



Multibeam Sonar Quick Start Guide



1 Introduction

Baywei sonars are highly-versatile, portable, high-resolution multibeam echosounders which are extremely simple to install and operate. Two Baywei models are available: the Baywei M2, a standalone multibeam echosounder, and the Baywei M5, which contains tightly integrated GNSS/INS subsystems to provide a complete hydrographic survey solution from one integrated system.

Due to their low power consumption and small form factor, Baywei sonars are ideal for installing on ultra-small vehicles such as ASVs/USVs. A single cable connects the sonar wet end to the dry end topside unit, making it extremely quick to mobilize.

2 Hardware Installation

2.1 System Inspection

Unpack the system and inspect all cables and connectors for damage, dirt or moisture. Inspect the sonar for damage, especially around the transducers, for cuts or gouges. Check that all cables are at-hand and in good working condition.

2.2 Power Requirements

Baywei sonars require clean power for proper operation. As most vessels utilize an inverter for this purpose, it is important that it be a **true sine wave inverter**. A modified sine wave inverter may cause unexpected behavior, even when using the included power brick. In general, inexpensive inverters are likely modified sine wave. Use high quality inverters for providing power to the Baywei sonar. If dirty power is assumed, connect the system directly to a 12-24VDC battery and test.

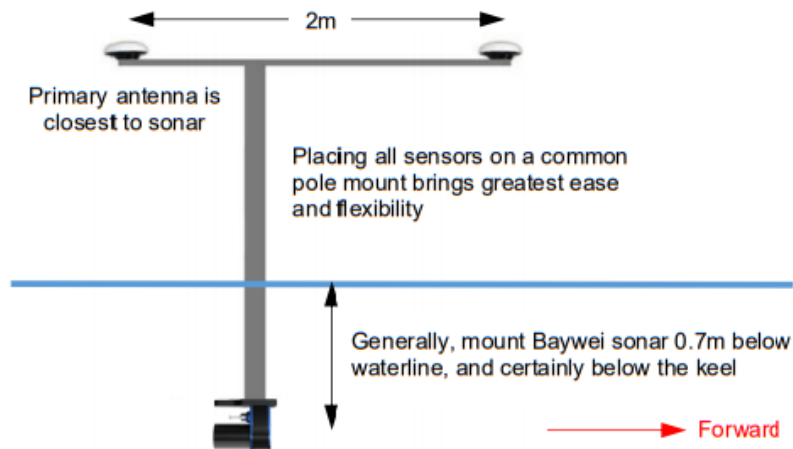
Additionally, power can be provided directly from a 12V deep cycle battery using the included pigtail that plugs into the power port on the SIU. The maximum power consumption is 55W for the Baywei M2, and 70W for the Baywei M5.

2.3 Wet-End Components

2.3.1 Mounting Location

The sonar should be installed on a mounting pole that is free from flexes and vibrations. Ideally, all sensors (sonar, IMU and GNSS antennas) should be mounted to the same pole to minimize offsets and errors caused by independent movement between sensors. All sensors should be fixed and rigid with respect to each other.

Install the sonar with the projector facing aft and the curved receiver array facing forward. It should be installed below the lowest part of the vessel to provide sufficient acoustic clearance for optimal performance, and at least 0.7m below waterline to avoid bubbles and turbulence at the surface which impact acoustic performance.

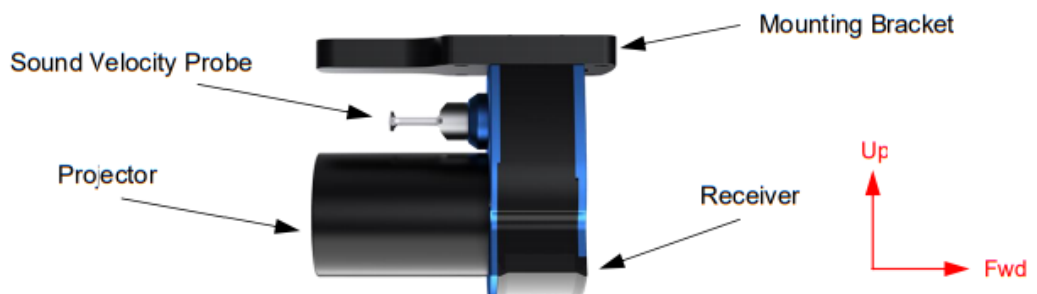


2.3.2 Sensor Mounting

Use at least 4 bolts (2 forward and 2 aft) made of high-quality stainless steel to mount the sonar wet end. Use a lock washer and/or an anaerobic thread adhesive such as Loctite 242 Blue to prevent loosening of sonar during long deployments.

