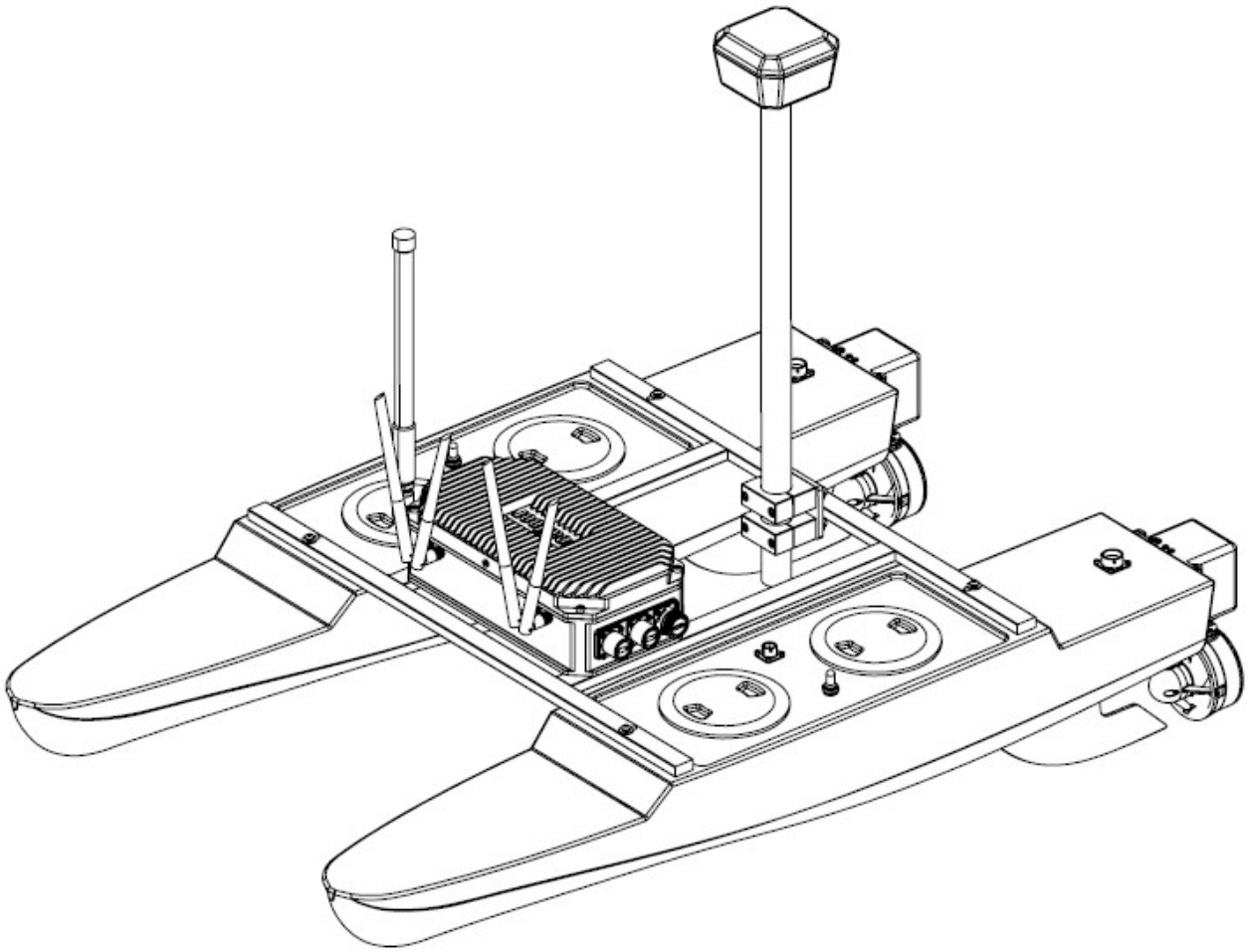
# Hydrone™ AutoNav Plus™ Servo

User and Technical Manual

**Seafloor Systems, Inc**



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# 1 Introduction

## 1.1 System Overview

Welcome to the Seafloor Systems Hydrone™ AutoNav Plus™ Servo manual. This document provides an overview of the key features and functionalities of our cutting-edge Uncrewed Survey Vessel (USV) designed for hydrographic surveying and marine mapping applications. The Hydrone™ AutoNav Plus™ Servo offers advanced hydrographic surveying capabilities, flexible payload options, and real-time data viewing. The Hydrone™ AutoNav Plus™ Servo features a robust hull and propulsion system, and reliable communication system. This manual is for hydrographic surveyors, marine scientists, and technical personnel involved in underwater mapping and surveying tasks using the Hydrone™ AutoNav Plus™ Servo.

## 1.2 Terms And Acronyms

| | |
|---|---|
| ANP | AutoNav Plus |
| ASV | Autonomous Survey Vessel |
| Bow | Front or forward part of the vessel |
| BHSC | Button Head Socket Cap Screw |
| CAA | Collision Avoidance Assist |
| CCW | Counter-Clockwise |
| CW | Clockwise |
| ESC | Electronic Speed Controller |
| FAQ | Frequently Asked Questions |
| GND | Ground (Voltage) |
| GNSS | Global Navigation Satellite System |
| GPS | Global Position Satellites |
| HDPE | High Density Polyethylene |
| HLP | Hydrolite Plus |
| HUD | Heads Up Display |
| LED | Light Emitting Diode |
| LiPo | Lithium Polymer Battery |
| Motor | Center electronic part of the Thruster |
| MBES | MultiBeam Echosounder |
| NMEA | National Marine Electronics Association |
| PoE | Power over Ethernet |
| Port | Left side of vessel - facing towards bow |
| Prop | Propeller |
| RCU | Remote Control Unit |
| RCV | Remote Controlled Vessel |
| RDP | Remote Desktop Protocol, Remote Desktop Connection |
| Receiver, RCVR | Receiver for the Transmitter |
| RSSI | Received Signal Strength Indicator |
| RTK | Real Time Kinematic |
| RTL | Return to Launch |
| Rx | Receive |
| SBES | Single Beam Echosounder |
| Servo Thruster | Servo Thruster Assembly |
| SOC | State of Charge |
| Starboard | Right side of vessel - facing towards the bow |
| Stern | Rear or aft part of the vessel |
| SVP | Sound Velocity Profiler |
| SVS | Sound Velocity Sensor |
| Thruster | Thruster assembly with prop |
| Transmitter | Transmitter also known as Radio Control Unit |
| Tx | Transmit |
| USV | Uncrewed Survey Vessel |
| VDC | Voltage - Direct Current |

| | |
|---|---|
| VAC | Voltage - Alternating Current |

**Information**

Information banner is to notify useful information for operator.

**Caution**

Caution banner is provide important information that if disregarded may result in accidental misuse or damage to the system.

**Important Alert**

Important Alert is to provide important information that if disregarded may prove harmful to personnel or equipment.

## 1.3 System Specifications

| | |
|---|---|
| Survey Speed | 2 knots (1m/s) |
| Max Speed | 4 knots (2m/s)* |
| Length | 49in (1.24m) |
| Pontoon Width | 8.37in (0.21m) |
| Overall Width | 29.25in (0.74m) |
| Hull Material | High-Density Polyethylene (HDPE) |
| Hardware | 316 Stainless Steel |
| Weight | 35lbs (15.8kg) |
| Payload | 25lbs (11.3kg) |
| Power | 14.8VDC Nominal |
| Battery Endurance | 5.5 Hours At Survey Speed With 16Ah Batteries |
| Thruster | 2x Electric Thrusters |
| Steering | Directed Thrust |
| Remote Control Range | Up To 0.6mi (1km) (Conditions Dependent) |
| Remote Control Voltage Range | 6-8.5VDC |
| Sea State | Beaufort Sea State 2 and Below (Figure 114) |
| Operating Air Temperature | 14°F – 113°F (-10°C – 45°C) |
| Operating Water Temperature | 28.4°F – 96.8°F (-2°C – 36°C) |

*Speed in ideal conditions. 8 hour operational endurance (with 4 batteries). Refer to Survey Duration Chart. 3.4

## 1.4 System Limitations

To limit potential damage to the Hydrone™ AutoNav Plus™ Servo, it is not recommended to use the USV in the following conditions:

- Colder environments can lead to decreased battery capacity and shorter endurance compared to what is indicated on the endurance chart. (Refer to 3.4)
- Range outside of 0.6mi (1km) line of sight.
- Charging: On land only. No equipment leakage circuit interrupter (ELCI) protections for on water charging.
- Weather Conditions: Do not use USV in adverse weather. Thunderstorms, lightning, hurricanes, monsoons, extreme heat, strong current, strong wind, heavy rain, etc.

## 1.5 Warranty

Seafloor Systems, Inc. is committed to upholding the highest standards of quality, reliability, and durability in its products. We provide a warranty to the original purchaser or purchasing agency, guaranteeing that each Hydrone™ AutoNav Plus™ Servo will be free from defects in materials or workmanship for a duration of one year from the date of shipment.
The warranty provided does not cover defects resulting directly or indirectly from misuse, negligence, accidents, repairs, or alterations conducted outside of our facilities. It also does not cover the utilization of the Hydrone™ AutoNav Plus™ Servo for purposes other than water measurements, or pairing it with instruments exceeding a weight of 25lbs (11.3kg).
Seafloor assumes no responsibility for the loss of boats, instruments, damage to property, or any injury or fatality associated with the utilization of its products or any products that may be included or utilized in conjunction with Seafloor products. Seafloor's warranty does not extend to third-party products sold by Seafloor, which may encompass items such as GPS devices, depth sounders, and other supplementary equipment.
All warranty-related services are carried out from Seafloor's facility in El Dorado Hills, California, U.S.A.

### 1.6 Technical Support

Seafloor Systems, Inc. provides comprehensive customer support through both an online support system and a phone support system during regular business hours. For assistance outside of standard business hours, support is available by appointment.

**If your Hydrone™ AutoNav Plus™ Servo was purchased through an authorized dealer, we kindly request that you contact your dealer's designated point of contact for immediate support and assistance.**

To submit a support request, please fill out our support form on our website www.seafloor.com via the big green button. You may also email us at support@seafloor.com. Please include as much information as possible:

- Your Name and Company
- Where you purchased the system
- Purchase Order number
- Serial number of the system
- In-depth explanation of the issue
- Any helpful pictures of the issue

Upon submitting your support request through our website or emailing us, a case will be automatically generated in our support system. One of our support representatives will reach out to you to assist with your inquiry or issue within 48 hours. Please note that this response time does not include weekends.

- Support: www.seafloor.com
- Support Email: support@seafloor.com
- Phone (PST/PDT): +1 530-677-1019 (Business Hours: Monday - Friday, 0700-1530)
  - Option 2 for Support
    - Option 1 for USV Support
    - Option 2 for Single Beam Support
    - Option 3 for Multibeam Support

# 2 Safety

### 2.1 Battery Safety

Please read through these instructions carefully before you operate the Hydrone™ AutoNav Plus™ Servo.

**Important Alert**

Danger to life from electric shock. Contact with uninsulated or damaged parts can result in severe physical injuries.

- Before and after every use of a LiPo battery, carefully inspect the pack to ensure no physical damage, swelling or "ballooning" is visible.
- If at any time you have an accident with your Hydrone™ AutoNav Plus™ Servo, or if the battery swells, "balloons", or feels too hot to the touch, immediately stop use and carefully follow these safety steps:

  - Using electrical protective gloves, remove the battery pack from your Hydrone™ AutoNav Plus™ Servo or charger.
  - Place the battery in a LiPo safety sack or other fireproof container, away from flammable materials and in a well-ventilated area.
  - Observe the battery from a safe distance for at least 30 minutes.
  - If after 30 minutes the pack appears stable, follow the battery disposal instructions below.
  - Under no circumstances should you return a battery to operation that has "ballooned" or been damaged in any way.

