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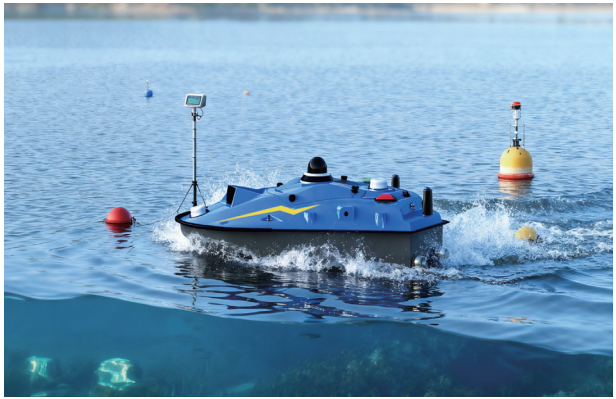
RBOAT-X

UNMANNED SURFACE VEHICLE



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USER GUIDE

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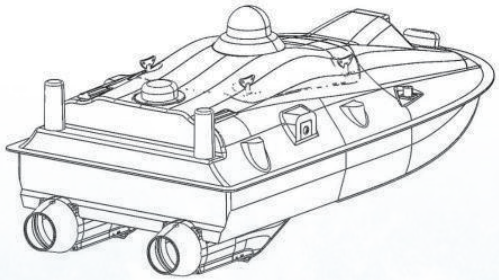
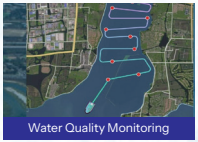
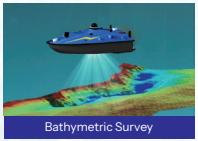




RBOAT-X-A



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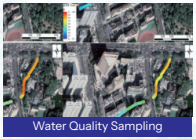

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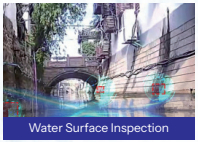


RBOAT-X-D

1. Overview

1.1 Introduction to Unmanned Surface Vehicle

RBOAT-X Unmanned Surface Vehicle (USV) is built on a fully modular, plug-and-play architecture.

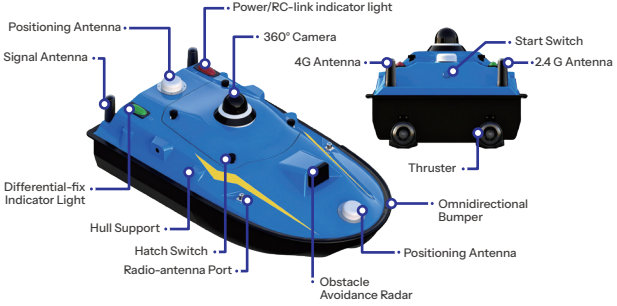
The vehicle integrates seven line-replaceable modules—hull shell, mission-control core, propulsion unit, collision-avoidance suite, high-precision positioning package, wireless telemetry link, and hot-swappable power pack—into a single, watertight assembly.

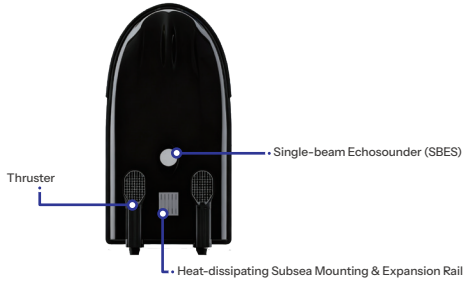
The shore-side segment is a single Android-based, long-range telemetry controller that unifies differential corrections uplink, real-time data downlink and remote control.

All onboard and post-mission workflows are handled by tSail, an integrated vessel-control and hydrographic-processing application.

Detailed functional descriptions of each hardware unit and software module are provided in the following sections.

1.2 Hull and Hardware Architecture





1.3 Heat-dissipating Subsea Mounting & Expansion Rail

(1) The Remote Controller is built around a 6 nm, octa-core Qualcomm SoC running Android 13 (64-bit). A high-power 2.4 GHz / 5.8 GHz dual-band radio module delivers low-latency, high-definition video with extended range and robust interference rejection.

(2) A built-in 7-inch high-brightness HD panel (1920 × 1200) provides real-time video feedback from the survey payload. Dual internal fans maintain thermal stability for continuous field operation.

(3) Interfaces include SIM card, USB and Type-C ports for differential corrections uplink, data logging and peripheral expansion.

(4) A high-energy-density Li-ion pack gives 6–8 h of autonomous runtime per charge.