The sonar cable should never be connected or disconnected underwater. Ensure all connector pins and sockets are clean and dry. Always use the supplied connector caps on wet-end, cables and topside. Use a synthetic O-ring lubricant on connector O-rings that are in good condition.

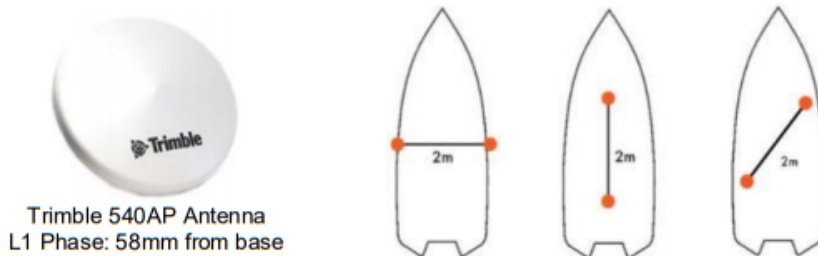
The mounting pole must be hollow and should be centered over the sonar connector, which exits through the top of the bracket. The cable must be routed inside the pole, and the minimum diameter of the pole must be 5.8cm.



When securing the sonar cable, push the connector while screwing the collar in place and wiggle it gently to ensure a robust connection. Note that the wet-end cable is **NOT** wet mateable. The cable should never be connected or disconnected underwater.

2.4 GNSS Antennas

The Baywei M5 includes integrated GNSS/INS subsystems, which comprises 2 Trimble 540AP antennas and an IMU integrated in the sonar head. The antennas must have a clear view of the sky to the horizon so that every satellite may be continuously tracked without obstruction. The mounting locations should be free from vibration and rigid with respect to each other and the IMU.

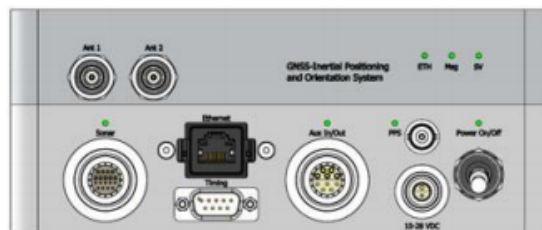


The Primary Antenna (Antenna 1) should be nearest to the sonar so that offset measurement errors are minimized. The Secondary Antenna (Antenna 2) should be a fixed distance from Antenna 1. It is recommended that the antennas be at least 2m apart. The antennas should be positioned parallel to the water surface to within 2-3cm.

While the antennas may be oriented in any direction horizontally, it is good practice to orient them to be parallel or perpendicular to the vessel centerline. Screw the antennas onto 5/8" UNC threads.

2.5 Dry-End Components

The dry end consists of a single topside unit which distributes power and data. The sonar (and GNSS antennas, for Baywei M5 models) should be connected to this unit. Take care not to bend the pins on the connectors.



Connector	Description
Sonar	18-pin interface to sonar and IMU
Ant 1	Primary GNSS antenna
Ant 2	Secondary GNSS antenna
COM (Serial)	GNSS corrections input (RTK/DGNSS)
PPS	1PPS output for external sensor (not typically used)
Ethernet	For communication between topside PC and sonar
10-28 VDC	Input DC voltage

3 Software Configuration

3.1 Baywei GUI Installation

The GUI executable file installs the Baywei Graphical User Interface (GUI). Baywei recommends disabling Windows Firewall, or adding a port exception, to allow communication with the Baywei M5 integrated INS.

3.1.1 PC System Requirements

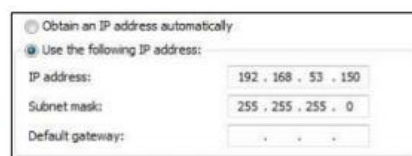
The minimum system requirements are shown below. Note that these may change depending on the acquisition software used.