- Always handle LiPo batteries with extreme care and take all necessary precautions to avoid battery packs and cells being dinged, dented, punctured, or otherwise damaged.
- Keep battery packs out of the reach of children and pets.
- Do not disassemble, modify, or attempt any form of repair of a LiPo battery.
- Do not allow exposed battery wires to touch each other.
- Always disconnect your battery from any device when not in use. All devices continue to draw power even when turned off.
- Store your batteries in a cool, dry place between 40°F - 80°F (4°C - 26°C). All battery packs should be stored away from any flammable materials in a LiPo safety sack or other fireproof container (not included) with the plugs/connectors covered.
- Batteries should be stored at 3.75-3.85V per cell. Failure to maintain these levels could result in a loss of battery capacity. Do not store batteries with voltage above or below this range for longer than one week. Check cell voltage with a voltage tester, following the included instructions. (Refer to 3.6)
- LiPo batteries must be fully charged and returned to the recommended storage voltage range (3.75-3.85V per cell) at least once a month. Max voltage of a 4S battery is 16.8VDC. (4.2VDC/Cell)
- Always take precautions to cover the battery plugs/connectors while not in use.
- Always transport LiPo batteries in LiPo safety sack or other fireproof container with the battery plugs/connectors covered.
- Never leave LiPo battery packs in an automobile. Temperatures within a vehicle can quickly reach unsafe levels.
- Always keep a class D chemical fire extinguisher nearby, in case of fire when storing, handling, charging, or using LiPo battery packs.
- Make sure the battery connections are connected in the proper polarity. Battery packs should be properly secured within the vehicle to prevent movement and damage to the battery while in use.
- If the battery exceeds temperatures of 140°F (60°C) immediately discontinue charging and isolate the battery pack. Refer to point number two above from the Safety Warnings for further instruction.
- Do not, under any circumstances, heat up a battery pack to increase pack performance. Doing so greatly increases the risk of fire.
- Never allow your Hydrone™ AutoNav Plus™ Servo to discharge a LiPo battery pack at more than the recommended continuous discharge rate. Refer to the label of your specific battery to determine the proper continuous discharge rate. You must also refer to your specific vehicle user manual to ensure your batteries' continuous discharge rate is not exceeded.
- Damaged or ruptured battery packs or cells may leak electrolytes which can cause moderate to severe irritation including burning and dryness of the skin and eyes. For contact with the skin, thoroughly wash the affected area with soap and warm water. For contact with the eyes, rinse thoroughly with cool water. Seek immediate medical attention for any burns.

**Important Alert**

Never open the batteries.

## 2.2 Battery Charging Safety

**Important Alert**

Failure to follow any of the instructions and safety warnings contained within this document may cause irreversible damage to the battery pack.

**Information**

Due to shipping regulations, batteries are not shipped fully charged. All battery packs should be fully charged prior to first use.

### Lithium Polymer Battery (LiPo):

- LiPo batteries, 2S and greater, feature a separate balancing plug that isolates each cell in a pack and allows each to be charged and monitored independently. This ensures that all cells charge equally and discharge at the same rate during use. Never charge a 2S or greater LiPo battery without connecting the balance lead to the charger. Always balance charge a 2S or greater LiPo battery.
- Charge each battery pack individually. Never charge battery packs in series. Charging packs in series may result in improper charger cell recognition, improper charging rate, and overcharging that may lead to a fire. We recommend using a LiPo balance charge when charging your LiPo batteries.
- Always check to make sure that your LiPo charger settings match those listed on the battery pack label. Refer to the battery label for the proper cell count and 1C charging amperage settings.
- Always use a charger specifically designed for LiPo batteries. Never use NiCD or NiMH chargers to charge LiPo batteries.
- Do not charge LiPo batteries to more than 4.2V per cell.
- Never leave batteries unattended while charging, even when using a LiPo safety sack or another fireproof container. Batteries on charge MUST remain under constant observation so that you may react quickly should any problems arise.

## 2.3 Vessel Safety

**Important Alert**

Working with electricity in water environments requires utmost caution and adherence to safety protocols. Here are some important safety guidelines when using the Hydrone™ AutoNav Plus™ Servo:

- Electrical Safety: Exercise extreme caution when dealing with electricity in water. Avoid exposed wires and electrical circuits to prevent electrical shock hazards.
- Propeller (Prop) Safety: Keep body parts away from the thruster inlet and outlet to prevent injuries.
- Operating Conditions: Avoid operating the thrusters for extended periods outside of the water. The thrusters rely on water for cooling and running them dry can result in increased heat build up and potential damage.
- Environmental Considerations: While the thrusters can handle saltwater and sandy environments, it's crucial to avoid sucking debris into the thruster. Steer clear of plants, weeds, and other aquatic debris to prevent damage.
- Battery Safety: Never leave batteries powered on while the Hydrone™ AutoNav Plus™ Servo is unattended. Always disconnect all batteries immediately after use.

Adhering to these safety guidelines is crucial for the safe and effective operation of the Hydrone™ AutoNav Plus™ Servo and to prevent accidents or damage to the equipment. Always prioritize safety when working with water-based electrical equipment.

# 3 System Operation

## 3.1 What's Included

| Item | Quantity | Description | Image* |
|---|---|---|---|
| Pontoons | 2 | Hydrone™ AutoNav Plus™ Servo USV | |
| Servo Thruster | 2 | Servo Thruster for Pontoons | |
| Frame | 1 | Frame with Pole Mounts | |
| Fins | 2 | Seafloor Fins | |
| Frame Bolts | 4 | M5x25mm BHSC, Washer, and Lock Washer | |
| AutoNav Plus™ | 1 | AutoNav Plus™ Module | |
| Shoreside Antenna | 1 | Paired to Hydrone™ AutoNav Plus™ Servo Antenna | |
| Shoreside PoE | 1 | To power Shoreside Antenna | |
| Shoreside PoE Power Adapter | 1 | To power Shoreside Antenna | |
| 10ft Ethernet Cable | 1 | To be used with Shoreside PoE and Shoreside Antenna | |
| Serial Cable | 2 | For GPS input or serial communication | |
| Hydrolite Plus™Data Cable | 1 | Used with a Hydrolite Plus system | |

| | | | |
|---|---|---|---|
| Pontoon Power Data Cable | 2 | Keyed for each pontoon | |
| DC Power Cable | 1 | To power the system without the pontoons | |
| SMA 2.4GHz Antennas | 4 | SMA Antennas for WiFi and Receiver | |
| N-Type 2.4GHz Antenna | 1 | N-Type Antenna for Bridge Antenna | |
| 90° Coupler | 1 | N-Type Female to Female to be used with 2.4GHz Antenna | |
| Remote Control Unit (RCU) | 1 | Remote Control Unit for Hydrone™ AutoNav Plus™ Servo | |
| USB Charging Cable | 1 | Charging Cable for RCU. USB A to USB Mini Cable. | |
| LiPo Charger with Power Cable | 2 | Charger for the 4S LiPo Battery | |
| Velcro | 4 | For pontoon batteries(Not included) | |
| Allen Driver: 5mm | 1 | For Pole Mount | |
| Allen Driver: 3mm | 1 | For Frame Bolts | |
| Allen Driver: 2.5mm | 1 | For Fin Set Screws | |
| Hatch Wrench | 1 | For Pontoon Hatches | |
| Thumbscrew | 4 | To attach AutoNav Plus™ to Frame | |

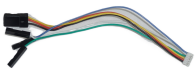
| | | | |
|---|---|---|---|
| USB Cover | 2 | If using a software dongle with the AutoNav Plus™ | |
| Voltage Tester | 1 | To measure the 4S LiPo voltage | |
| USB Drive | 1 | Loaded with software, drivers, and manuals | |
| Programming Card | 1 | To Program the ESC | |
| Receiver Programming Cable | 1 | For Firmware Flashing |  |
| DB9 Null Modem | 1 | Swaps TX and Rx, usually orange in color | |
| DB9 Gender Changer | 1 | Male to Male DB9 gender changer, usually yellow in color | |
| USB to Serial Adapter | 1 | For devices that do not have a DB9 port | |

Table 3: What's Included

*Please note that images provided are for illustrative purposes only and may not precisely represent the delivered product. Seafloor Systems reserves the right to modify any product at its discretion.

