

3. Select the baud rate, output protocol and frequency.
4. Click **Submit**.

3.1.2 Communicate with Remote Terminals

The **PBOX** supports communication with remote terminals via serial ports, i.e. use the analog terminal software to establish communication with the serial port of the **PBOX**.

A computer can serve as a remote terminal for navigation data storage.

Before communicating with remote terminals, please make sure the serial port configuration of the remote terminal and the **PBOX** is the same.

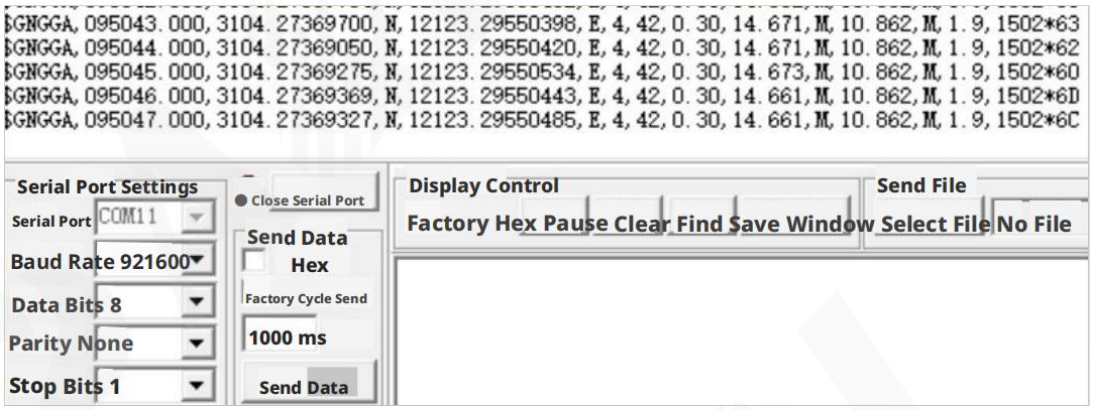

Figure 3- 3 Receiving data via serial assistant

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

3.2 Ethernet

3.2.1 Set the Static IP Address

To set the static IP address, do the following:

1. After logging in to the web UI, to enter the **Network Settings** interface, click **Network Settings**.
2. Select **Static**. The interface is shown in Figure 3- 4:

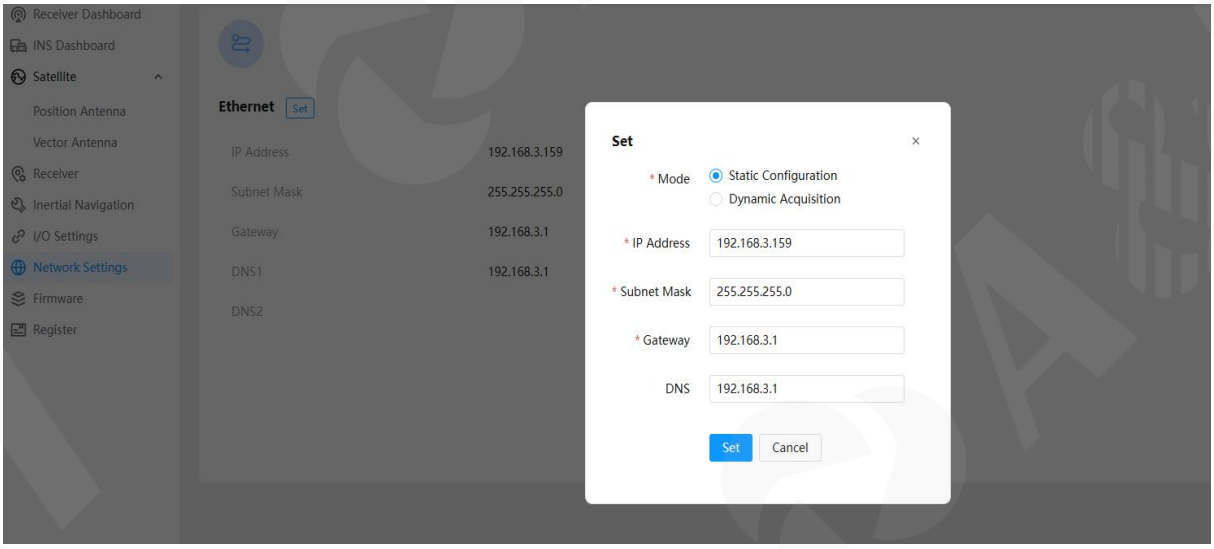

Figure 3- 4 Web UI setting-network static

3. Input the IP address, subnet mask, gateway and DNS.
4. Click **Set**.

3.2.2 Set the Dynamic IP Address

To set the dynamic IP address, do the following:

1. After logging in to the web UI, to enter the **Network Settings** interface, click **Network Settings**. The interface is shown in Figure 3- 5:

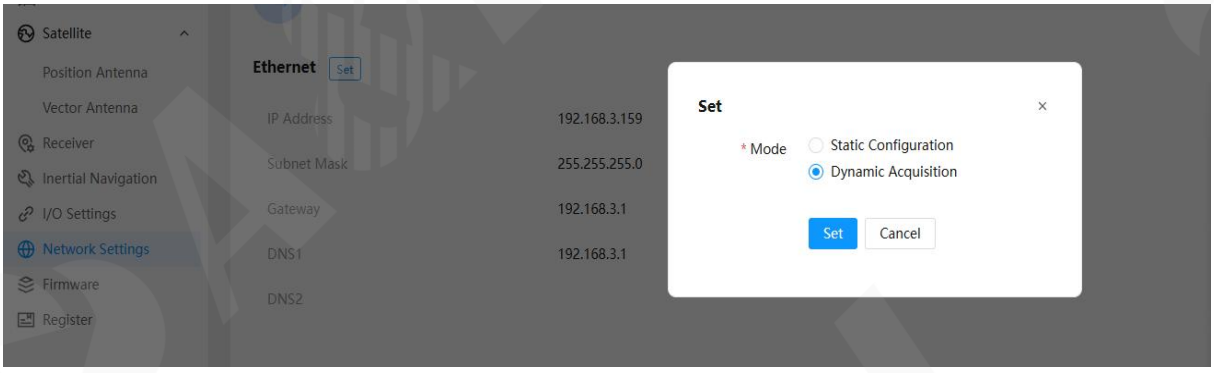

Figure 3- 5 Web UI setting-network dynamic

2. Select **Dynamic**.
3. Click **Set**.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

3.3 CAN/CAN FD

3.3.1 Configure the Bus

To configure the bus, do the following:

1. After logging in to the web UI, to enter the **IMU** interface, click **IMU**.
2. Select **CAN Bus** → **CAN-1**. The interface is shown in Figure 3- 6:

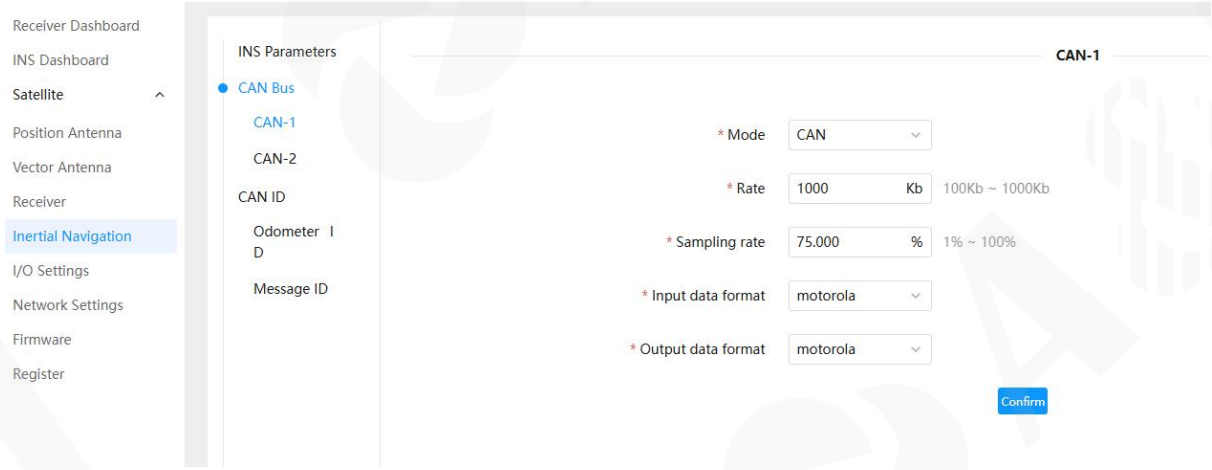

Figure 3- 6 Web UI setting-CAN bus

3. Select the desired CAN/CAN FD mode, set rate and sampling rate, and select input/output data format.
4. Click **OK**.

3.3.2 Set the CAN ID

To set the CAN ID, do the following:

1. After logging in to the web UI, to enter the **IMU** interface, click **IMU**.
2. Select **CAN Bus** → **CAN ID**. The CAN ID setting interface is shown in Figure 3- 7:

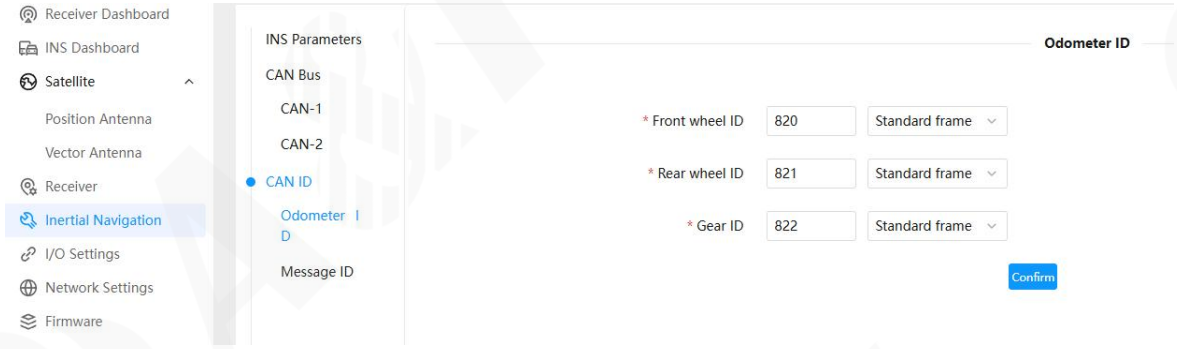

Figure 3- 7 Web UI setting-odometer ID

3. Set the odometer ID and click **OK**.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

4. To set the message ID, click **Message ID**. The message ID setting interface is shown in Figure 3- 8:

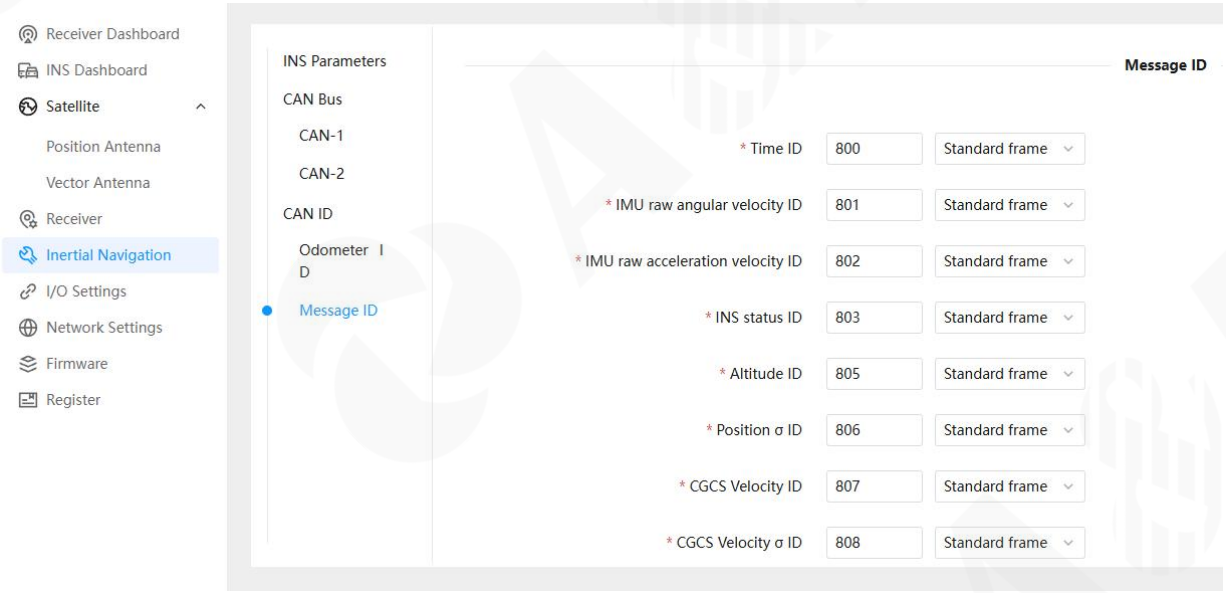

Figure 3- 8 Web UI setting-message ID

5. Set the message ID, and click **OK**.

3.4 Time Synchronization

The **PBOX** provides PPS (Pulse Per Second) as a time synchronization signal. By default, it outputs a 3.3V PPS signal with its rising edge aligned to GPS time. The synchronization accuracy is better than 10 ns when GNSS signal is good.

Additionally, the **PBOX** supports NTP and GPTP time synchronization protocols, with NTP accuracy better than 10 ms and GPTP accuracy better than 1 us.

To set time synchronization, do the following:

1. After logging in to the web UI, to enter the **Receiver Setting** interface, click **Receiver Setting**.
2. To switch to **Timing** interface, click **Timing**. The timing interface is shown in Figure 3- 9:

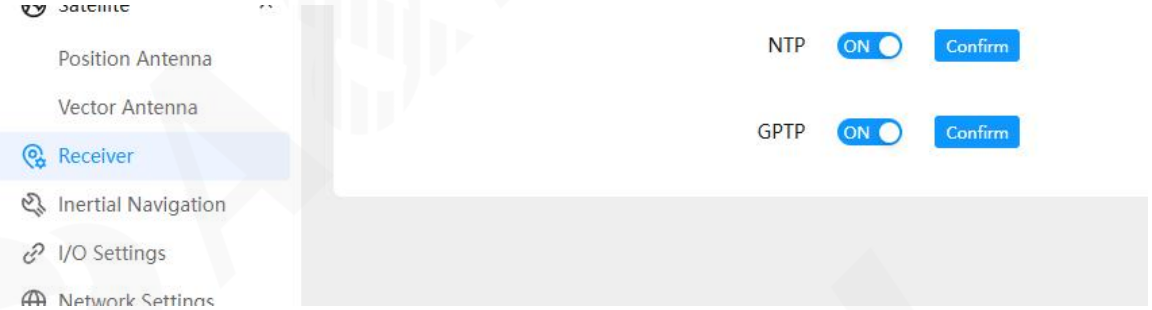

Figure 3- 9 Web UI setting-timing

3. Enable **NTP**, and click **OK**.
4. Enable **GPTP**, and click **OK**.

Archimedes Innovation Technology Co., Ltd.
Email: sales@archi-inn.com
https://archi-inn.com

4 HOW TO USE

4.1 Start Communication

At first startup, all communication ports of the **PBOX** default to no data output and are in a state of waiting for commands.