Hardware	Requirements
Operating System	Windows 10 Pro (Recommended) / Windows 8.1 (Fully Updated) / Windows 7 or Vista (Unsupported) * / Windows XP (Untested)
Processor	2GHz or more
Memory	4GB or more
Display Resolution	1400x900 or higher Lower resolution can be used but it is not optimal. It will not impair data acquisition.
Graphics Card	Integrated graphics are sufficient for running the GUI. A dedicated graphics card is required for running data acquisition or processing software.
Network Speed	100Mbit Ethernet
Storage	GUI operation only: <1GB; Full system with logging: >100GB

3.2 Network Configuration

Baywei sonars connect to the acquisition computer via standard Ethernet protocol. The computer network adaptor must be configured to the same subnet.

To configure the computer IP address, navigate to the network adaptor properties in Windows control panel and change the **TCP/IPv4** settings. The last 3 digits of the IP address must not conflict with the address of the sonar or integrated INS.



The screenshot shows the 'Internet Protocol Version 4 (TCP/IPv4)' properties window. The 'Obtain an IP address automatically' radio button is unselected, and the 'Use the following IP address:' radio button is selected. The IP address field contains '192 . 168 . 53 . 150', the Subnet mask field contains '255 . 255 . 255 . 0', and the Default gateway field contains three empty boxes separated by dots.

The Baywei M5 integrated INS is pre-configured with an IP address of **192.168.53.100**. The IP address of the sonar is always **192.168.53.XX**, where XX represents the last two digits of the sonar serial number. A subnet mask of **255.255.255.0** should be used. Baywei recommends setting the IP address of the acquisition computer to **192.168.53.150**.

3.3 Connect to Sonar

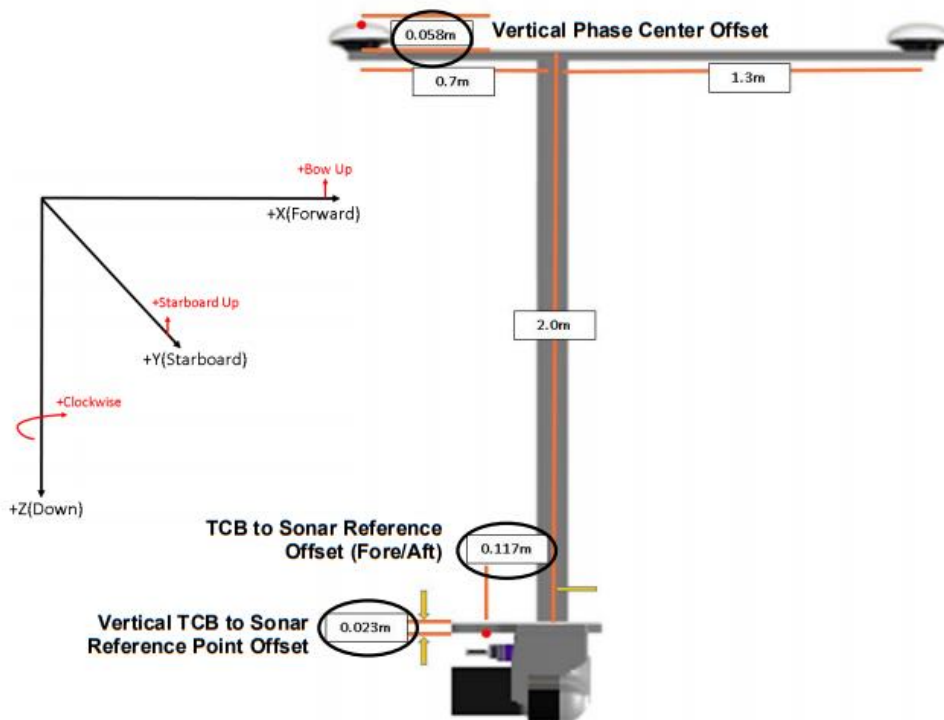
Upon launching the GUI, the **Connection Dialog** is displayed. If a sonar is powered on and active on the network, a green light is displayed. A red light indicates that the sonar is offline.