### 3.2 System Overview Diagram

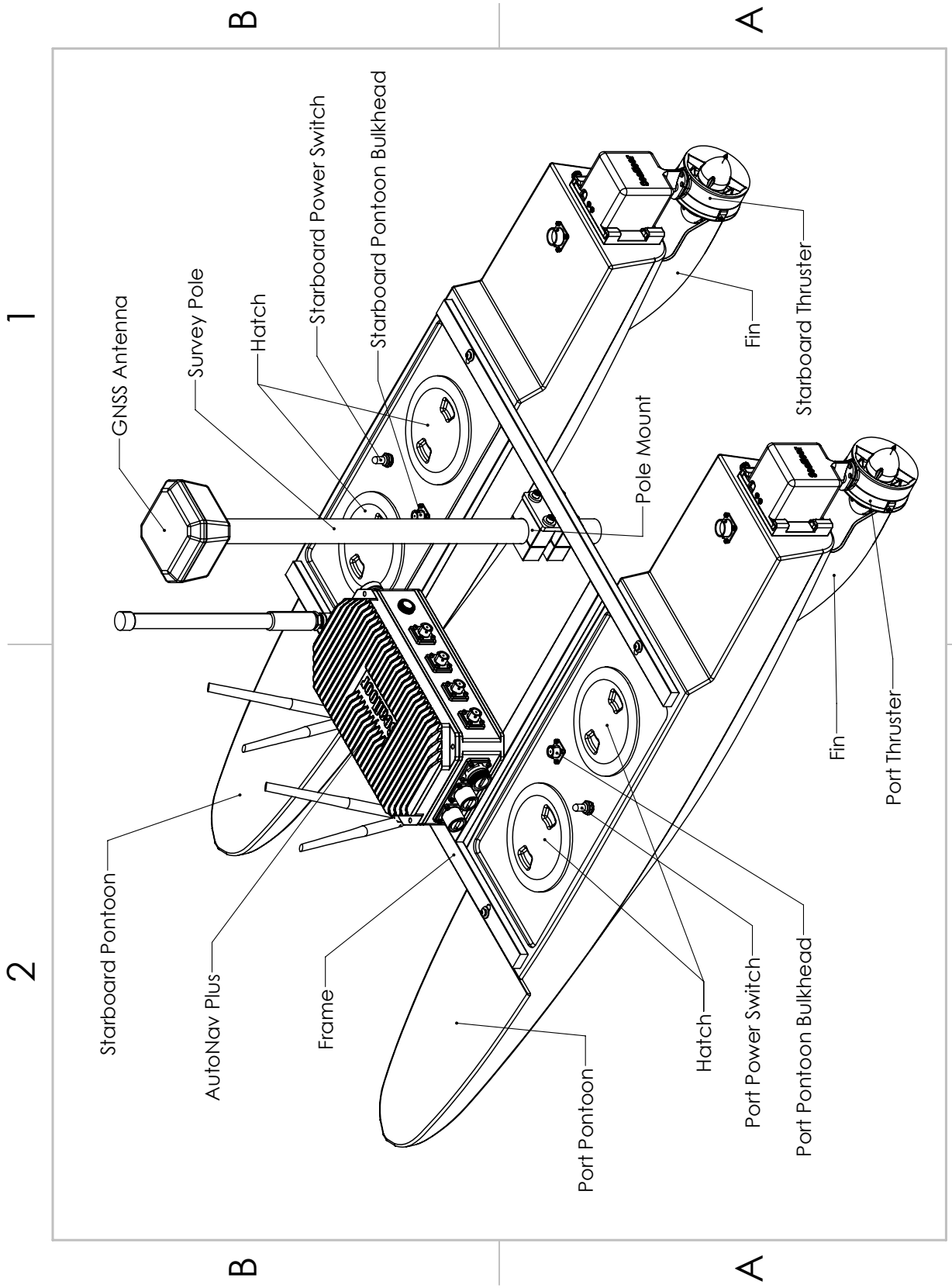



Figure 1: Hydrone™ AutoNav Plus™ Servo System Overview

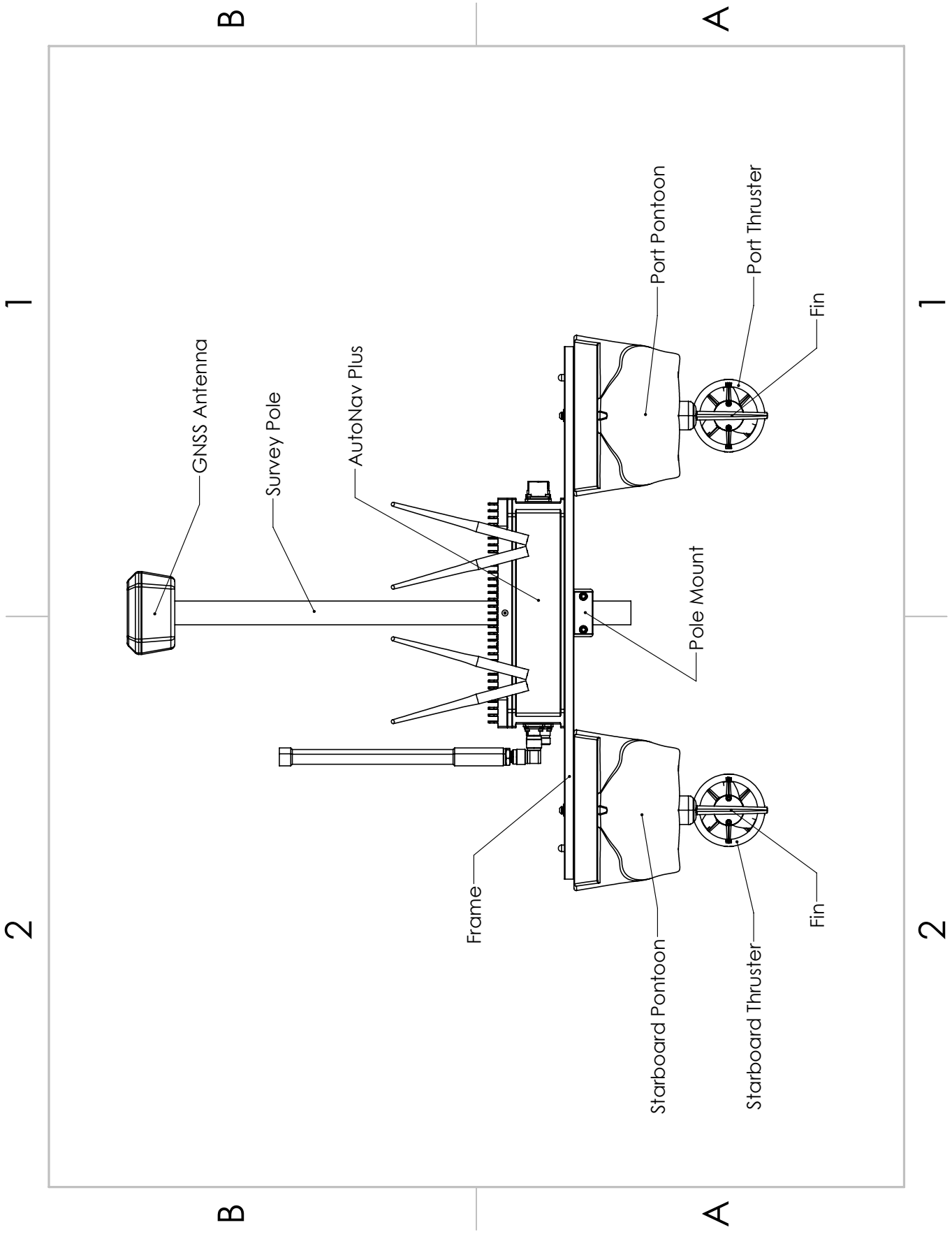



Figure 2: Hydrone™ AutoNav Plus™ Servo Front View

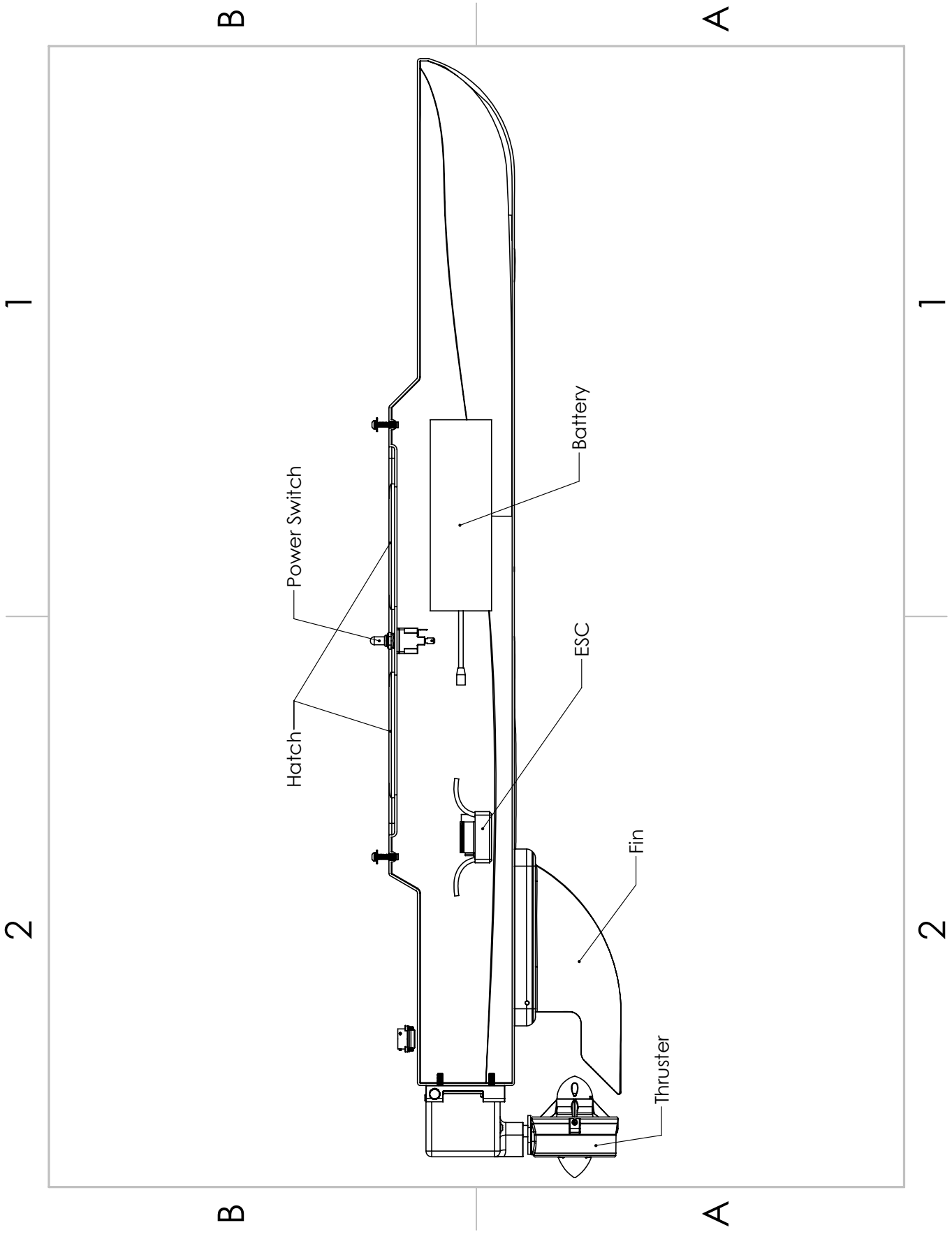



Figure 3: Hydrone™ AutoNav Plus™ Servo Side View

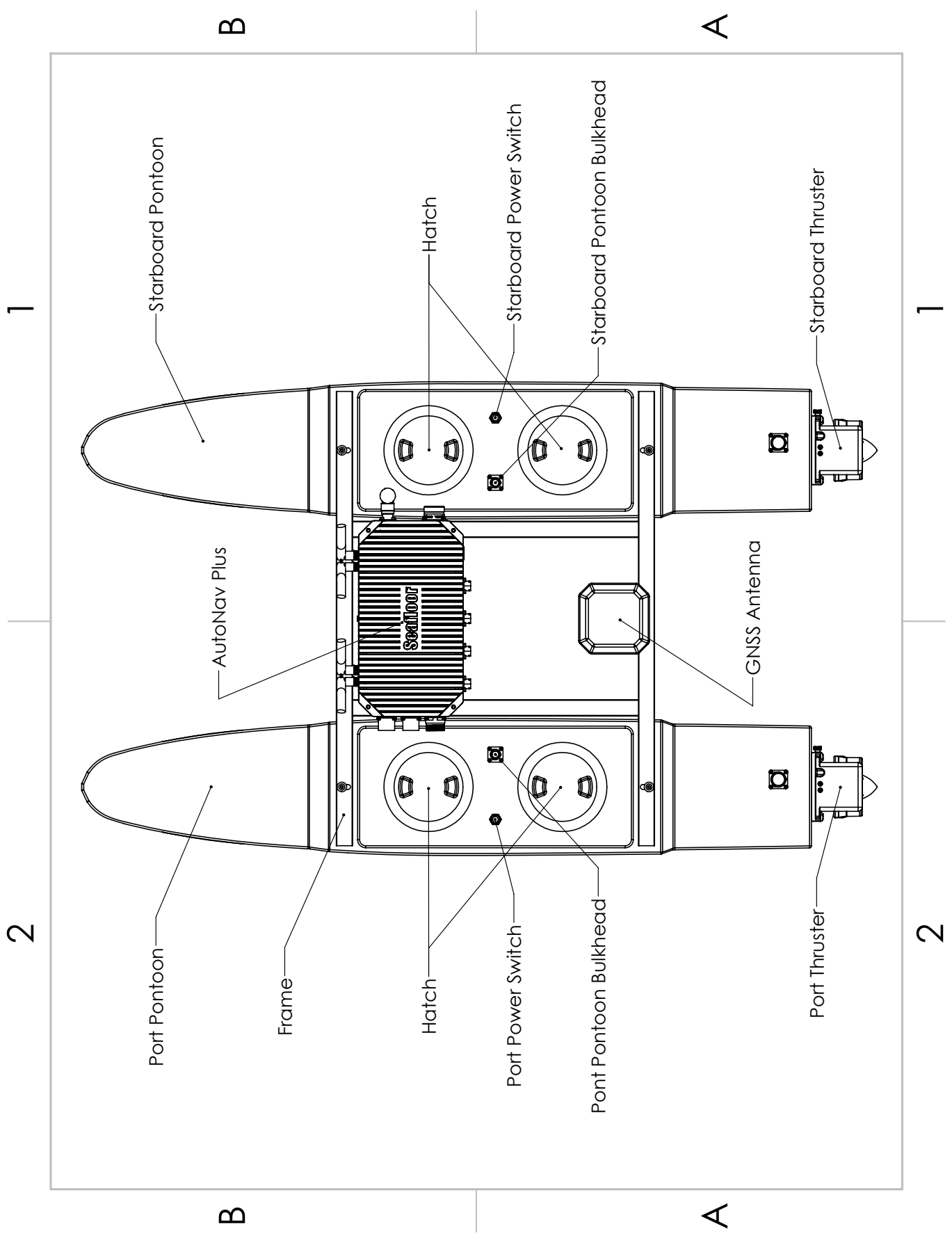



Figure 4: Hydrone™ AutoNav Plus™ Servo Top View

1. Auxiliary USB 2.0 port.
2. Auxiliary USB 2.0 port.
3. HDMI: For a monitor connection.
4. Port: To Hydrone Port Pontoon Bulkhead (Amphenol Male 6pin)
5. Starboard: To Hydrone Starboard Pontoon Bulkhead (Amphenol Female 6pin)
6. GPS: To external GPS antenna. (Amphenol Female 6pin)
7. Serial: To external serial device. (I.E Hydrolite Plus) (Amphenol Female 6pin)
8. Power Button: To power on and off the AutoNav Plus™.
9. Auxiliary Ethernet Port: 192.168.1.10 Remote Desktop IP.
10. 2.4GHz Antenna: 192.168.1.8 Remote Desktop IP - To Shoreside Antenna.
11. 2.4GHz Antennas: Onboard computer WiFi.
12. 2.4GHz Antennas: RCU receiver.

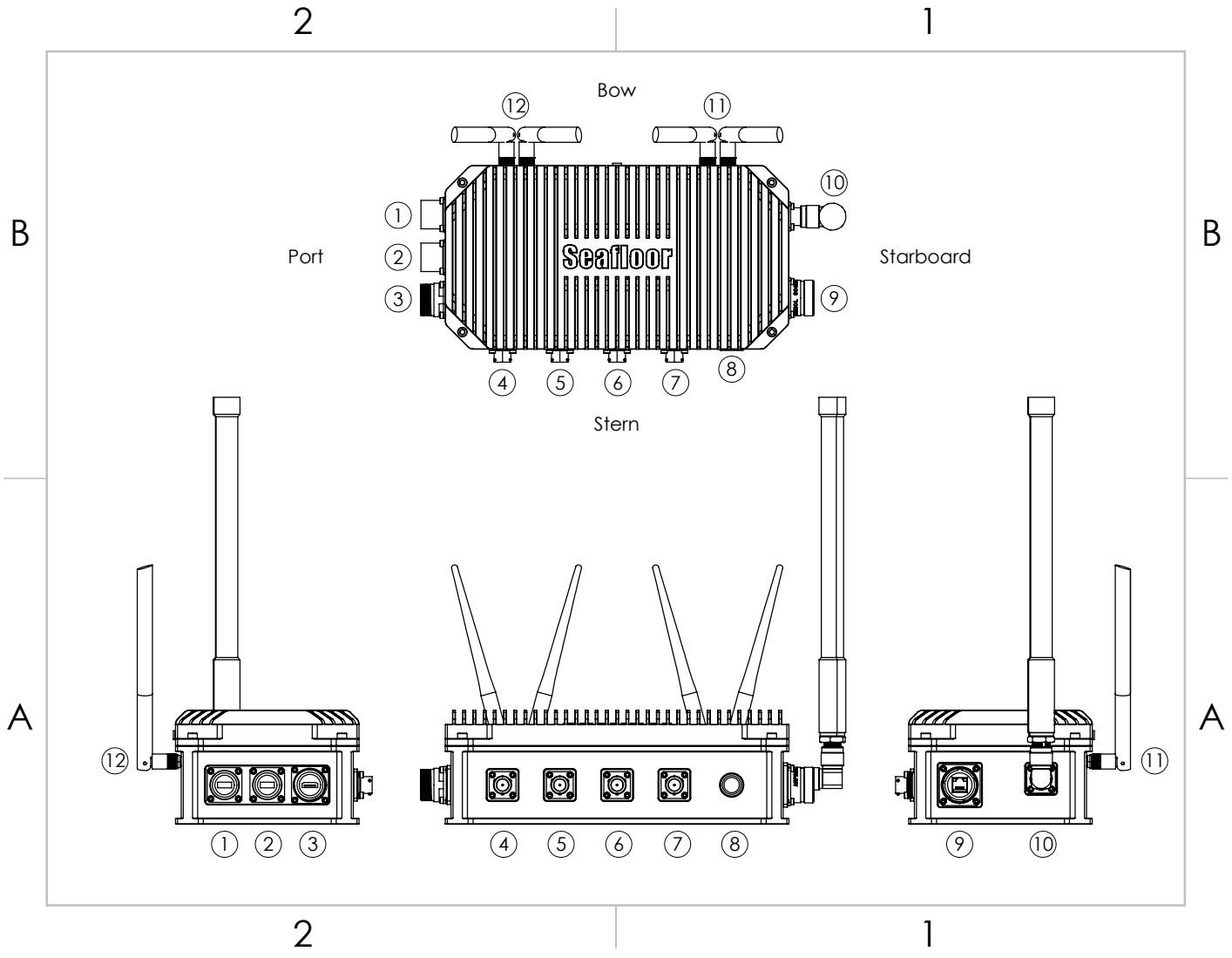



Figure 5: AutoNav Plus™ Layout

## 3.3 Assembling Your Hydrone™ AutoNav Plus™ Servo

1. Open the Hydrone™ AutoNav Plus™ Servo case.
2. The top section that houses the frame, fins, and other components can be removed and set aside.