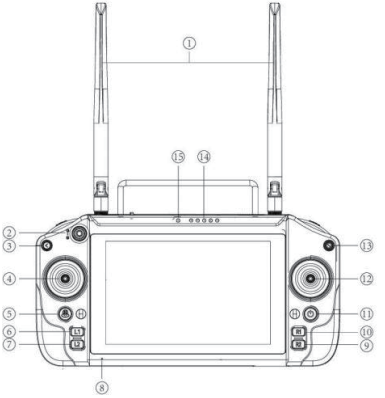
(5) It is made of meteorological silicone, matte rubber, and ABS material. The RBOAT-X has taken dust-proof protection

measures on the body, control switches, and all peripheral interfaces to ensure stable and smooth operation in harsh environments.

Controller Specifications

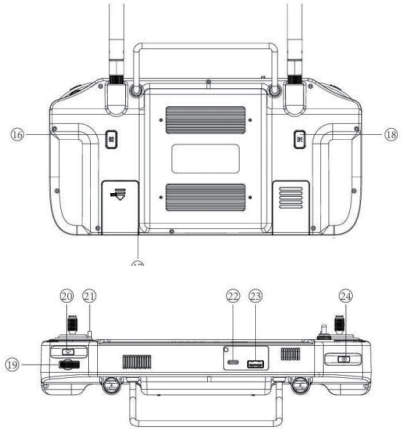
1	Channels	16
2	Operating voltage	4.2 V (internal battery)
3	RF power	23 dBm @CE/FCC
4	Band	2.4 GHz
5	Dynamic FHSS	hopping enabled
6	Dimensions	277 mm (L)×138 mm (W)×96 mm (H)
7	Weight	1.2 kg
8	Endurance	6–8 h
9	Battery	20000 mAh
10	Firmware update	OTA / on-line
11	Charge port	TYPE-C
12	RAM	4 GB
13	Internal storage	64 GB

1.4 Controller Operations



1	2.4 GHz antenna
2	3-position toggle switch (FWD: Auto / MID: Hold / AFT: Manual)
3	Back key
4	Left stick (forward/reverse control)
5	Return-to-home (RTH) key
6	L1 – mission-planning shortcut
7	L2 – safety-settings shortcut
8	Microphone
9	R2 – USV status shortcut
10	R1 – vessel-control parameters shortcut
11	Power key
12	Right stick (port/starboard control)

13	Data-logging stop key
14	Battery Indicator Light
15	Linking Indicator Light



16	B2 key (reserved)
17	TF-card / SIM-card slot
18	B1 key (reserved)
19	Spring-return thumb-wheel for gimbal pan control
20	Camera-view toggle key
21	Lanyard eyelet
22	TYPE-C port
23	USB port
24	Photo-capture key

Operating Environment

a. Ambient temperature: –10 °C to +45 °C

b. Storage temperature: –20 °C to +50 °C

c. Relative humidity: ⩽ 85 % RH

d. Atmospheric pressure: 86 kPa – 106 kPa

e. Location must be free of explosive, corrosive or electrically conductive media; gases that attack metals or degrade insulation; significant water vapour; and heavy mould growth

f. Site shall provide protection against rain, snow, wind-blown sand and dust

Power Supply & Safety Notes

a. The ground station contains an integrated, rechargeable Li-ion battery and can be charged through the market-standard TYPE-C port using any certified USB charger (e.g., phone or camera adapter).

b. If smoke, odour or electrolyte leakage is observed during charging, discontinue immediately and return the unit to an authorised service centre.

c. Keep the charging area out of reach of children to prevent electric-shock hazards.

d. Do not charge at ambient temperatures exceeding 60 °C.

Pre-operation Checks

a. Verify that the controller battery is adequately charged before use.

b. Confirm that all antennas are positioned as specified to ensure optimum performance.

c. Do not operate the unit while under the influence of

alcohol or any impairing substance.
e. Use only certified, professional-grade chargers for the battery.
f. The antennas are fragile—avoid excessive force or impact.

2. Hardware Operation

2.1 Accessory Installation

(1) Install battery → mate aviation power plug → switch battery ON.
(2) Connect main-camera Ethernet and power cables.
(3) Close hatch; tighten thumb-screws.

2.2 Pre-Launch Checks

(1) Power On
USV: Press and hold the stern power button for 3 s until the indicator light blinks rapidly, then release. After around 10 s the light turns solid, indicating the onboard mission computer is fully booted.

Controller: Switch on the Controller, launch the tSail app and connect to the USV via video-link. A solid red LED on the port side of the hull confirms successful link establishment.

(2)Thruster airflow check
Use the stick commands to verify correct blower direction:

Forward (left stick forward): both thrusters exhaust aft.
Reverse (left stick back): no airflow from either thruster.
Port turn (right stick left): port thruster—no airflow; stbd thruster—exhaust aft.
Stbd turn (right stick right): port thruster—exhaust fwd; stbd thruster—no airflow.