Select the sonar to highlight the row and click **Connect**. After the first successful connection is established, all subsequent connections to the sonar are automatic.

3.4 INS Setup for Baywei M5

3.4.1 Measuring Offsets

With all sensors installed, measure the primary GNSS antenna offset. Measure from the top center of the sonar bracket to the bottom of the primary antenna (Ant 1) along all 3 axes, as defined by the sonar housing. Note that the sign convention is +Forward, +Starboard and +Down, therefore the vertical offset should always be a negative value.



Configure the GNSS correction source if required. By default, with no corrections, the GNSS system works in standalone (Coarse Acquisition) mode with ~5m accuracy. DGNS corrections may be configured on the third page of the setup wizard

3.4.2 Setup Wizard

Run the setup wizard in the GUI to configure the GNSS/INS subsystems for Baywei M5 models. Baywei advises that, prior to each new installation, the factory default settings are restored. Open the **INS Setup Wizard** and select **Factory**. Note, this only resets the INS configuration and has no impact on the sonar configuration or GUI display preferences. Baywei recommends reviewing all inputs prior to each survey, even if the installation has not changed.

3.4.2.1 IMU Offset & Mounting Angles

The first page of the setup wizard shows the sonar model in the **System** selection and the relevant offsets and mounting angles. The model is automatically detected and there is nothing to change here.

3.4.2.2 Antenna Offsets

Select the **Primary Antenna** model, which in most cases will be **Trimble 540AP**, to ensure that the correct phase center offset is applied.

Select the **Measure Point** to define a convenient reference point from which to measure the primary antenna offset. **Top Center of Bracket** should normally be selected. A **Custom** point may also be defined.

Carefully measure the distance from **Measure Point to Antenna Bottom** and enter the correct values, bearing in mind the sign convention (positive down).

Users can specify the **Heading Threshold** for the heading alignment procedure which follows later. The **Default Value** (2.0°) should be used. Every time a heading alignment is performed, a patch test should be performed afterwards.

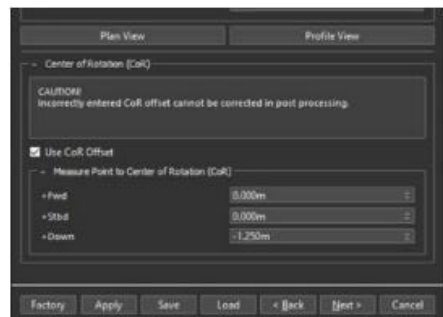
For **Heading Alignment** method, select **Heading Alignment Wizard** to populate the fields in **Primary to Secondary Antenna Baseline Vector** with zeros initially. Correct values are displayed after the alignment is complete (described in section 3.4.3). If the antenna baseline vector is already known, i.e. if it was measured using land survey techniques, the results can be entered by selecting **Custom**.



3.4.2.3 Center of Rotation Offset

The vessel **Center of Rotation (CoR)** offset should be entered relative to the **Measure Point**. Note that the center of rotation is more of an area rather than a well-defined point on the vessel, therefore an approximation will suffice. Select **Use CoR Offset** and enter the measured values under **Measure Point to Center of Rotation (CoR)**.

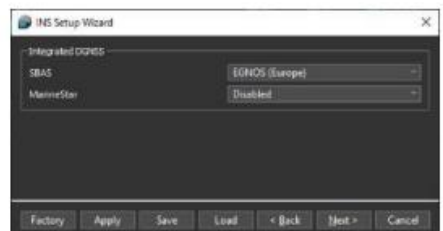
The CoR, for most commercial vessels, is documented in the vessel design plans. For other vessels, it must be estimated. The location can be hard to determine, as it may change over time depending on fuel stowage and distribution of personnel body weight. Generally, choose a location that is about 3/4 distance from bow to stern, centered on the keel, and located at approximately water level.



3.4.2.4 Integrated DGNSS

The **Integrated GNSS** settings are used to specify the desired satellite GNSS correction service. Satellite Based Augmentation Service (**SBAS**) may be configured here. This is a correction source that is regional and free.

Alternatively, **Marinestar**, a paid subscription service providing decimeter accuracy, may be configured.