Figure 6: Opening Hydrone™ AutoNav Plus™ Servo Case

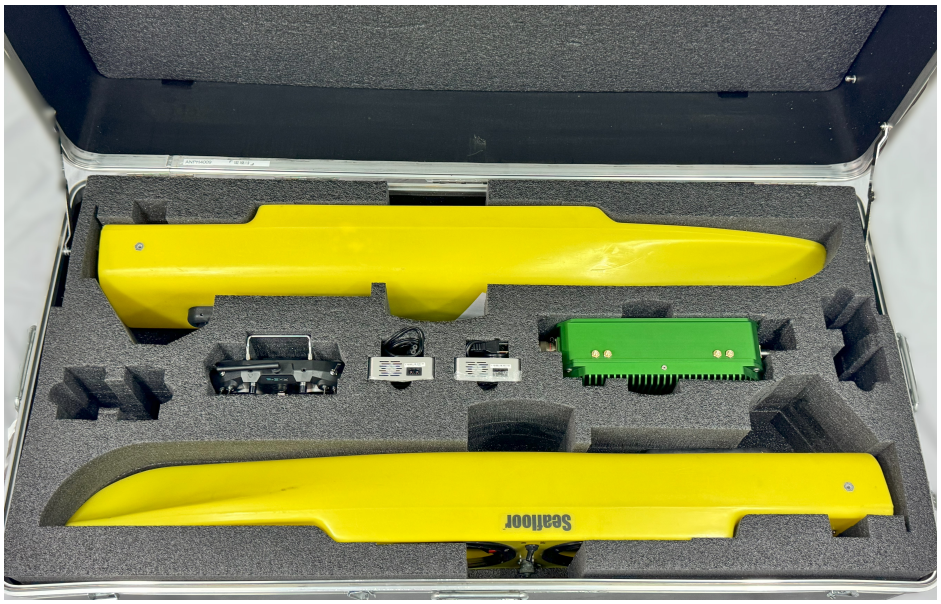



Figure 7: Removing Top Layer

3. Arrange an elevated platform for positioning the Hydrone™ AutoNav Plus™ Servo pontoons, ensuring sufficient clearance for fins and thrusters.

Figure 8: Port(Left) Pontoon

4. Space the pontoons roughly 1' (30.4cm) apart.
5. Verify the port pontoon and starboard pontoon are on their correct sides.

Figure 9: Left And Right Pontoons

- Power switches and Hydrone Stickers should be facing outward
- Using the stickers at the stern. Port is left. Starboard is right.

6. Remove the frame from the top section of foam and lay it across the two pontoons. The pole mount should be on the back half of the vessel.

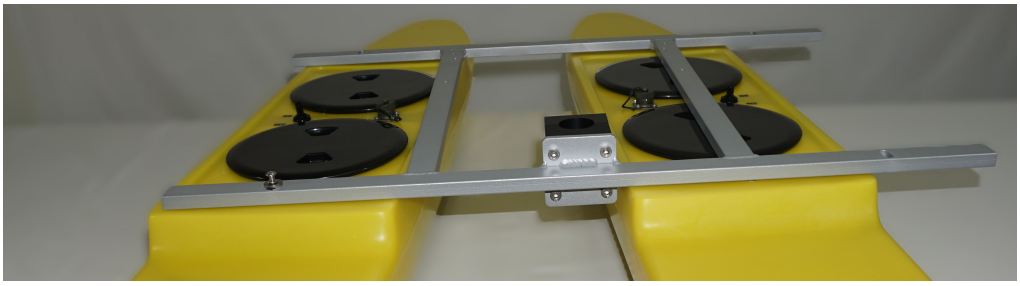


Figure 10: Pontoons Not Spaced Correctly

7. Loosely install all the supplied stainless steel frame hardware.

Figure 11: Frame Hardware

8. Tighten them with the supplied 3mm Allen driver.

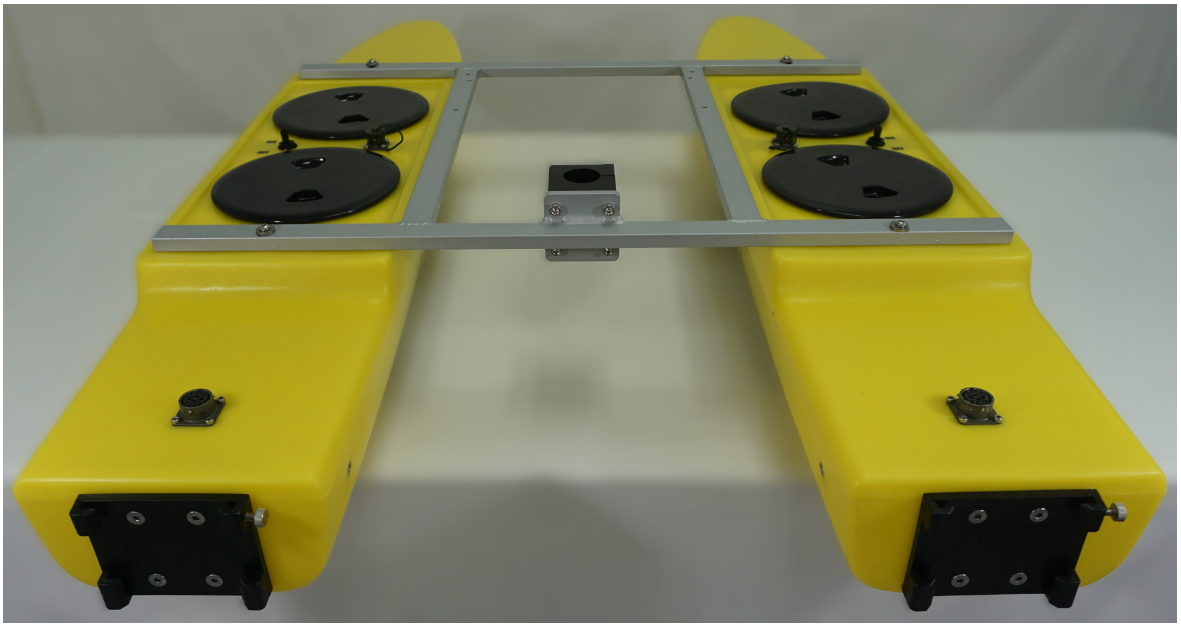


Figure 12: Frame Attached

9. Flip the Hydrone™ AutoNav Plus™ Servo upside down to gain access to the fin mount channel.
10. Slide the fin with the notch facing the bow into the fin mount channel.
11. Using the supplied 2.5mm Allen driver, tighten the set screw (circled red) to hold the fin in place.

Figure 13: Fin Installation

12. Flip the HyDrone™ right side up.
13. At the stern, install the servo thruster and slide it into it's mount. Each servo thruster will have a backing plate engraved with Left or Right. You can also confirm the correct side by the prop orientation. (Refer to Figure 15 or 5.1)
14. Tighten the thumbscrew to lock the thruster in place.
15. Connect cable into pontoon bulkhead.

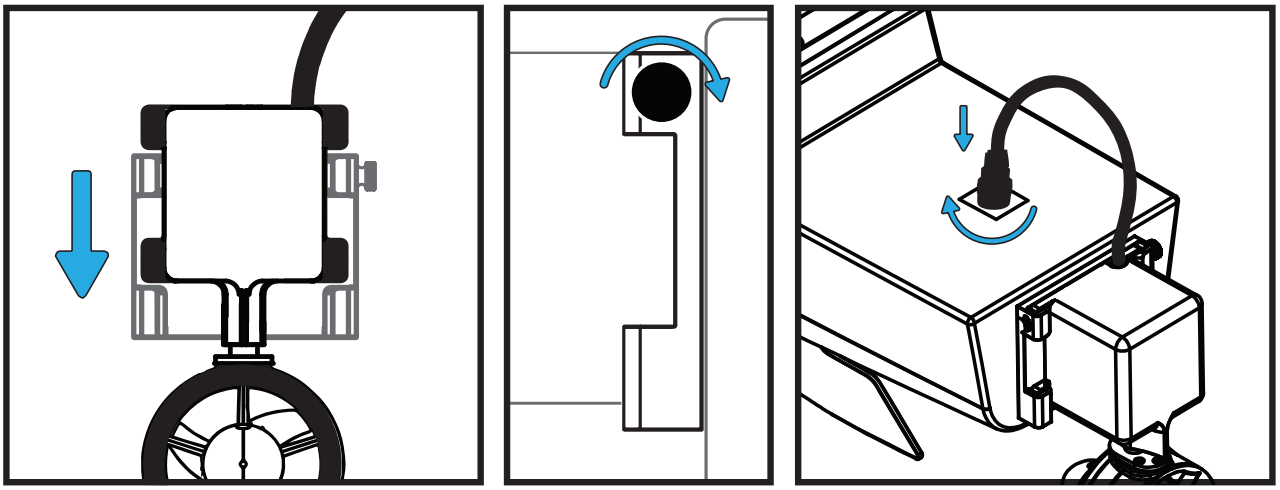
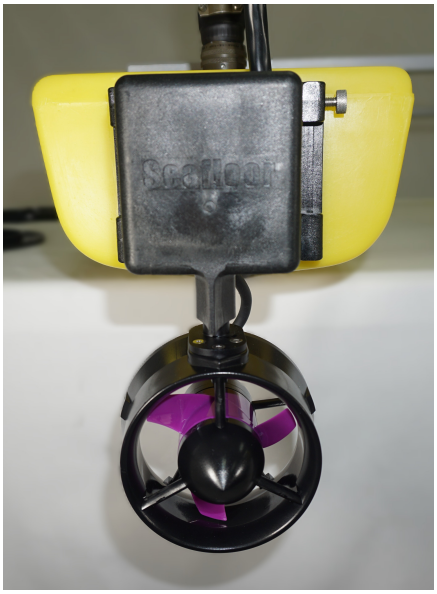
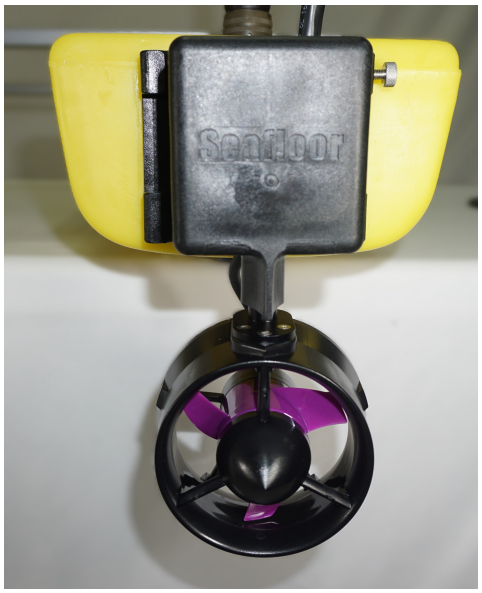


Figure 14: Servo Thruster Installation



(a) Port Servo Thruster



(b) Starboard Servo Thruster

Figure 15: Servo Thruster Locations

16. Place the AutoNav Plus™ on the Hydrone™frame. Power button facing the stern. (Figure 5)
17. Install the 4x M5x30 thumbscrew through frame into the AutoNav Plus™ box.

Figure 16: AutoNav Plus™ Mounted

18. Screw in the 4x 2.4GHz Antennas into SMA bulkheads on the front of the AutoNav Plus™.
19. Screw in the N-Type right angle with the antenna.