Take serial port COM1 communication as an example, to start communication, in the web UI, set the GPGGA data.

The COM1 serial port outputs GPGGA data, indicating that the **PBOX** has started working normally and the current port communication is functioning correctly.

4.2 Configure Parameters for the First Time

At the first startup, you need to configure the compensation values for the antenna heading and pitch angle. By default, the **PBOX** outputs the position of the primary GNSS antenna. If you need to specify the output position, you need to set to the lever arm to the user coordinate system.

To configure parameters for the first time, do the following:

1. After logging in to the web UI, to enter the **IMU** interface, click **IMU**.
2. To enter the **IMU Parameters** interface, select **IMU Parameters**. The interface is shown in Figure 4- 1:

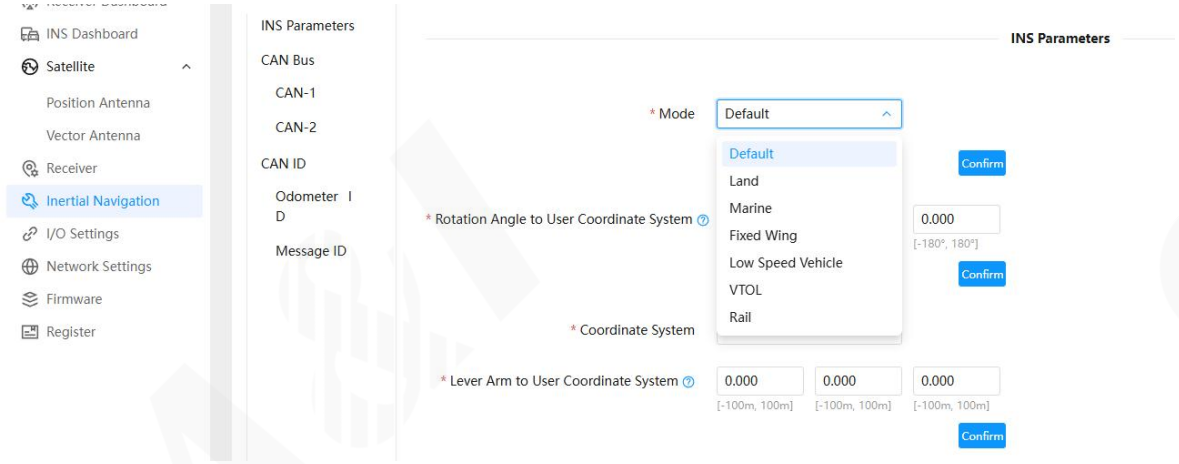

Figure 4- 1 Web UI setting-vehicle mode and lever arm to user coordinate system

3. Select a mode and set the lever arm to the user coordinate system.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

4.3 Transmit Differential Data

Differential data is transmitted from a base station to a rover station to improve the positioning accuracy of the rover station. Its data format typically uses the RTCM protocol (RTCM 3.x version).

A base station is a GNSS receiver set up at a fixed and known position and broadcasts differential data via a specific method. The rover station, in turn, continuously acquires this differential data from the base station to calculate its current precise real-time position.

You may either set up your own base stations or lease commercial ones. In either case, a datalink is required between the base station and the rover station to transmit differential data. During testing, this transmission can be accomplished by a computer and data forwarding software like STRSVR. In working environments, the datalink can be established with equipment such as wireless radios or DTUs (Data Transfer Units).

4.3.1 Transmit Differential Data via a Serial Port

Differential data can be transmitted through any serial port.

4.3.2 Transmit Differential Data via Ethernet

Differential data can be transmitted through any port.

To transmit differential data via Ethernet, do the following:

1. After logging in to the web UI, to enter the **I/O Setting** interface, click **I/O Setting.**
2. To switch to **Ethernet** interface, click **Ethernet**.
3. Select one of the following ports, and click **Set**. The interface is shown in Figure 4- 2:
   - TCPServer
   - TCPClient
   - NtripClient

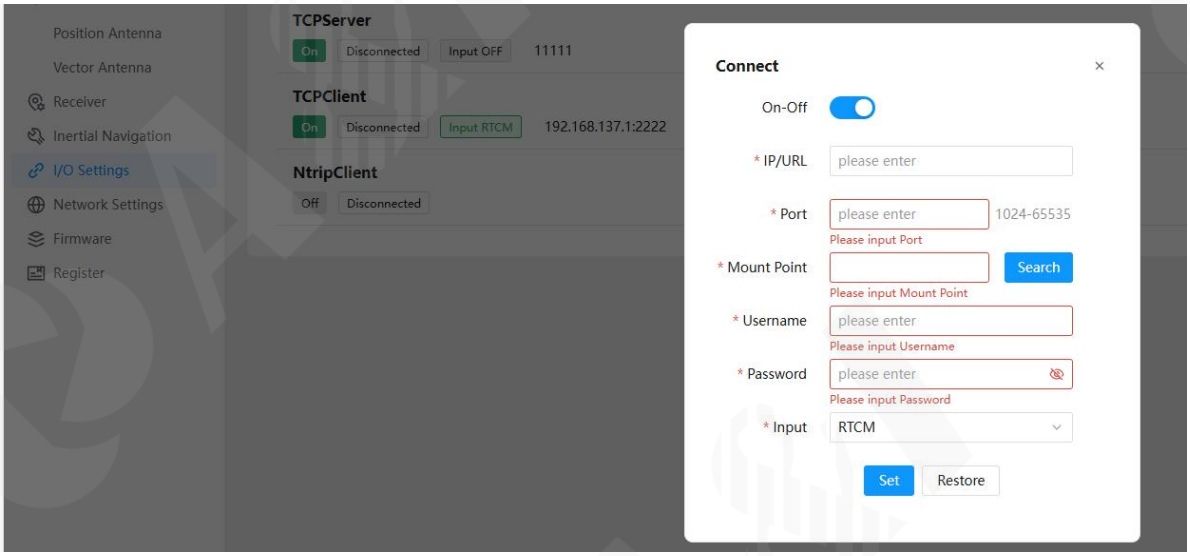

Figure 4- 2 Web UI setting-differential data

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

4. Set the following:
    - IP/Domain
    - Port
    - Mount point
    - Username
    - Password
    - Input
5. Click **Set**.