(3) Power-on self-test (POST)
After the tSail video-link is established the vessel runs its POST; all items must pass before launch

2.3 Battery Charging Procedure

(1) Charge both the lithium battery pack and the controller only with the supplied dedicated charger.
(2) Mating procedure:
Align and fully seat the charger plug into the battery port first. Then insert the charger mains plug into 220 V AC.
LED logic:
POWER LED only → no battery connected
CHARGE LED red → charging
CHARGE LED green → charge complete; battery ready for use
(3) Battery care
a. New batteries are shipped with ⩾30 % SOC; bring to 100 % within two months.
b. Recharge immediately when the one-bar (low-battery) indicator appears.
c. A fully-charged battery may be stored for up to six months; recharge again after this period.

3. Software Operations

3.1 Software Overview

tSail is a proprietary, survey-ready control and post-processing suite developed for unmanned surface vehicles. It supports multiple survey modes, enabling unmanned vessels to execute tasks automatically and adapt to various scenarios. The software provides hull control, route planning, status display, safety alerts, and online upgrades; it uses an integrated remote, supports 4G communication and data-link connection, and allows real-time triple-view video display. It supports external sensors, whose data can be integrated and shown in the vessel-control app without carrying a computer; post-processing overlays water-depth waveforms, so depth noise points are traceable; multiple data correction modes are offered to ensure accuracy and reliability. From the customer's perspective, the software pursues more accurate measurement, more user-friendly operation, and simpler functions for rapid deployment.

(1) Technical specifications
Operating environment: Android 13.
(2) Installation & removal
Installation: copy the tSail vessel-control package (*.apk) to the local Download folder on the Controller; tap the desktop file icon, open the Download folder, and tap the tSail package to start installation; after successful installation the App icon appears on the desktop.

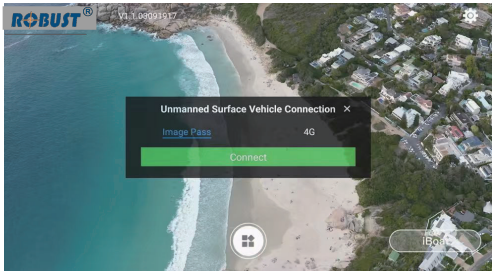
Uninstall: Long-press the tSail icon, drag it to the uninstall area on the screen, tap "OK" when prompt of uninstalling appears, and the software is removed.

(3) Version check and update
When the app is launched with an active network, it queries the server. If a newer build is available, a pop-up appears with the update details. If the handset is not on Wi-Fi, you will be asked whether to proceed with the download.
The Controller comes with the tSail USV control app pre-installed; if it is missing, please contact the technical support for installation.

Note: many features require a mobile data connection, and network RTK corrections for the vessel are delivered via the Internet—ensure a reliable network is available whenever the system is operated.

3.2 Establishing Connection

(1) Tap the tSail app icon to launch it; on the home screen tap the "Tboat10" button in the lower-right corner to open the USV connection dialog, then select "Video-Link → Connect" or "4G → Connect".



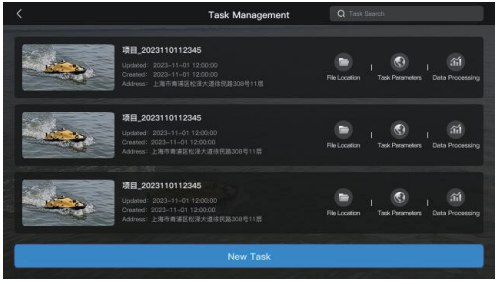
(2) The USV offers two link options—4G and video-link (default: video-link).

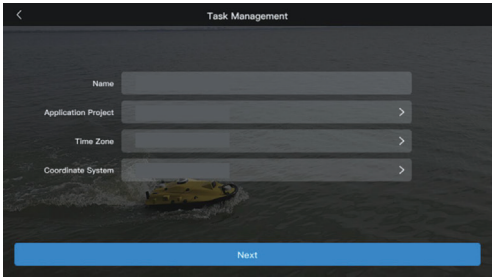
In 4G mode the vessel ID is its SN number and the password is “ubinavi2023”.

After successful pairing the button changes to “Disconnect”.

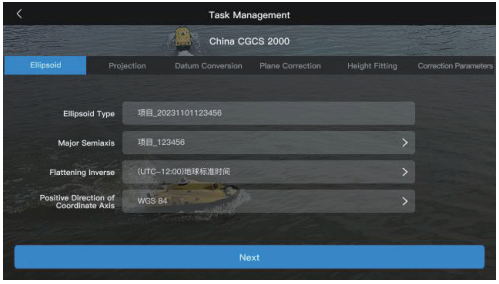
3.3 Project Creation

(1) Go to Task Management to select an existing project or create a new one.





After configuring the project parameters, click |Next] to complete the projectsetup and enter the vessel control interface.



3.4 (USV) Self-Test

(1) When the unmanned vessel is connected, the system will prompt for a startupself-test upon initial entry into the vessel control interface. Click [Confirm] toproceed to the next step.