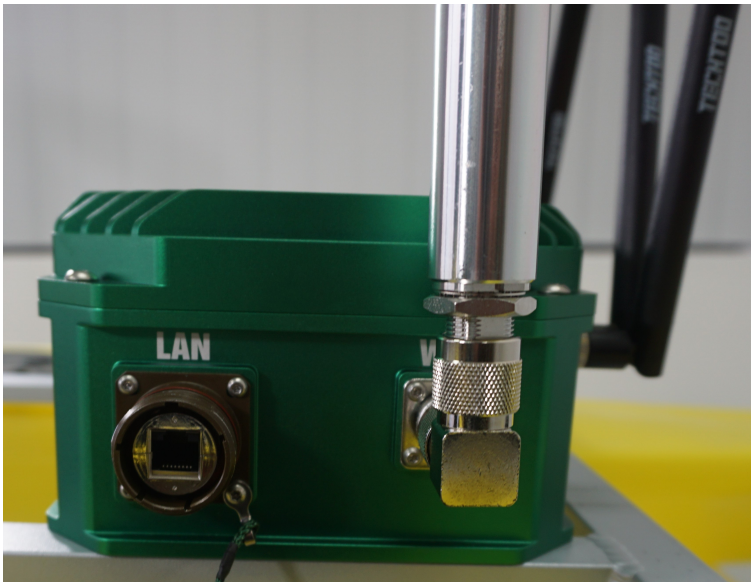



Figure 17: Antennas Installed

20. Unscrew the pontoon and AutoNav Plus™ bulkhead caps.

**Information**

Verify the Pontoon Power Data Cables have same gender cable ends. Port cable is female cable ends. Starboard cable is male cable ends.

21. Connect the Pontoon Power Data Cable between the pontoon and AutoNav Plus™. **They are gender keyed**. Female cable for port, male cable for starboard. Figure 18 below: The center same length cables are Pontoon Power Data Cables. The longer cable is for the Hydrolite Plus integration.

Figure 18: Pontoon Power Data Cables and Hydrolite Plus Cable

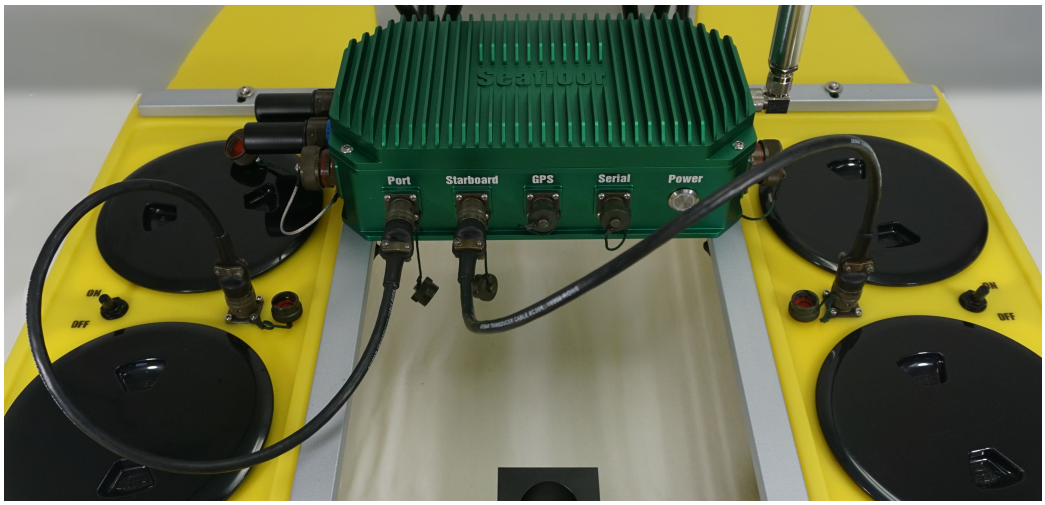



Figure 19: AutoNav Plus™ Installed

22. If using a software USB dongle, the USB cover can be installed now.

Figure 20: USB Covers Installed

**Caution**

Excessive tightening of the shell can displace the O-ring, compromising its water resistance.

USB Cover Software Dongle Installation:

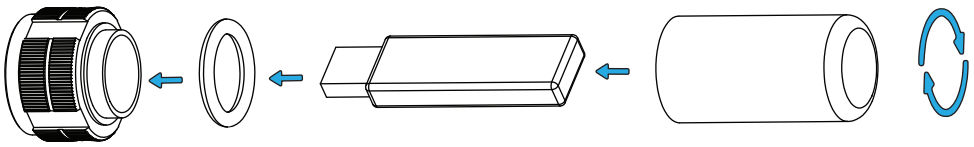


Figure 21: USB Cover Exploded View

## 3.4 Hydrone™ AutoNav Plus™ Servo Endurance Chart

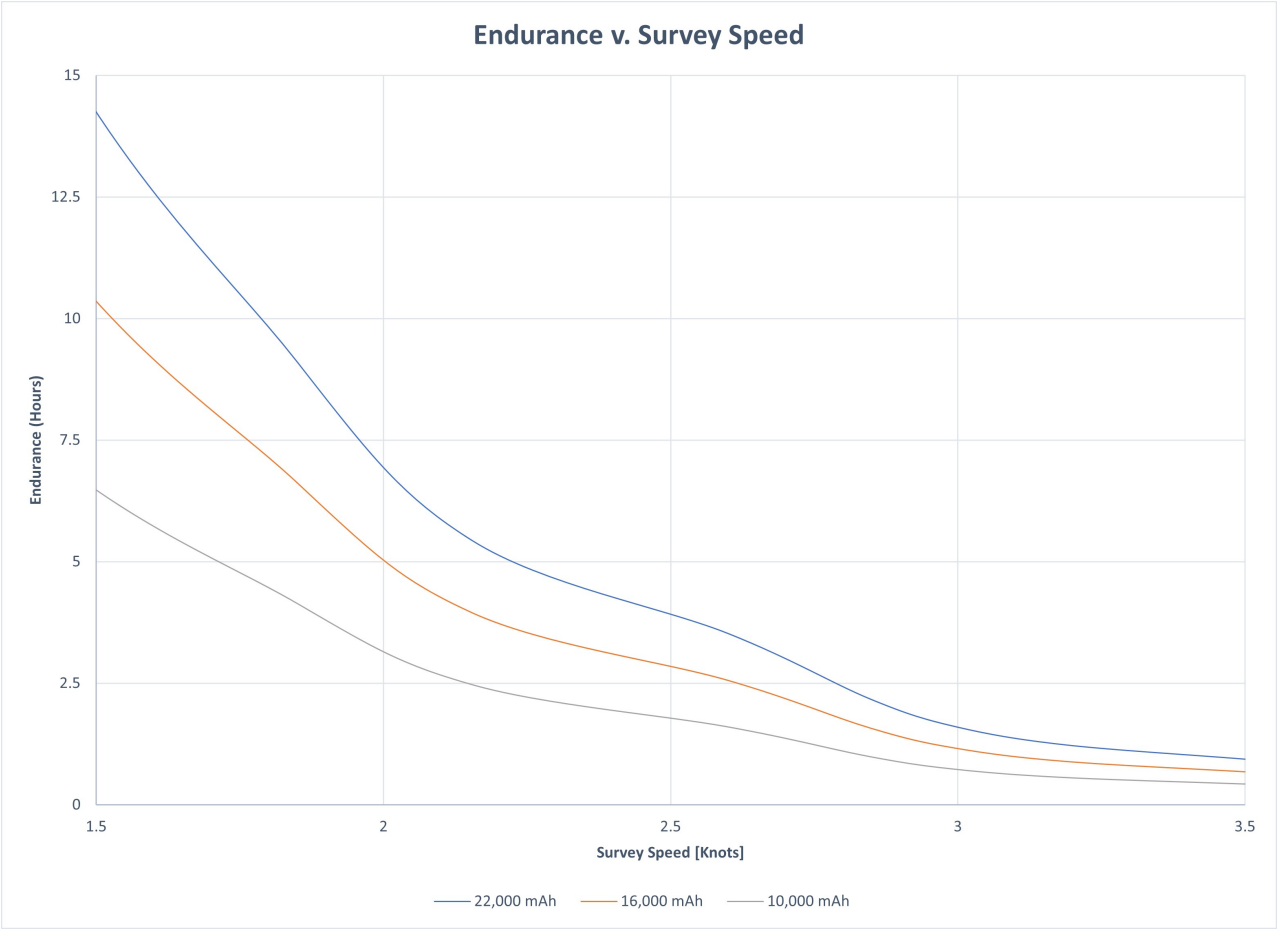



Figure 22: Hydrone™ AutoNav Plus™ Servo Endurance Chart

## 3.5 Remote Control Unit (RCU)

The Hydrone™ AutoNav Plus™ Servo is controlled by a Taranis Q-X7 Access Transmitter.

**Information**

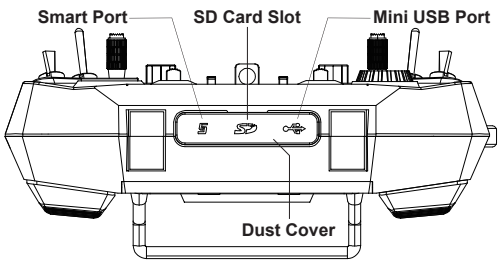



Figure 23: Bottom View

**To charge the battery:**

- Open bottom dust cover to reveal Mini USB port.
- Connect supplied USB Charging Cable.
- Connect USB A into a suitable charger source. (5VDC at 2A)

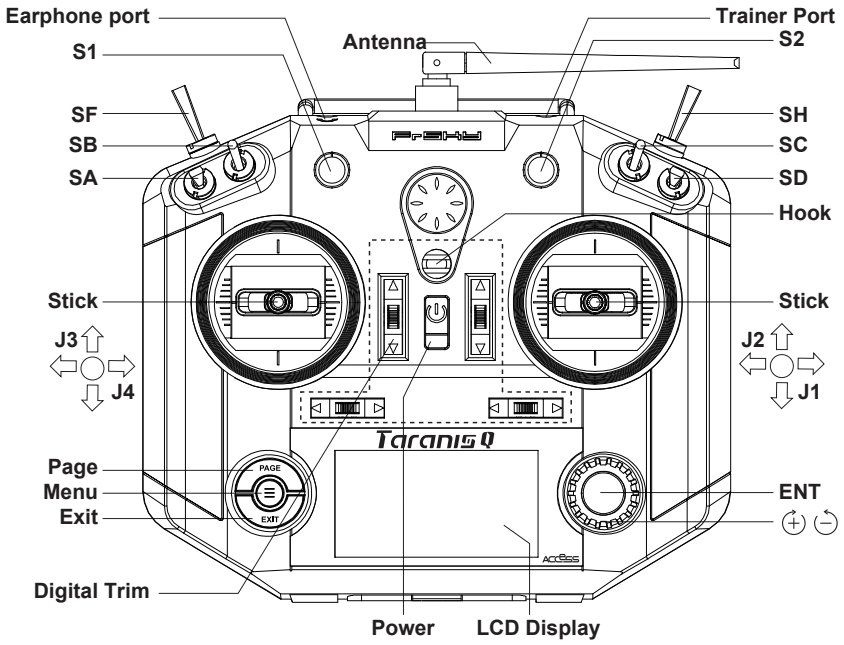



Figure 24: RCU Front View

## Remote Control Unit Functions

| | |
|---|---|
| Power | Press and hold<br>Release when the fourth loading dot appears - to power on<br>Release when the last loading dot shows - to power off |
| J1/J2 | Throttle (Up/Down<br>Steering (Left/Right) |
| J3/J4 | Unused |
| S1 | Volume<br>Clockwise to turn up<br>Counter-Clockwise to turn down |
| S2 | Unused |
| SA | Arm (Up) (+ SH down/pull)<br>Unused (Center)**(Default Position)**<br>Disarm (Down) (+ SH down/pull) |
| SB | Loiter (Up)<br>Unused (Center)**(Default Position)**<br>Unused (Down) |
| SC | Unused |
| SD | Unused |
| SF | Manual (Up/Push)**(Default Position)**<br>Auto (Down/Pull) |
| SH | Unused (Up)**(Default Position)**<br>Send Command (Down/Pull) Hold for 5 seconds.<br>To **Arm** SA up + SH down<br>To **Disarm** SA + plus SH down |
| Digit Trims | Unused |
| Earphone Port | Unused |
| Trainer Port | Unused |
| Module Bay | Unused |
| Battery Cover | RCU Internal Battery Location (Refer to Fig 25) |

Table 4: RCU Functions

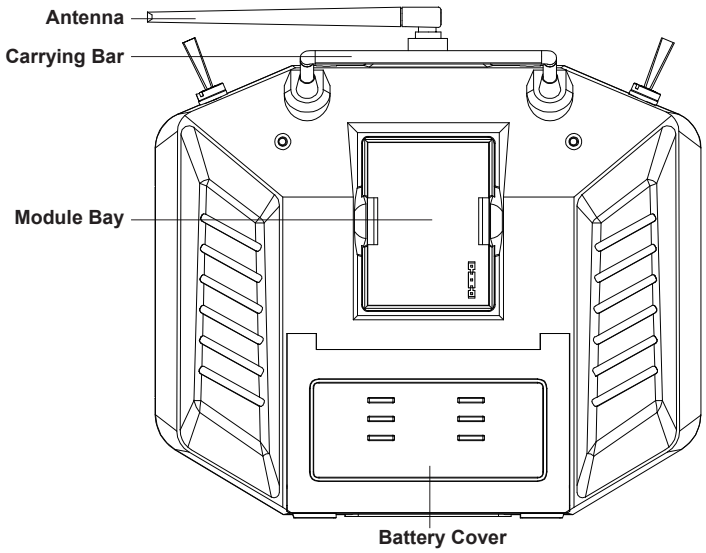



Figure 25: RCU Back View

**Information**

### To arm Hydrone™ AutoNav Plus™ Servo:

Move SA switch up and hold SH down for 5 seconds. A long alert tone (Beep——) will emit from the AutoNav Plus™, indicating system is armed. See Figure 24

### To disarm Hydrone™ AutoNav Plus™ Servo:

Move SA switch down and hold SH down for 5 seconds. A short alert tone (Beep-) will emit from the AutoNav Plus™, indicating system is disarmed. See Figure 24

## 3.6 Voltage Tester

**Information**

Max voltage of a 4S battery is 16.8VDC. (4.2VDC/Cell)

### Connecting to a Voltage Tester:

1. Connect the balance cable connector to the voltage tester.
2. Due to the versatile nature of the voltage tester, it may take a few configurations to connect correctly.