4.3.3 Check the PBOX Status

To check the **PBOX** status, after logging in to the web UI, do one of the following:

- Configure the serial port to output GPGGA messages, and check if the flag bit is 4.
- In the **Receiver Status** interface of the web UI, check the position of the **PBOX**. The interface is shown in Figure 4- 3:

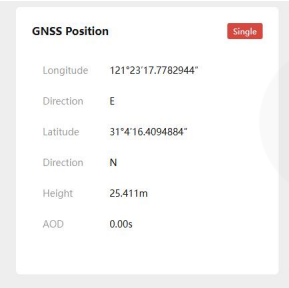

Figure 4- 3 Web UI setting-RTK status

4.4 Access Wheel Speed Signals

When the **PBOX** accesses the vehicle wheel speed signals, it can effectively assist in dead reckoning during severe satellite signal blockage or complete signal loss, thereby enhancing positioning accuracy in challenging satellite signal environments.

The **PBOX** generally uses CAN/CAN FD protocols to access wheel speed signals. Before accessing wheel speed signals, please make sure that CAN/CAN FD bus configuration has been completed.

The wheel speed data is generally required to meet the following specifications:

- Update frequency: ≥ 20 Hz (Recommended: ≥ 50 Hz)
- Accuracy: < 0.1 m/s (Recommended: ≤ 0.01 m/s)
- Resolution: < 0.02 m/s
- Delay: ≤ 10 ms

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

4.5 Output Real-time Information

You can configure the **PBOX** to output real-time position, attitude, and other real-time information via commands.

Please pay attention to the following while configuring the **PBOX** to output real-time information:

- The environment in which the **PBOX** is located should normally receive satellite signals. When the satellite signal quality is poor, the relevant position and attitude may not meet the requirements for use.
- The INS navigation data and GNSS navigation data are separately calculated. That is, the GNSS navigation data remains available even if the combined navigation algorithm is not working. The combined navigation data are typically output via INS-related data statements.

4.5.1 Initialize the Combined Navigation System

This operation is used to initialize the combined navigation system by obtaining estimates of position, velocity, and attitude.

After the **PBOX** is powered up, initialize the combined navigation system.

After the initialization is completed, in the **IMU Status** interface of the web UI, it displays the combined mode **GNSS | IMU** and the GNSS mode **RTK Fixed for Positioning and Heading** as shown in Figure 4- 4:

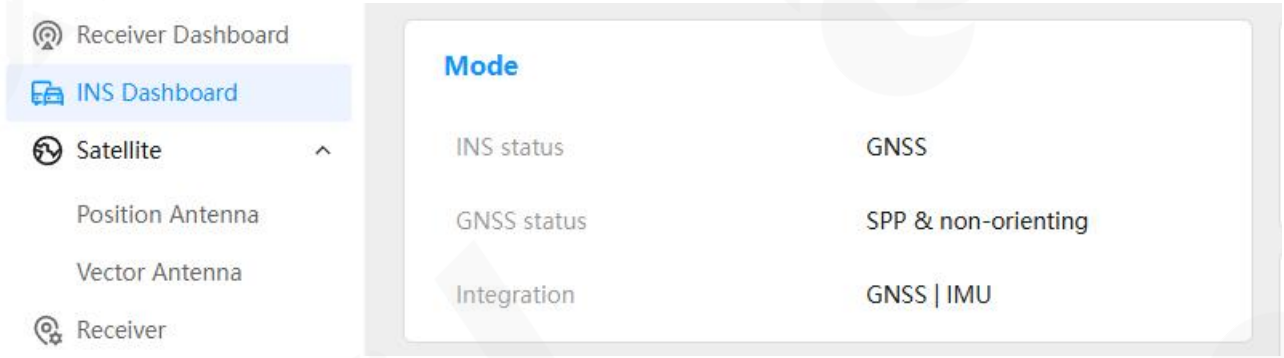

Figure 4- 4 Web UI setting-IMU status

4.5.2 Collect Data

When the combined navigation system is in navigation mode, navigation data can be collected.

GNSS solution results are exclusively provided by GNSS related messages such as BESTPOS and BESTVE. When the combined navigation algorithm is in normal operation, non-INS type messages support a maximum output rate of 5 Hz, while INS related messages achieve a maximum output rate of 100 Hz.

When INS-related messages such as INSPVA and RAWIMU are output at high frequency, the amount of data is large. In order to make sure data integrity, it is recommended to use the Ethernet port and CAN for transmission. If you use a serial port for transmission, please set the serial port baud rate to 921600.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

4.6 Post-process Data

The raw data output from the **PBOX** can be post-processed via specialized software. By employing bidirectional solving and smoothing, the post-processing software is able to obtain more accurate localization results, which can be served as a testing benchmark.

For detailed performance specifications of the **PBOX**, please refer to APPENDIX 1: TECHNICAL PARAMETERS.

4.7 Upgrade Firmware

Due to continuous product iteration and optimization, firmware upgrades may be required. Firmware upgrade package can be downloaded from our official website https://archi-inn.com/.

To upgrade firmware, do the following:

1. After logging in to the web UI, to enter the **Firmware** interface, Click **Firmware**. The interface is shown in Figure 4- 5:

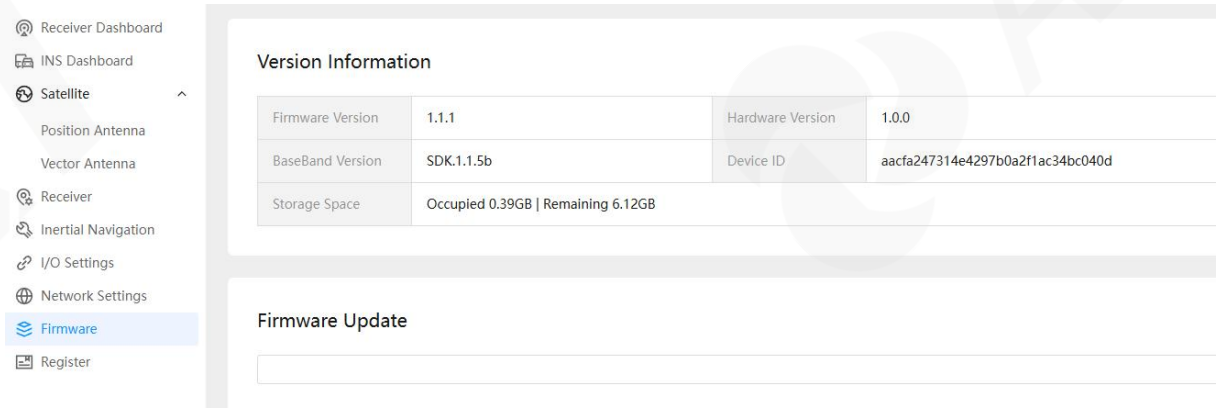

Figure 4- 5 Web UI setting-firmware upgrade

2. Click **Select File**, and select the firmware that needs to be upgraded.
3. Click **Upgrade** and wait for the upgrade.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

5 APPENDIX 1: TECHNICAL PARAMETERS

5.1 Performance Parameters

The performance parameters for GNSS are listed in Table 5- 1:

Table 5- 1 GNSS performance parameters

Satellite Tracking	BDS	B1I, B1C, B2I, B2a, B2b*
	GPS	L1C/A, L2C, L2P, L5
	Galileo	E1, E5a, E5b
	GLONASS	G1, G2*
	QZSS	L1C/A, L2C, L5
	NavIC	L5*
	SBAS	L1
	Lband*	
Positioning Accuracy (1)	Single Point	Horizontal: 1.5 m; Vertical: 2.5 m
	DGPS	Horizontal: 0.4 m; Vertical: 0.8 m
	PPP	Horizontal: 10 cm; Vertical: 20 cm @ 10 min
	RTK	Horizontal: 0.8 cm + 1 ppm; Vertical: 1.5 cm + 1 ppm
Velocity Accuracy	0.03 m/s	
Directional Accuracy	0.1°/m	
Timing Accuracy	PPS: ≤10 ns; GPTP: ≤1 us; NTP ≤10 ms	
Cold Start	30s	
Output Frequency	10 Hz (Max 20 Hz)	