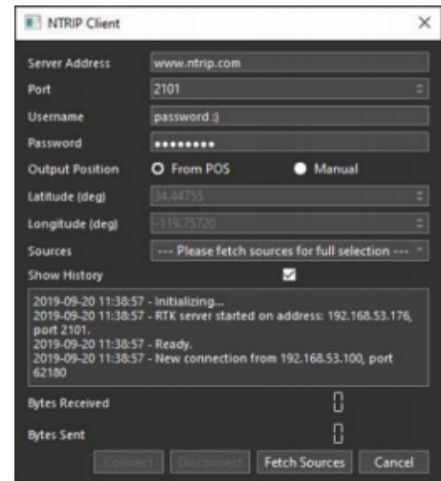
3.4.2.5 RTK/Aux GNSS Input & NTRIP Client

RTK corrections may be transmitted to the vessel from a land base station (via radio) and interfaced to the system via the serial COM port on the SIU. The radio on the vessel must therefore have a serial output, containing **only** the correction message. The incoming radio baud rate must match the selection in the setup wizard.

Select the correct RTK **Input Type** (CMR, CMR+, CMRx, RTCM, etc.) as well as the input **Line**, either **Serial** or **Modem**. Please note that if an input type other than **None** is selected, the INS only uses GPS satellites, so it will likely result in fewer satellite vehicles being detected. Selecting **None** enables the INS to use additional satellites from other constellations such as GLONASS.

To enable RTK corrections via NTRIP, select **Ethernet** as the **RTK/DGNSS Input**. Select **NTRIP Client** and enter the login details. Select **Fetch Sources** and select the source from the dropdown menu. Click **Connect**.

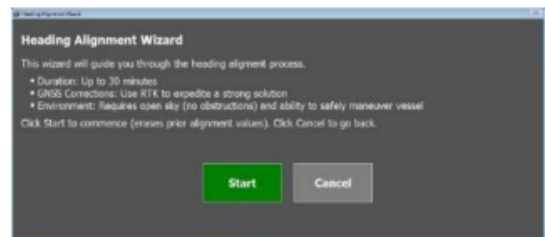
Click **Finish** to complete the setup wizard. If **Heading Alignment Wizard** was selected in section 3.4.2.2, finishing the setup wizard automatically starts the alignment wizard. If performing a heading alignment calibration is not possible at this time, you may select **Cancel**, with no loss of input values, and perform the calibration later.



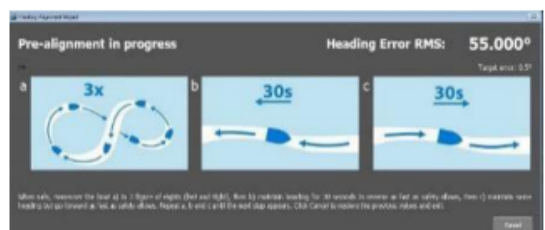
3.4.3 Heading Alignment Wizard

A heading alignment must be performed when the Baywei sonar is first installed, or when one of the INS sensors (IMU or GNSS antennas) is moved. The heading alignment determines the vector offset from primary antenna to secondary antenna, and in doing so ensures proper alignment of the IMU with the GNSS antenna pair. RTK positioning must be used when performing a heading alignment, otherwise the primary-secondary antenna vector should be measured by hand and applied as a custom offset.

Step 1. Press **Start** to begin the calibration. RTK positioning must be used, and antennas must have a clear sky view, away from tall structures that impede GNSS performance. The installation must be completely rigid and free from vibration. The primary antenna offset must be accurately measured and applied during the INS setup stage described in the preceding section.



Step 2. Follow the recommended maneuvers during the pre-alignment stage and observe the display as the **Heading Error RMS** decreases from its initial value of 55°. Once the value drops below the defined threshold (**Target Error**) and stabilizes, the heading alignment begins. Continue to maneuver the vessel until this occurs.



Step 3. Follow the instructions and continue to perform figure-of-eight maneuvers while the heading alignment is in progress. The overall time to complete the calibration depends on the size of the vessel and the speed at which the maneuvers are performed, as well as positioning quality.

The computed results are unique to each installation. If the primary to secondary antenna baseline was manually measured beforehand, the calculated results should be similar. Select **Commit** to save the results. Baywei recommends performing a patch test after the heading alignment.