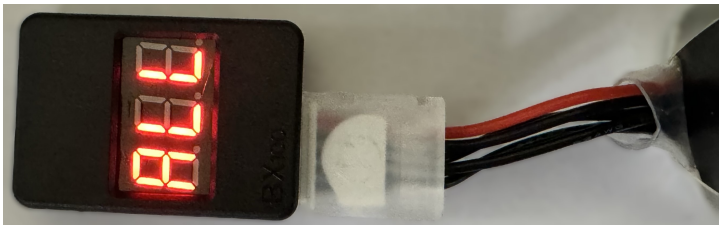


Figure 26: LiPo Voltage Tester

3. The voltage tester will cycle from overall voltage to each cell voltage.
4. It is recommended to check every battery prior to operation.

## 3.7 Battery Charging

### 3.7.1 E4 Cube Charger

**Important Alert**

Never leave batteries unattended while charging. Batteries on charge MUST remain under constant observation so that you may react quickly should any problems arise.

**Caution**

Max voltage of a 4S battery is 16.8VDC. (4.2VDC/Cell)

**Caution**

### Charging LiPo Battery: with E4 Cube Balance Charger

1. Using the supplied voltage tester, verify each cell is above 3.2V, below 4.2V, and within 10% of each other.
2. Plug the E4 Cube charger into an AC 100-240VAC/50-60Hz outlet. Note that the battery is not connected to the charger currently.

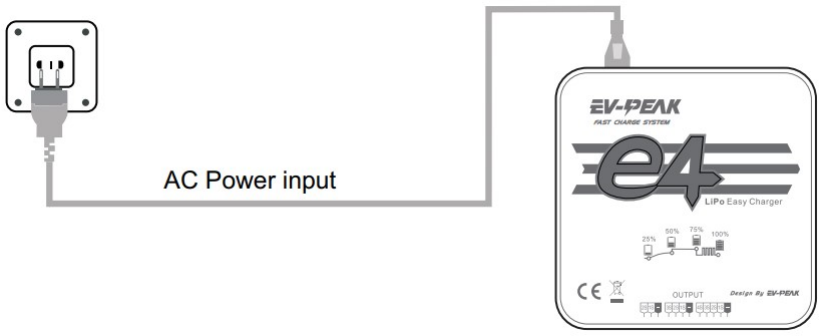



Figure 27: Cube Balance Charger Power

3. Charger will run a self-check. Wait for LED 1, 3 and LED 2, 4 to blink alternately before proceeding.
4. Connect the 4S 14.4V LiPo battery balance cable to the 4S (right) port.

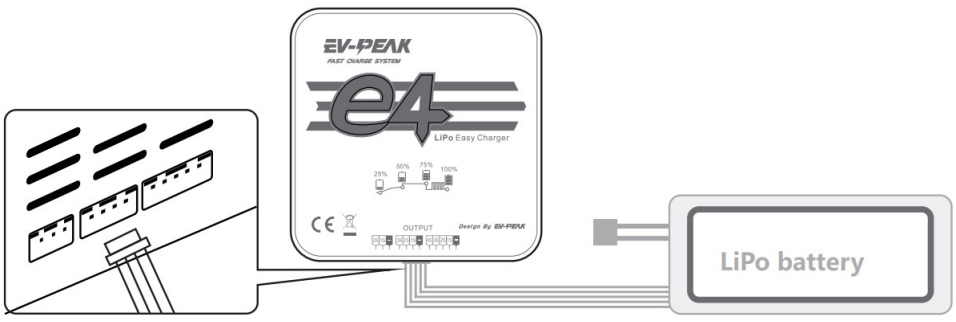



Figure 28: Cube Balance Charger Connection

5. After connecting the battery, the LED will blink and indicate the battery capacity percentage.
   - First LED indicates 25% capacity
   - Second LED indicates 50% capacity
   - Third LED indicates 75% capacity

- Fourth LED indicates 100% capacity
- Four LEDS will always be on when the battery is fully charged

6. When the battery is fully charged, disconnect the AC power first. Then disconnect the LiPo battery.

## Technical Data

| **Property** | **Value** |
|---|---|
| AC Input | 100-240VAC |
| Rated Voltage | 2S - 4S |
| Maximum charge current | 4A |
| Charge Mode | Balance |

Table 6: E4 Cube Balance Charger Technical Data

### 3.7.2 Optional - Spektrum Charger

**Important Alert**

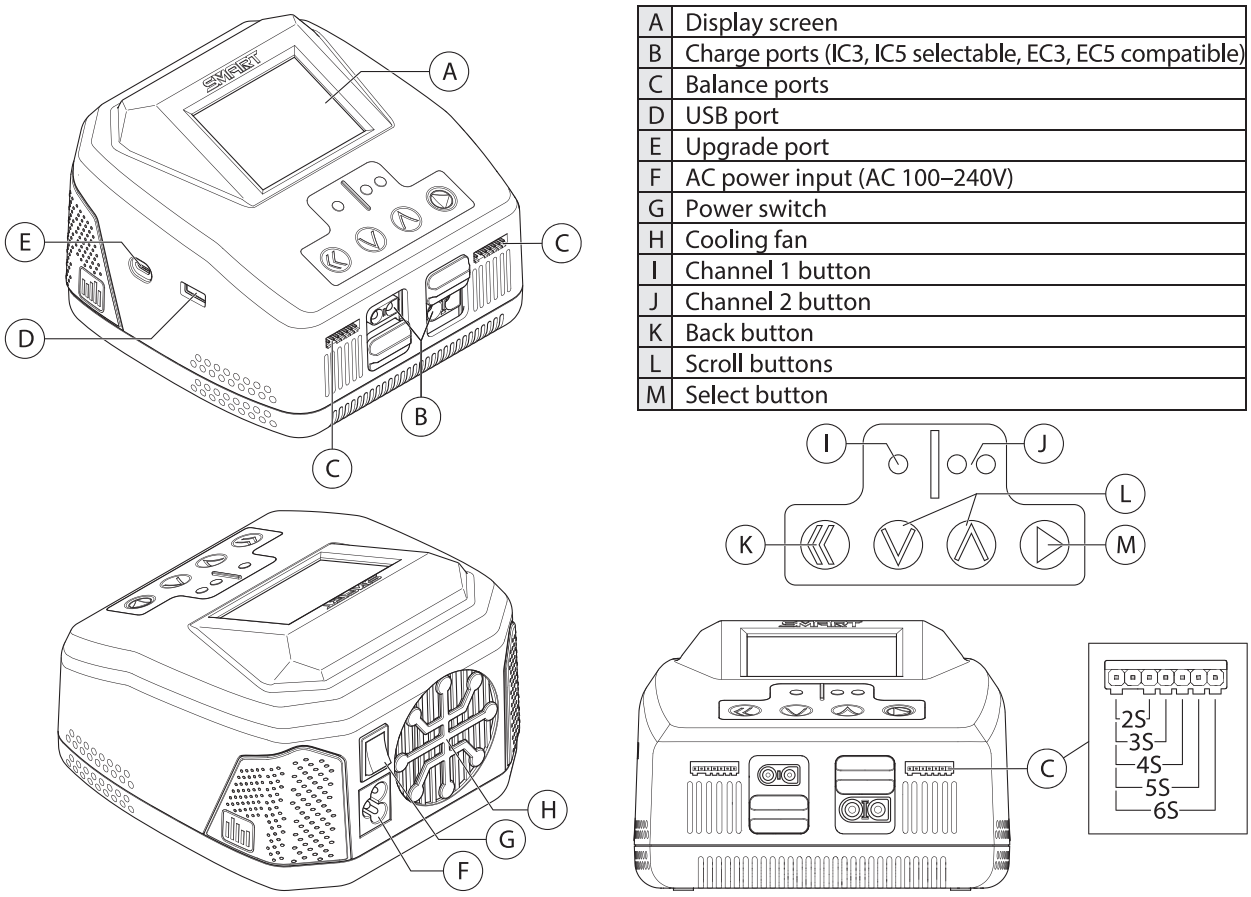
Never leave batteries unattended while charging. Batteries on charge MUST remain under constant observation so that you may react quickly should any problems arise.

**Caution**

Max voltage of a 4S battery is 16.8VDC. (4.2VDC/Cell)

**Caution**

**Charging LiPo Battery:** with Spektrum Charger




| | |
|---|---|
| A | Display screen |
| B | Charge ports (IC3, IC5 selectable, EC3, EC5 compatible) |
| C | Balance ports |
| D | USB port |
| E | Upgrade port |
| F | AC power input (AC 100–240V) |
| G | Power switch |
| H | Cooling fan |
| I | Channel 1 button |
| J | Channel 2 button |
| K | Back button |
| L | Scroll buttons |
| M | Select button |

Figure 29: Spektrum Charger Layout

1. Using the supplied voltage tester, verify each cell is above 3.2V, below 4.2V, and within 10% of each other.
2. Plug the S2200 G2 Smart Charger into an AC 100-240VAC outlet. Note that the battery is not connected to the charger currently.
3. The charger will initialize and display the home screen, which indicates that the charger is ready to be used.
4. Locate the charger adapter cables. Female IC5 connector to male XT90.
5. Connect male IC5 into the charger. Slide the port cover down to access the female IC5 connector.

6. Connect the female XT90 from the 4S LiPo into the male XT90 on the adapter cable. Then, connect the balance lead into the charger.

7. Press and release the menu/select button to display the charger settings list.

| | |
|---|---|
| Task | Select Charge, Discharge, or Storage |
| Battery (Type) | Select LiPo |
| Cells (Cell Count) | Select 4 cells for 4S LiPo battery |
| Current | Select **10A** for 10,000mAh, **16A** for 16,000mAh and **20A** for 22,000mAh batteries |
| Start | Start the charger cycle |
| Smart Battery Settings | N/A |
| System Settings | Charger Settings |
| Charger History | Displays number of charger cycles per day, total number of cycles, charger temperature, and input power |

Table 7: Spektrum Charger Settings

8. Select the 'Charge Task' option to charge the battery.

9. Confirm the settings are correct for the battery.

**Important Alert**

WARNING: Always check charging parameters before initiating the charge process. Charging any battery with improper settings, including charging a battery in the wrong mode, can result in property damage and fire.

10. Scroll to the 'Start' menu item. Press and release the 'Select' button to begin charging.

11. During the charging process the main screen will provide the following information:

    (a) Charge percentage

    (b) Battery data

    (c) Charge rate

    (d) Capacity rate

    (e) Total charge time

12. To view additional cell voltage (scroll to the next screen)

    (a) To stop the charging cycle, press and release the 'Back' button during charge or press and hold the 'Menu' button.

    (b) Select the 'Stop' menu item. The charger will then return to the home screen.

13. When charging is complete the charger will beep once to indicate fast charging is done. When the charger is finished balancing the battery it will double beep twice.

    (a) The main screen will display a green battery bar at the top to indicate the battery is full and the charging process has finished.

    (b) The total capacity charged and total charge time will be displayed.