: * *Supported in subsequent firmware updates.*

The performance parameters for IMU are listed in Table 5- 2:

Table 5- 2 IMU performance parameters

Gyroscope	Measure Range	±300°/s
	Bias Instability	1.8°/h (XY), 1.4°/h (Z)
	Angle Random Walk	0.09°/√ h (XY), 0.10°/√ h (Z)
	Output Frequency	200 Hz
Accelerometer	Measure Range	±6 g
	Bias Instability	15 ug
	Angle Random Walk	0.03 m/s/ h√
	Output Frequency	200 Hz

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

The performance parameters for combined navigation are listed in Table 5- 3:

Table 5- 3 Combined navigation performance parameters

GNSS Interruption Time	Positional Accuracy (m)		Speed Accuracy (m/s)		Attitude Accuracy (°)	
	Horizontal	Vertical	Horizontal	Vertical	Heading	Posture
0s	0.02	0.03	0.02	0.01	0.08	0.08
10s	0.29	0.12	0.05	0.02	0.10	0.04
60s	2.5	1.1	0.25	0.06	0.06	0.075

5.2 Mechanical Parameters and Navigation Center

The mechanical parameters and navigation center are shown in Figure 5- 1:

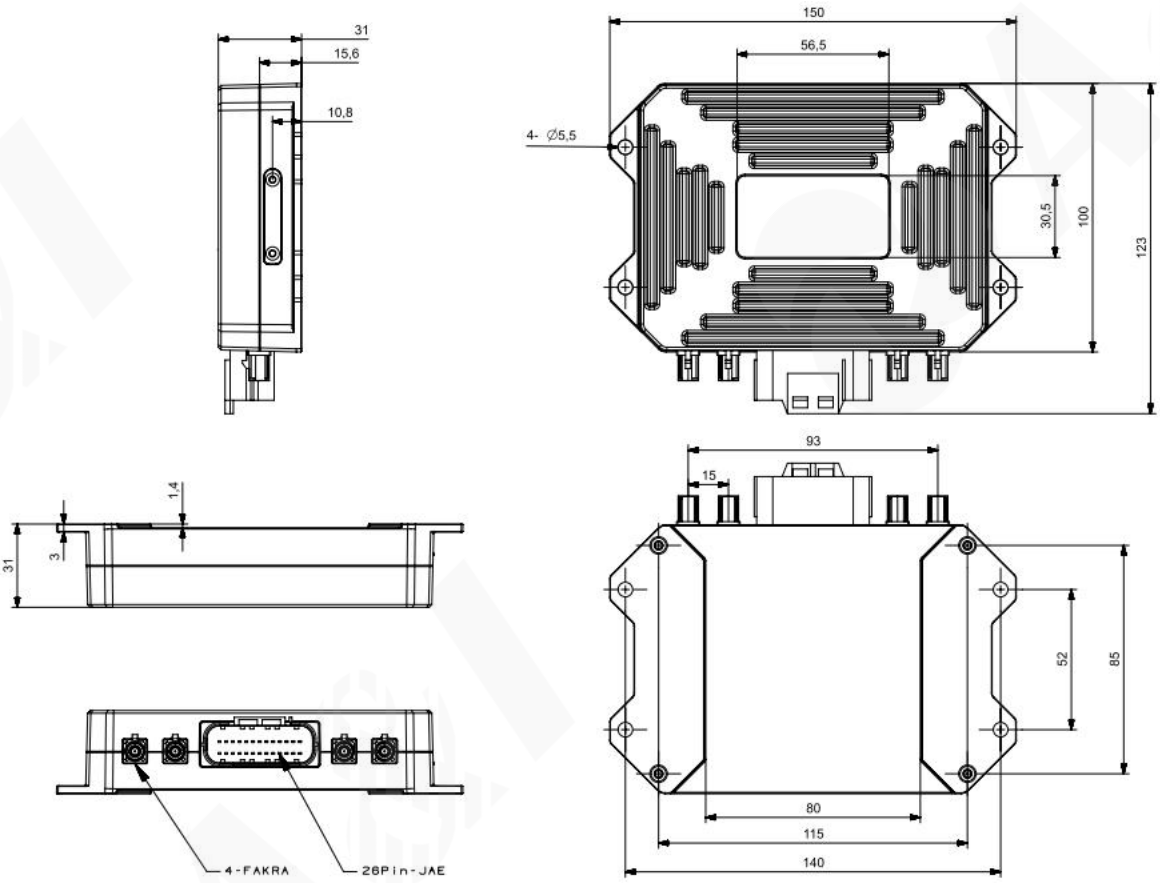

Figure 5- 1 Mechanical parameters and navigation center (unit: mm)

5.3 Physical and Electrical Parameters

The physical and electrical parameters are listed in Table 5- 4:

Table 5- 4 Physical and electrical parameters

Dimension	15 cm *12.3 cm * 3.1 cm	**Weight**	<450 g (without antenna and cables)
Humidity	95% non-condensing	**Water/Dust Proof**	IP67
Operating Temperature	-40°C - +85°C	**Storage Temperature**	-55°C - +95°C

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

Shock	EP455 Section 5.15.1 Random		
Working Voltage	9-36V	**Power Consumption**	<2W

5.4 Connectors

The connectors are listed in Table 5-5:

Table 5-5 Connectors

Name	Connector Type	Description
GNSS1	FAKRA	5V power supply. Connected to the GNSS antenna
GNSS2	FAKRA	5V power supply. Connected to the GNSS antenna
AI-POX	MX23A26SF1	Power supply, Ethernet, RS232*2, RS422*1, CAN*2, 1PPS*1

The pin definitions of power cable are listed in Table 5- 6:

Table 5- 6 Pin definitions of power cable

Pin	Name	Definition	Description
1	VCC	Power Positive	DC female connector 5.5 mm * 2.1 mm * 20.5 mm
2	VCC	Power Positive	
3	GND	Power Ground	
4	GND	Power Ground	
5	RS422_TXP	RS422_T+	Twisted 15EDGRK-3.81-2P holes
6	RS422_TXN	RS422_T-	
7	RS422_RXP	RS422_R+	Twisted 15EDGRK-3.81-2P holes
8	RS422_RXN	RS422_R-	
9	CAN1_L	CAN1_Low	Twisted 15EDGRK-3.81-2P holes
10	CAN1_H	CAN1_High	
11	CAN2_L	CAN2_Low	Twisted 15EDGRK-3.81-2P holes
12	CAN2_H	CAN2_High	
13	GND	232A Ground	DB9 female
14	RESETN		
15	EVENT		
16	RS232_TXD1	232A Tx	DB9 female
17	RS232_RXD1	232A Rx	
18	GND	232B Ground	DB9 female
19	RS232_TXD2	232B Tx	
20	RS232_RXD2	232B Rx	
21	GND	PPS Ground	Bare wire
22	PPS	PPS Output	
23	ETH_TPO+	Ethernet Differential Output +	Ethernet female port
24	ETH_TPO-	Ethernet Differential Output -	