Vessel Control Interface Status Indicators:
4G Network Signal:
Displays real-time network quality of the unmanned vessel.

1. ⩾80%: Full bars (3 bars)
2. ⩾60%: 2 bars
3. ⩾40%: 1 bar
4. <40%: 0 bars GNSS Solution Mode:

Positioning status:

5. Single (White)
6. Float (Yellow)
7. Fixed (Green)

Echosounder (Depth Sensor):

8. Normal (Green) if connected successfully; otherwise, Abnormal (Red). Propulsion System:
9. Normal (Green) if connected successfully; otherwise, Abnormal (Red). Camera:
10. Normal (Green) if connected successfully; otherwise, Abnormal (Red). Obstacle Avoidance Module:
11. Normal (Green) if connected successfully; otherwise, Abnormal (Red). Remote Controller:

12. Normal (Green) if connected successfully; otherwise, Abnormal (Red).

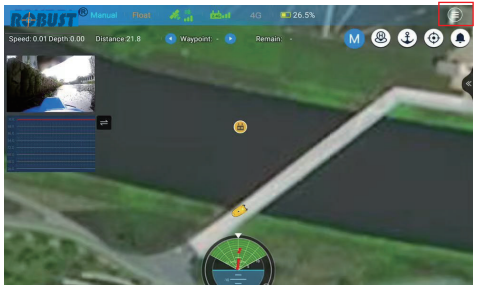
Unmanned Vessel Battery:

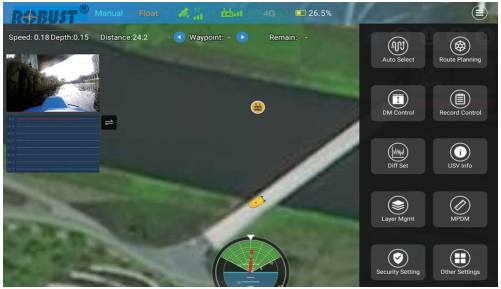
13. Normal (Green) if connected successfully; otherwise, Abnormal (Red). Battery Level Indicators:
14. >50%: Green
15. 10%~50%: Yellow
16. ⩽10%: Red

3.5 Navigation Route Planning

Navigation to Route Planning Interface:

1. Access the vessel control interface, then locate and select the red-highlighted button on the right side.
2. Choose the "Route Planning" function to enter the route planning interface.



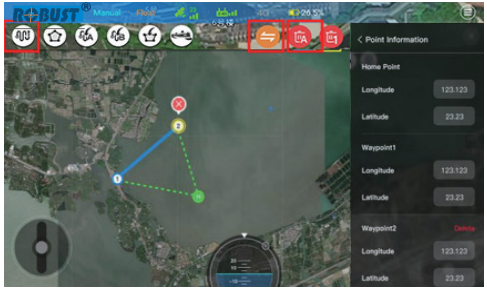


3.6 Manual Route Drawing

1. Select Waypoints:
Click the red-highlighted button to activate selection mode.
On the satellite map, click multiple locations to generate waypoints. The system will automatically determine the navigation path and direction based on the order of clicks.

2. Adjust Waypoint Order:
Use the blue-highlighted bidirectional arrow to swap the sequence of selected waypoints.

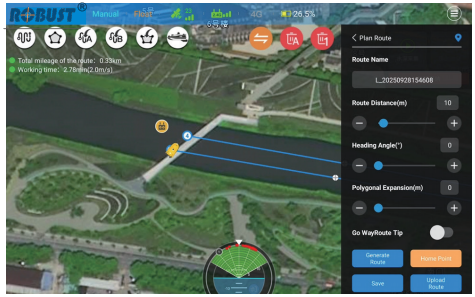
3. Delete Waypoints:
Click the yellow-bordered button to remove unwanted waypoints.



4. Polygon-Based Route Generation Instructions:
Click the red-highlighted button to activate polygon mode.
Single click on the map adds a boundary point.Three clicks generate a triangular polygon; continue clicking to add more vertices.

5. Edit Polygon (Left Panel):
Ensure the "Edit Polygon" button remains selected to:
Drag & move the entire polygon.
Delete points: Click a vertex to select it, then press the "Delete Point" button.

6. Generate Route (Right Panel):
Click "Generate Route" to create a default path within the polygon.
Customize routes by adjusting:
Spacing (between parallel tracks)
Angle (route direction)
Buffer (expand/shrink polygon edges)
Start Point (initial waypoint).



3.7 Video Surveillance

Camera View Operation:

1. Enter Camera View:
Click the camera feed icon (top-left corner) to enter the live video interface.
Supports split-screen display for multitasking.

2. Main Video Feed:
Displays real-time environmental footage from the unmanned vessel's perspective during navigation.