14. Disconnect the battery from the charger.

**Information**

**Charger error – If the charger displays an error, follow the on-screen prompts to remedy the error. If necessary, disconnect the battery from the output and balance ports, disconnect the power supply, and then restart the charger.**

**Technical Data**

| | |
|---|---|
| Input Voltage | 100-240 VAC |
| Charge Current | 0.1 - 20.0A |
| Discharge Current | 0.1 - 1.5A |
| USB Output | 5V / 2A |
| Max Charge Power | 2x200W |
| Max Discharge Power | 10W |
| Balance Current | 1.5A/cell |
| Balance Cells | 1-6s |

Table 9: Spektrum Charger Technical Data

## 3.8 Pre-Launch Check List

- Check all RCU switches and knobs are in correct positions for power on. **Ensure volume knob is fully clockwise**. (Refer to 3.9)
- Check that no warnings are displayed when RCU is powered on. Determine cause of any warning and correct.
- Check that no alarms are heard (**See volume knob note above**) or felt (Haptic Vibration Feedback System).
- Check model displayed on main screen is correct. (Figure 73)
- Check RCU battery voltage level is sufficient to perform lake test. 6-8.5VDC
- Check pontoon battery voltage level is sufficient to perform lake test. 13.6-16.8VDC
- Check propulsion system functions properly with manual control.
- Check the GPS system is fully charged.
- Check the AutoNav Plus™ is receiving accurate GPS position in Mission Planner.
- Check the AutoNav Plus™ has the correct heading in Mission Planner.
- Check the AutoNav Plus™ does not show any errors in Mission Planner.

## 3.9 Hydrone™ AutoNav Plus™ Servo Power On Procedure

**Caution**

- Disconnect the batteries of the Hydrone™ AutoNav Plus™ Servo at 12.8VDC (3.2VDC/Cell) to avoid irreversible damage. (Refer to 1.4)
- To extend the battery life of the Hydrone™ AutoNav Plus™ Servo, it is advisable to power it off when the voltage reaches 13.6VDC (3.4VDC/Cell). (Refer to 1.4)

**Information**

1. Power on the RCU. (Refer to 3.5)
2. Verify the right joystick is centered.
3. Install fully charged 4S 16.8VDC (4.2VDC/Cell) batteries into each pontoon. Connect the female XT90 connector of the battery to the male XT90 connector of the power switch.
4. Power on the AutoNav Plus™. Three step up tones can be heard roughly 10 seconds after powering on, indicating that the AutoNav Plus™ is initialized.
5. Power on both pontoon switches (Figure 1), wait 15 seconds for the ESCs to initialize with a series of beeps.
6. Arm the Hydrone™ AutoNav Plus™ Servo with the RCU. (Refer to 3.5)
7. Verify controls function correctly. (Refer to 5.1)
8. Secure all hatches before launching vessel with the hatch wrench.

**Caution**

Do not run thrusters for more than a few seconds out of the water.

### Powering the AutoNav Plus™ without the Hydrone™

1. Remove the port and starboard pontoon cables.
2. Connect the DC power cable into the port bulkhead.
3. Connect a 4S LiPo battery to the male XT90 connector.
4. Power on the AutoNav Plus™.

**Information**

The AutoNav Plus™ features hot-swappable electronics, allowing you to seamlessly disconnect one pontoon battery and replace it with a fully charged one, ensuring uninterrupted power while keeping the AutoNav Plus™ operational using the other pontoon battery.

## 3.10 Shoreside Setup Communications

**Information**

- Let the Ethernet ports and Bridge Antennas initialize before connecting through Remote Desktop. If not given enough time, the connection will attempt to initiate and fail.
- It is not recommended to use an Ethernet to USB adapter.
- If multiple Seafloor Systems vessels are operating in the same zone. Please contact Seafloor Systems to modify Bridge settings.

**Information**

## Hardware setup:

1. Connect the 10ft(3m) Ethernet cable into the Shoreside Bridge Antenna.
2. Connect the other end of the Ethernet cable into the PoE adapter.
3. Connect the PoE Ethernet adapter into the shoreside laptop being used to remote into the Hydrone™ AutoNav Plus™ Servo.
    - Shoreside laptop supplied by customer and recommended to have an Ethernet port.
4. Connect the barrel connector from the power adapter into the PoE adapter.
5. Plug the power adapter into an AC source. 100-240VAC/50-60Hz

Figure 30: Shoreside Hardware Setup

## Software setup (Windows 11):

1. Right click the WiFi icon on the taskbar.

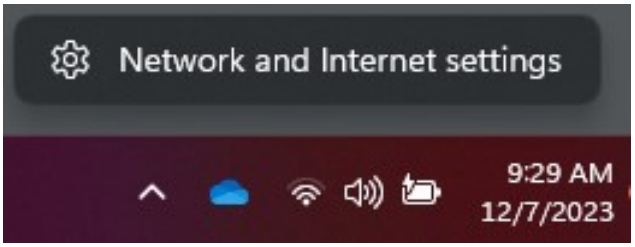



Figure 31: Network And Internet Settings

2. Open Network and Internet Settings.
3. Open Advanced Network Settings.

Figure 32: Advanced Network Settings

4. Open More Network Adapter Options.

Figure 33: Network Adapters

5. Right click on the Ethernet port with the description "Unidentified Network" and select Properties.

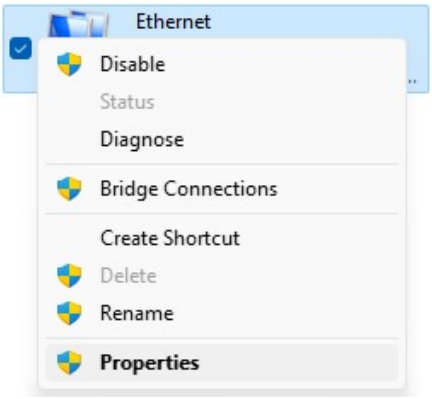



Figure 34: Ethernet Properties

6. Double click "Internet Protocol Version 4 (TCP/IPv4).

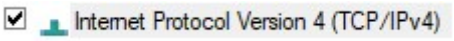



Figure 35: Internet Protocol

7. Change the follow settings:

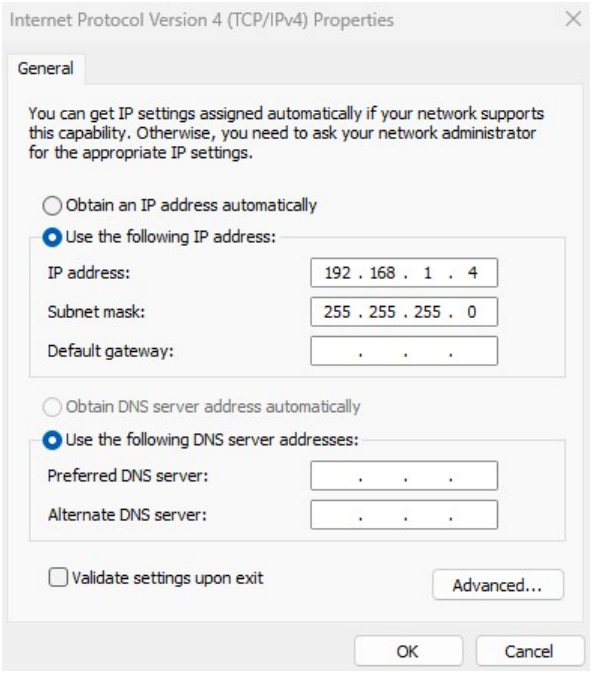



Figure 36: Ethernet Settings

- Use the following IP address:
  - IP address: 192.168.168.4
  - Subnet mask: 255.255.255.0
- Leave Preferred DNS and Alternate DNS servers blank.

## To Login:

1. Search "Remote Desktop" in the windows task bar and select it.

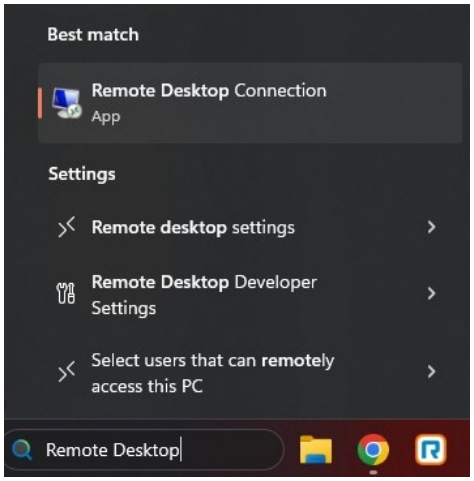



Figure 37: Taskbar Search

2. Type in 192.168.1.8 for the Computer.
3. Using "Show Options", change User name to "ANP".

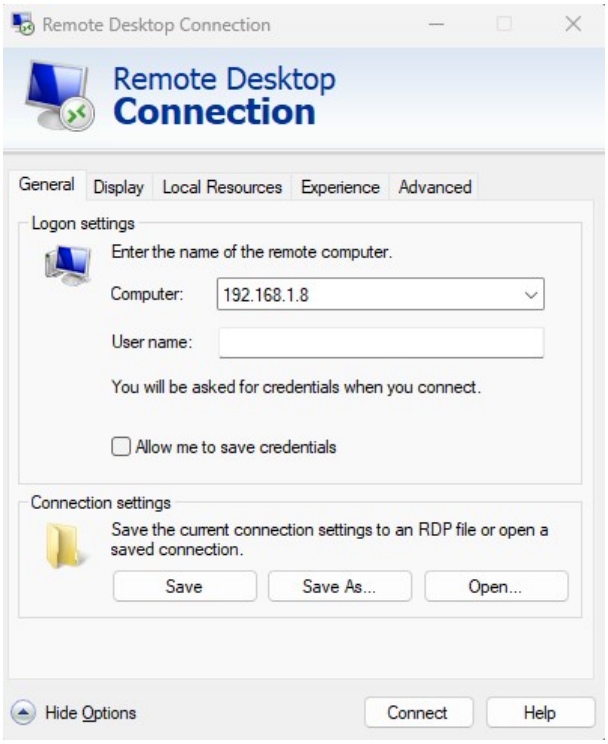



Figure 38: Remote Desktop Connection

4. Click Connect.
5. Password is "Seafloor".

## 3.11 Manual Operation

Hydrone™ AutoNav Plus™ Servo is a directed steered vessel. The right joystick controls both throttle and steering. Must have forward or reverse thrust for steering.

- Adjust speed using the RCU's throttle control: push forward for forward motion, pull back for reverse, and center for neutral.
- To turn left, move the right joystick to the left. For a right turn, move the right joystick to the right.
- Familiarize yourself with the controls in a safe area to get a feel for the boat's responsiveness.
- Be mindful of the apparent opposite steering when the Hydrone™ AutoNav Plus™ Servo is headed toward you.

## 3.12 Autonomous Operation

### 3.12.1 Mission Planner

**Information**

Seafloor Systems AutoNav Plus™ requires two NMEA input GPS strings. GPS/GNSS system not provided by Seafloor, will need to be configured to output the required NMEA strings.

- GGA and RMC at 5Hz with a GP Talker ID(Prefix) at 38400 baud rate. RS232 Protocol with DB9 connector. USB to DB9 adapter does not work.
- Example:
  - $GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47
  - $GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

**Caution**

Important: The AutoNav Plus™ navigates using GPS waypoints, users should toggle to Manual mode to avoid objects and always maintain line of sight
AutoNav Plus™ does have a Return to Home(Launch) function, it is not enabled on the RCU. To activate in Mission Planner, navigate to the Data tab and below the Heads Up Display (HUD). On the Actions tab, click RTL. (Return to Launch)

**Caution**

Below will show you how to setup a mission in Mission Planner. However, it's important to note that a mission can be started one of two ways.

- RCU - using the SF switch. (Refer to 3.5)
- Software - Mission can be started via HUD Actions.

*If started with software, the toggle switch will be in "Manual". To stop the survey, you must toggle the switch to "Auto" then back to "Manual". Same goes for the opposite scenario.*

**Information**

Internet connection is required to view satellite background images.

**Caution**

Do not assume satellite images of water level are correct. Always drive the perimeter with the Hydrone™ AutoNav Plus™ Servo.