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

Pin	Name	Definition	Description
25	ETH_TPI+	Ethernet Differential Input +	
26	ETH_TPI-	Ethernet Differential Input -	

6 APPENDIX 2: COMMON COORDINATE SYSTEMS, ANTENNA LEVER ARM AND ROTATION PARAMETERS

6.1 Common Coordinate Systems in Combined Navigation

6.1.1 PBOX Coordinate System

The origin and axes of the coordinate system for the **PBOX** are marked on the housing of the **PBOX**, as shown in Figure 6- 1 (front view) and Figure 6- 2 (side view), with the navigation center serving as the coordinate system origin:

Figure 6- 1 PBOX coordinate system (front)

Figure 6- 2 PBOX coordinate system (side)

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

6.1.2 Vehicle Body Coordinate System

The origin of the coordinate system for the vehicle body is the navigation center marked on the housing of the **PBOX**. The axes of the coordinate system for the vehicle body are defined as follows:

- Z-axis: perpendicular to the vehicle chassis, pointing toward the vehicle roof.
- Y-axis: aligned with the forward direction of the vehicle.
- X-axis: orthogonal axis derived from the Y-axis and Z-axis via the right-hand rule.

The vehicle body coordinate system is shown in Figure 6- 3:

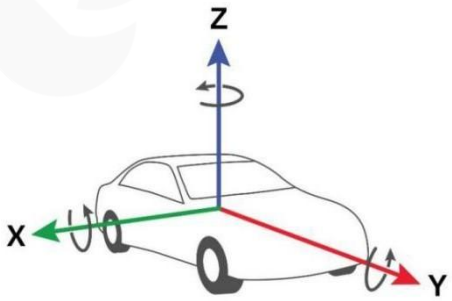

Figure 6- 3 Vehicle body coordinate system

For land vehicle models, please strictly adhere to this vehicle body coordinate system when configuring antenna lever arm and rotation parameters.

6.1.3 User-defined Coordinate System

A coordinate system whose origin is specified by the user is called a user-defined coordinate system.

The **PBOX** defaults to output the attitude information under the vehicle body coordinate system in vehicle mode and low-speed vehicle mode, and the attitude information under the **PBOX** coordinate system in other modes. If you need to output the attitude information under other user coordinate system, you need to configure the rotation angle to the user coordinate system through the web UI.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

6.2 Lever Arm and Offset

6.2.1 Lever Arm (GNSS Antenna)

You can configure the lever arm of the GNSS antenna and output the position of the primary GNSS antenna in the web UI of the **PBOX** as shown in Figure 6- 4:

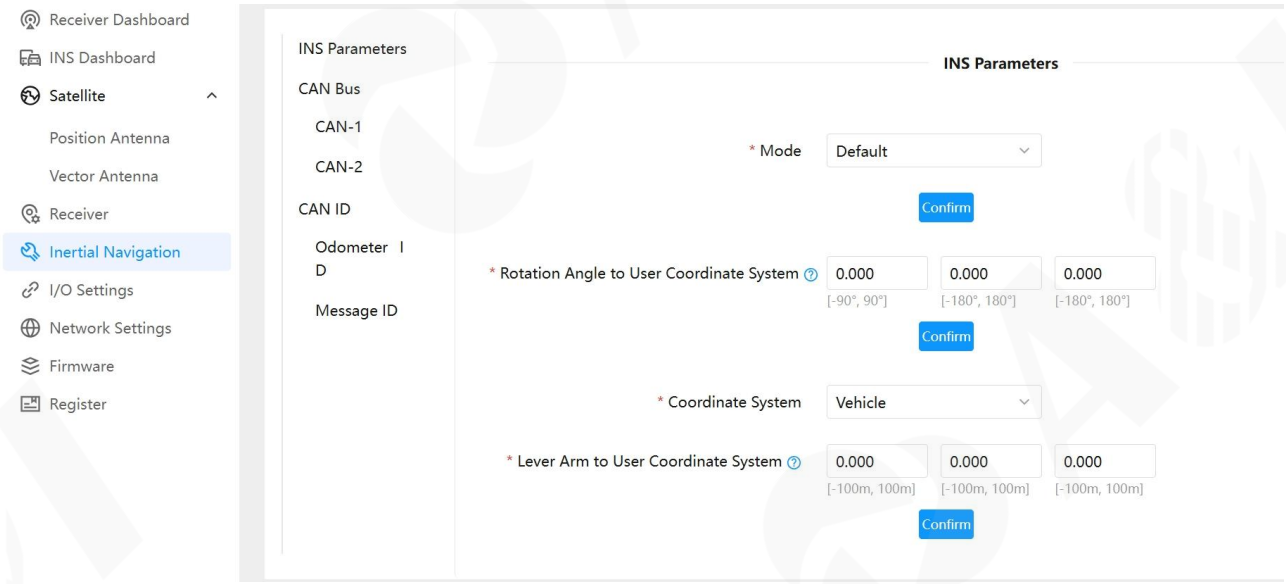

Figure 6- 4 Web UI setting-lever arm of GNSS antenna

6.2.2 Lever Arm (Vehicle Body Coordinate System)

If you need the **PBOX** to output the positions of other user-specified points, please configure the lever arm through the web UI.

If the configured lever arm is in the vehicle body coordinate system, the descriptions of axes for the vehicle body coordinate system are as follows:

- X-axis: perpendicular to the forward direction of the vehicle, and pointing to the right side.
- Y-axis: pointing to the forward direction of the vehicle.
- Z-axis: perpendicular to the ground and pointing upward.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

The measurement of the lever arm takes the navigation center of the **PBOX** as the origin of the coordinate system, and the X-axis, Y-axis and Z-axis of the vehicle body coordinate system as the reference, as shown in Figure 6- 5:

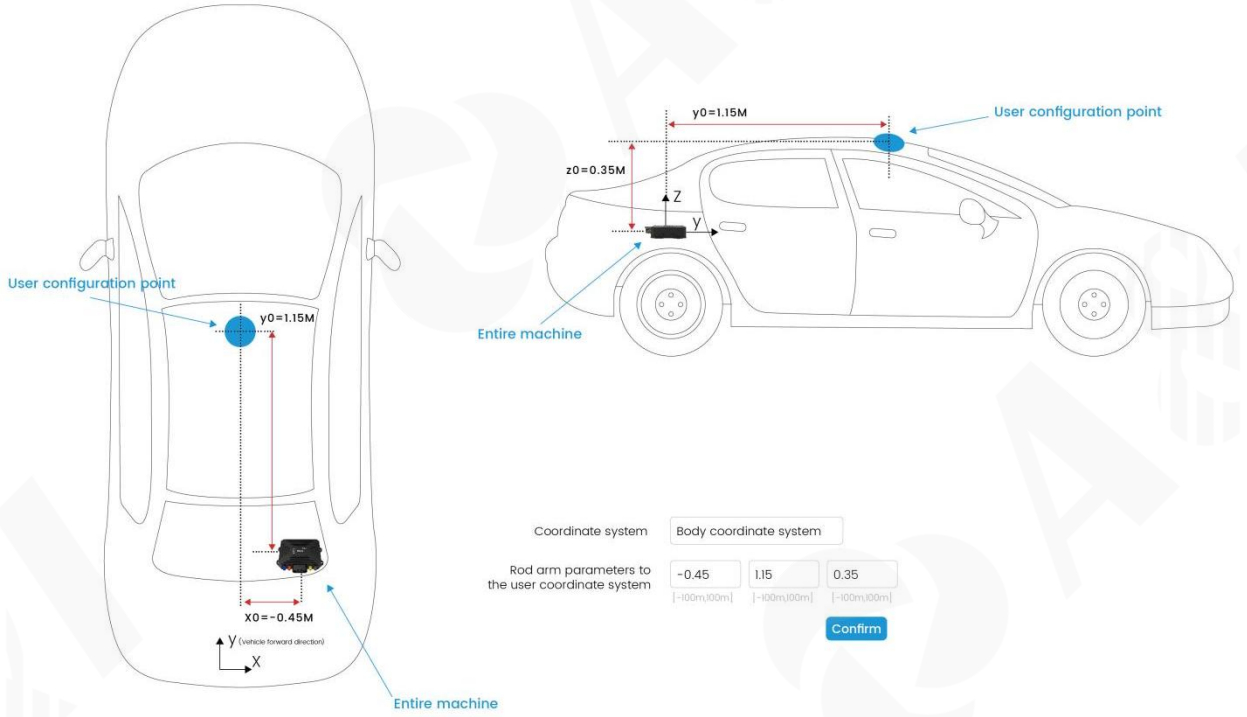

Figure 6- 5 Web UI setting-lever arm parameters in vehicle body coordinate system (example)

- To get the value of x0 (unit: meter), along the X-axis of the vehicle body coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the X-axis of the **PBOX** navigation center, the value of x0 is positive; otherwise, it is negative.

- To get the value of y0 (unit: meter), along the Y-axis of the vehicle body coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the Y-axis of the **PBOX** navigation center, the value of y0 is positive; otherwise, it is negative.

- To get the value of z0 (unit: meter), along the Z-axis of the vehicle body coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the Z-axis of the **PBOX** navigation center, the value of z0 is positive; otherwise, it is negative.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

6.2.3 Lever Arm (PBOX Coordinate System)

If the configured lever arm is in the **PBOX** coordinate system, assuming that the **PBOX** is mounted on the vehicle, the descriptions of axes for the **PBOX** coordinate system are as follows:

- X-axis: pointing to the direction of the rear of the vehicle.
- Y-axis: perpendicular to the forward direction of the vehicle and pointing to the right side.
- Z-axis: perpendicular to the ground and pointing upward.

The measurement of the lever arm takes the navigation center of the **PBOX** as the origin of the coordinate system, and the X-axis, Y-axis and Z-axis of the **PBOX** coordinate system as the reference, as shown in Figure 6- 6:

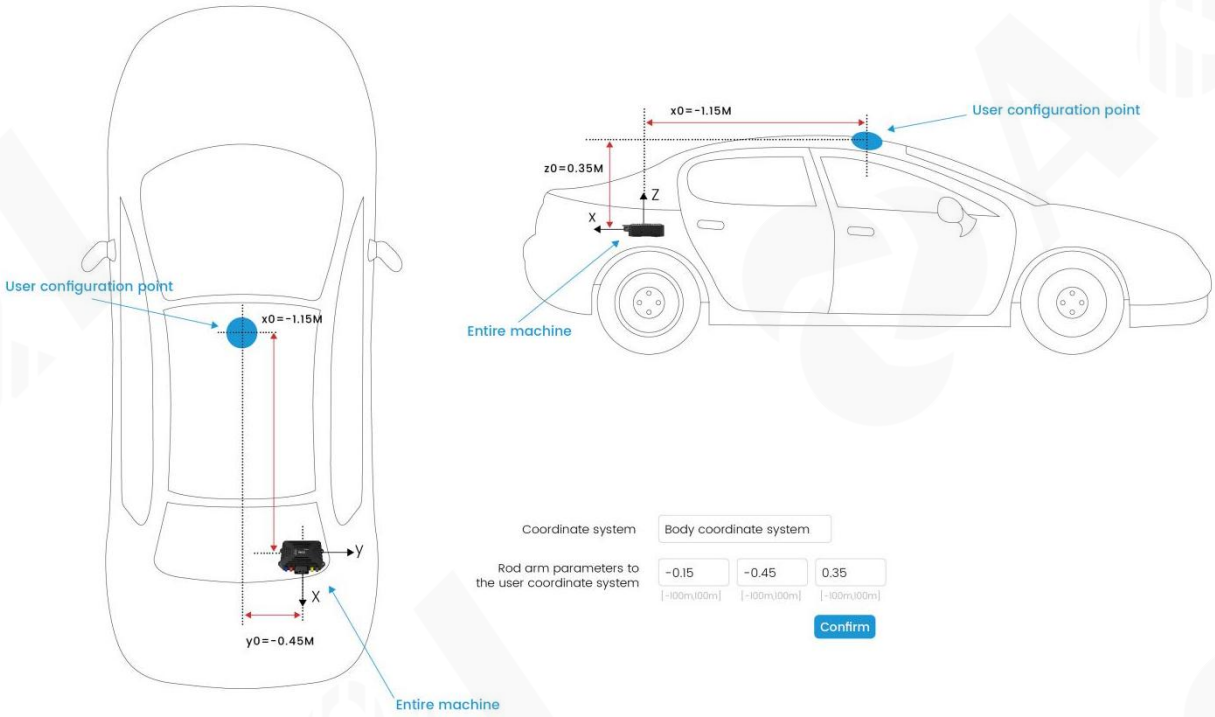

Figure 6- 6 Web UI setting-lever arm parameters in PBOX coordinate system (example)

- To get the value of x0 (unit: meter), along the X-axis of the **PBOX** coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the X-axis of the **PBOX** navigation center, the value of x0 is positive; otherwise, it is negative.

- To get the value of y0 (unit: meter), along the Y-axis of the **PBOX** coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the Y-axis of the **PBOX** navigation center, the value of y0 is positive; otherwise, it is negative.

- To get the value of z0 (unit: meter), along the Z-axis of the **PBOX** coordinate system, measure the distance from the user-configured point to the navigation center of the **PBOX**.

  If the user-configured point is in the positive half-axis of the Z-axis of the **PBOX** navigation center, the value of z0 is positive; otherwise, it is negative.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

6.2.4 Rotation Angle to the User Coordinate System

In vehicle mode and low-speed vehicle mode, the **PBOX** outputs attitude information in the vehicle body coordinate system by default. In all other modes, it outputs attitude information in the **PBOX** coordinate system. If you need to output the attitude information in other user coordinate system, you need to configure rotation angle to the user coordinate system through the web UI.

The **PBOX** coordinate system is xyz, and the user coordinate system is x0y0z0, as shown in Figure 6- 7:

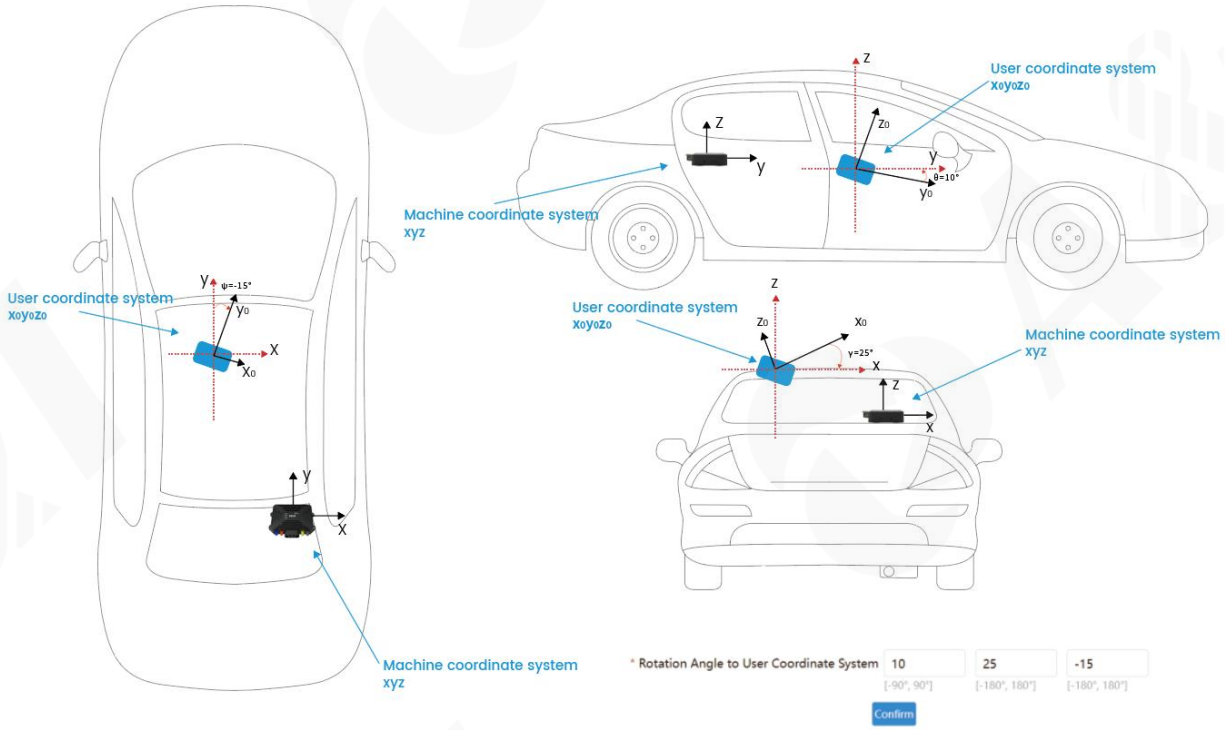

Figure 6- 7 Web IU setting-rotation angle to user coordinate system (example)

- The rotation angle from the user coordinate system to the **PBOX** coordinate system around the z0-axis is Ψ, with clockwise rotation being positive and counterclockwise rotation being negative.
- The rotation angle from the user coordinate system to the **PBOX** coordinate system around the x0-axis is θ, with counterclockwise rotation being positive and clockwise rotation being negative.
- The rotation angle from the user coordinate system to the **PBOX** coordinate system around the y0-axis is γ, with clockwise rotation being positive and counterclockwise rotation being negative.

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

6.2.5 Heading Offset and Pitch Offset

The offsets of the heading angle and pitch angle will correct the heading angle and pitch angle in the HEADING and GPTHS information output from the high-precision positioning module.

You can select any one of the antenna placement methods to install the GNSS antennas shown in Figure 6- 8:

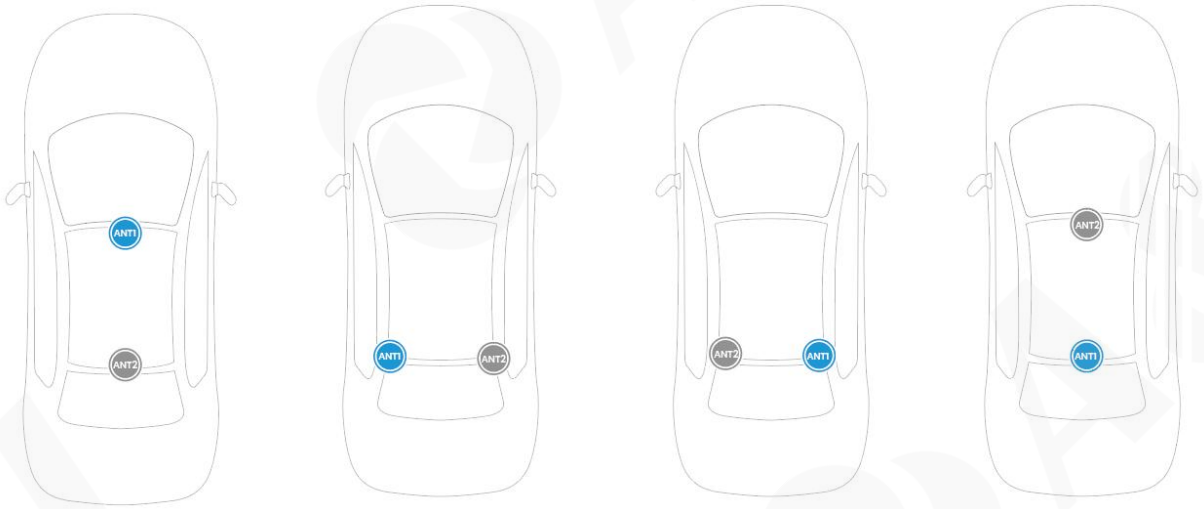

Figure 6- 8 Antenna placement

The offset will be automatically configured in the web UI as shown in Figure 6- 9:

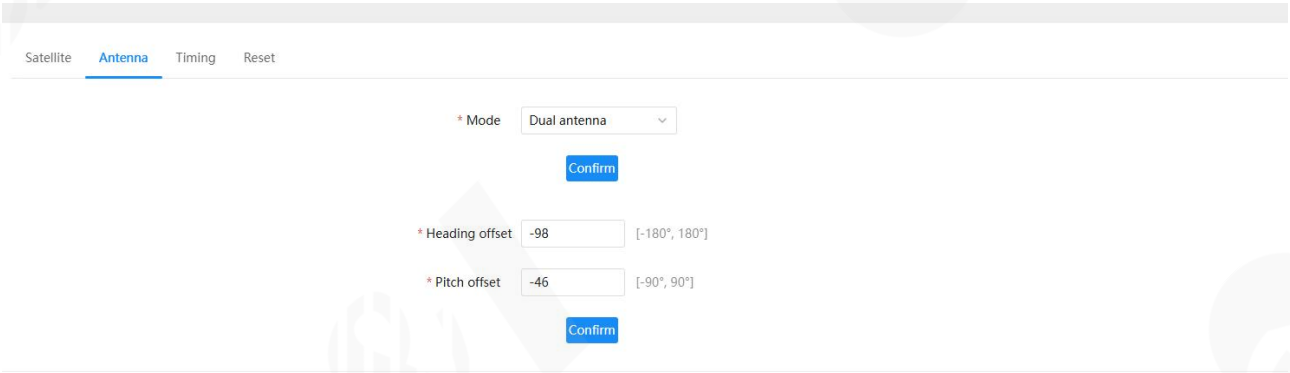

Figure 6- 9 Web UI setting-heading and pitch offsets

Archimedes Innovation Technology Co., Ltd.
Email：sales@archi-inn.com
https://archi-inn.com

Archimedes Innovation Technology Co., Ltd.

Website

Social media

+86 17749791507
sales@archi-inn.com