**Mission Planner:**

1. Open Mission Planner.
2. Connect to the AutoNav Plus™.

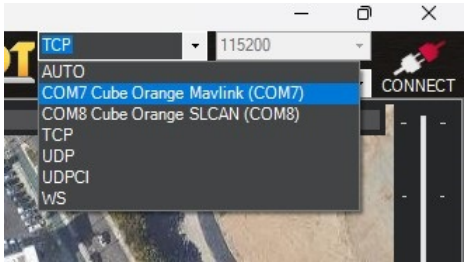



Figure 39: COM Port

   - Choose Mavlink COM port
   - 115200 baud rate

3. Click PLAN.
4. Find your survey area.
5. Click the circled polygon in the top left and select 'Draw a Polygon'.

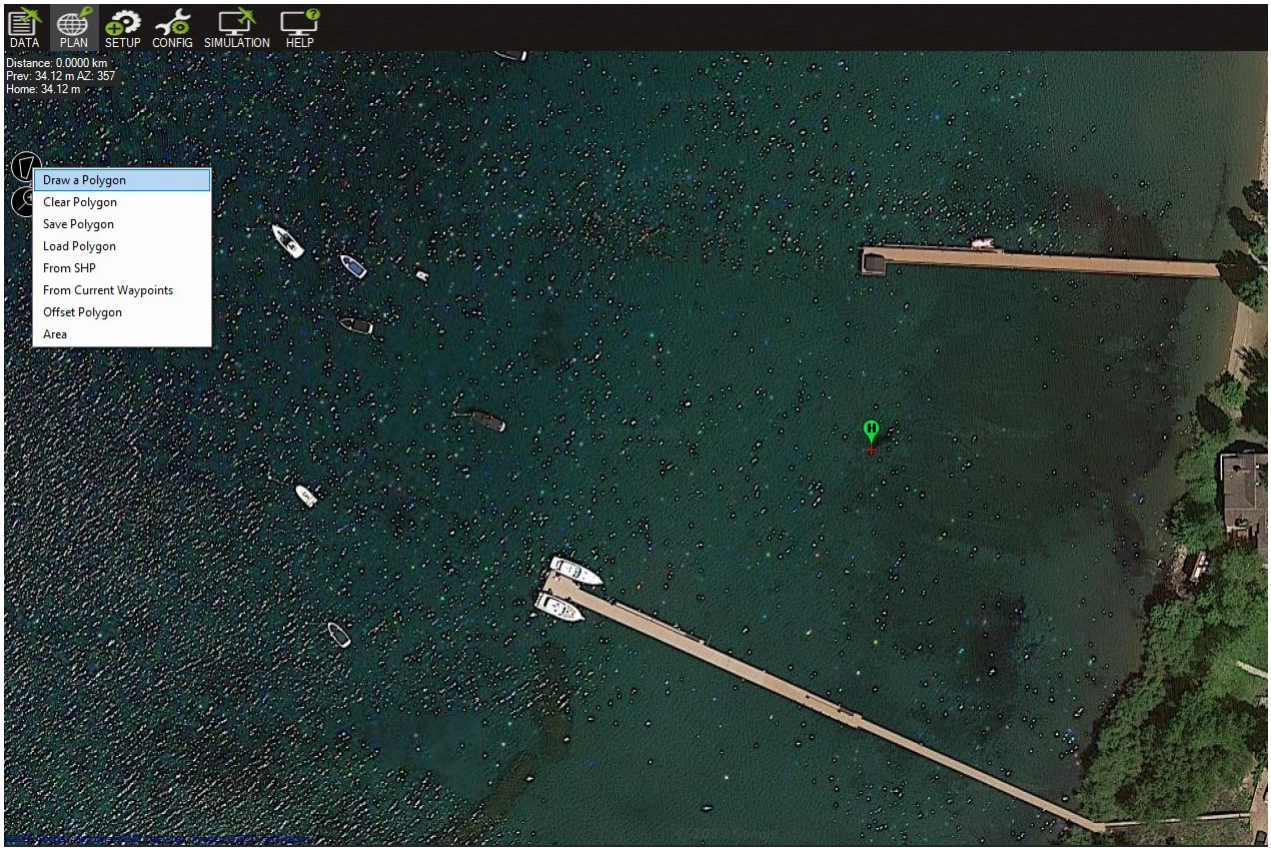



Figure 40: Polygon Select

6. Click on the survey area to define the borders of the survey. Use mouse to drop red polygon points to outline survey area.
    - Give enough distance for tides. Can also manually drive the Hydrone™ AutoNav Plus™ Servo to desired location and drop polygon points at each extent.
7. Right click survey area. Highlight 'Auto WP' and select 'SimpleGrid'.

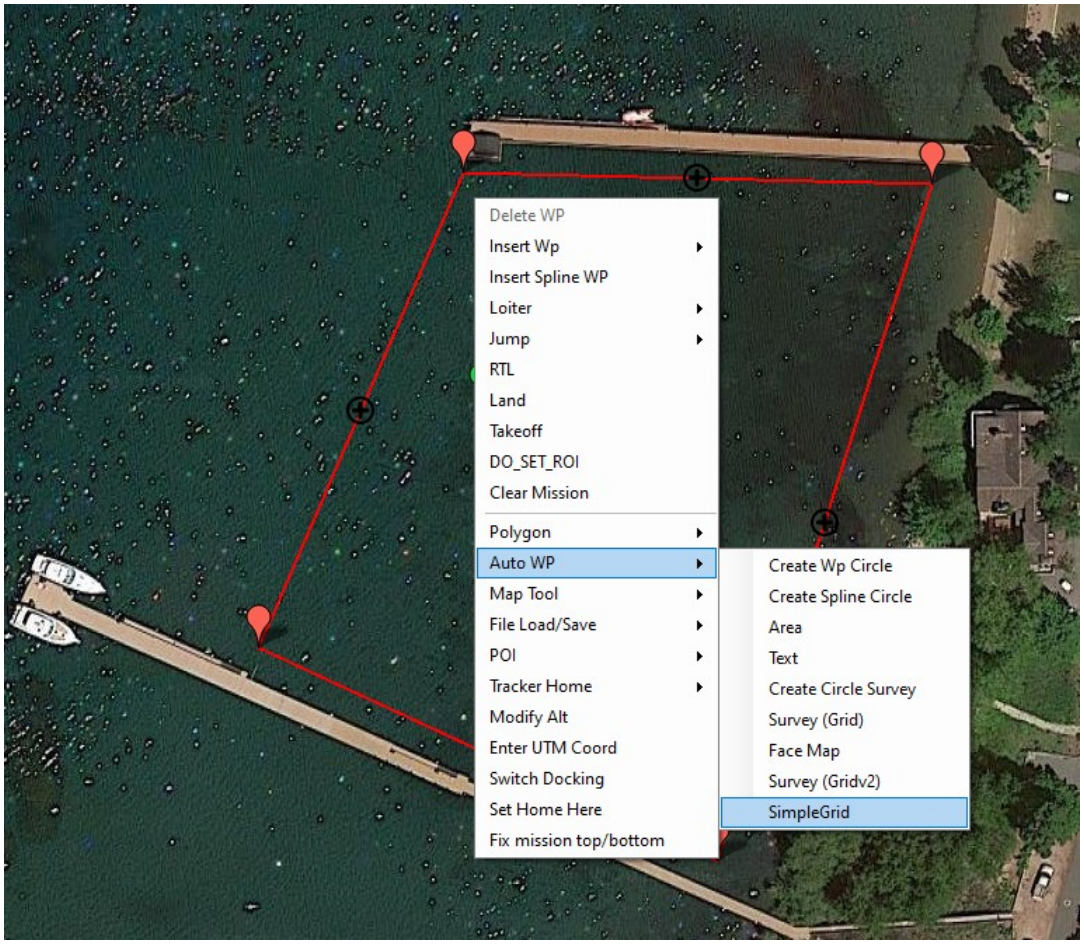



Figure 41: SimpleGrid Select

| | |
|---|---|
| Altitude | Leave as is |
| Angle | Change the angle of the survey |
| Line spacing | Distance between lines, dependant on your swath width |
| Spacing inline | Increase until only start/end are present |
| Overshoot | Leave as is |
| Overshoot | Leave as is |
| Speed | Drop down to survey speed or delete later |
| Start From | Leave as is |

Table 10: SimpleGrid Settings

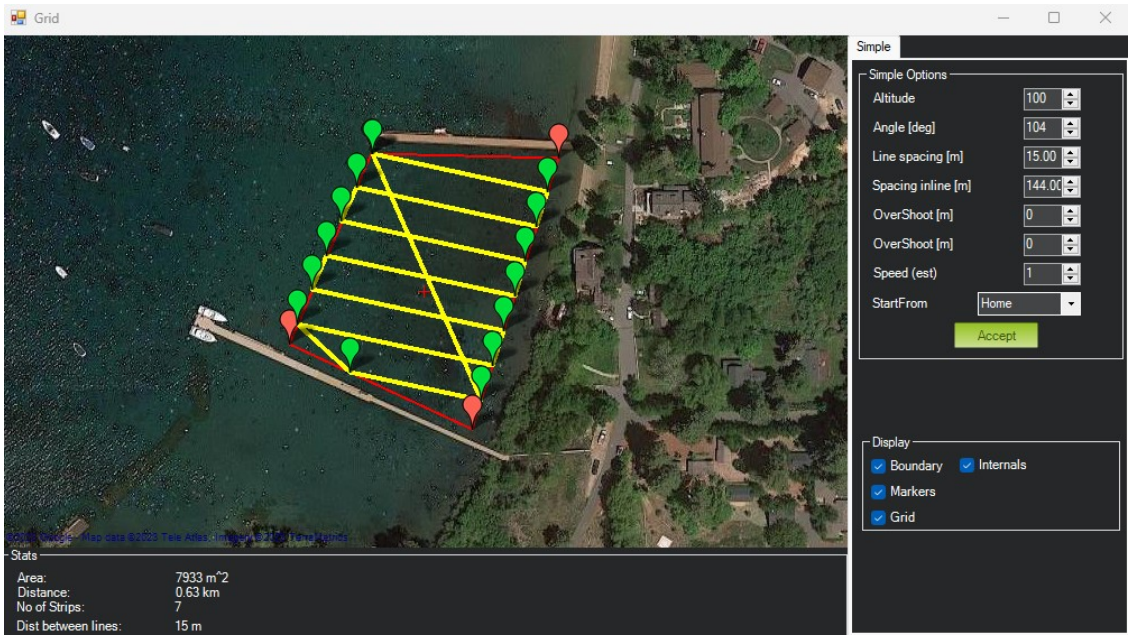



Figure 42: SimpleGrid Settings

8. Delete the first command, speed change.

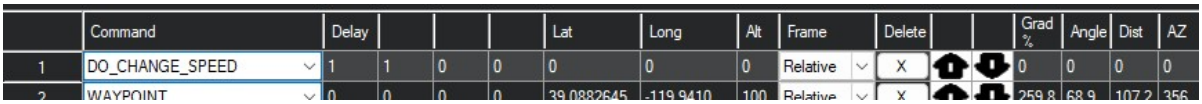



Figure 43: Delete DO_CHANGE_SPEED

- By deleting it will revert back to default survey speed.

9. Click 'Write' on the right panel.

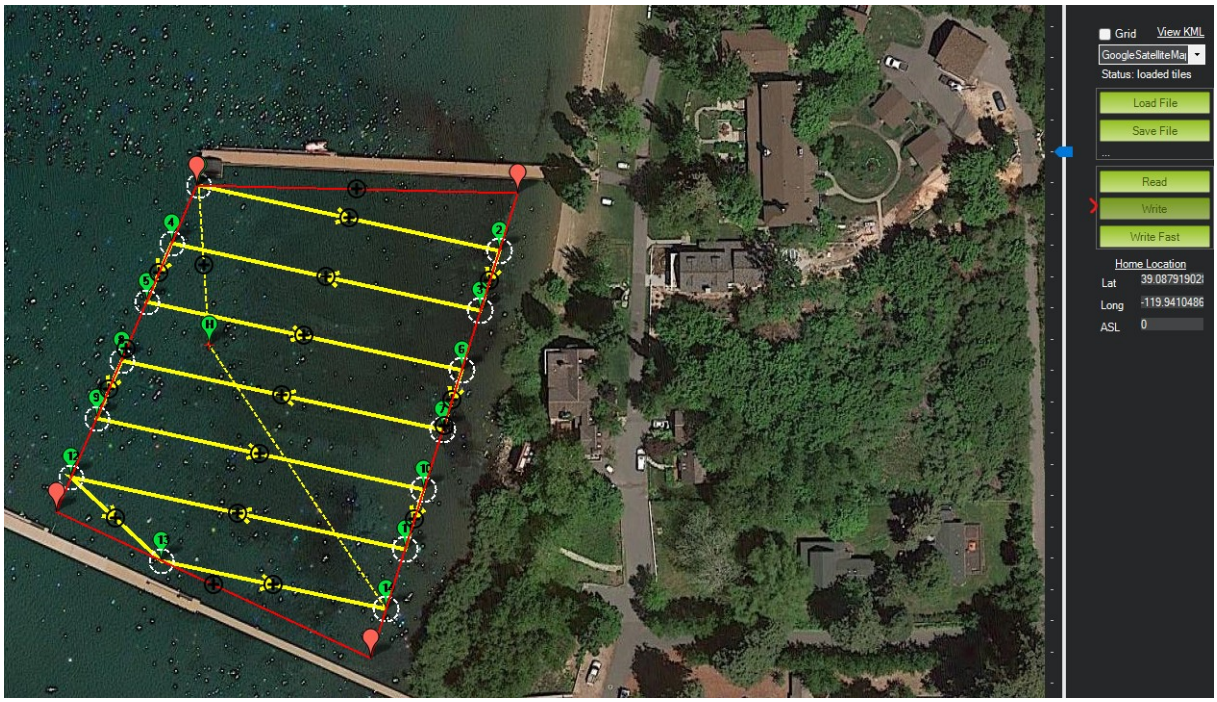



Figure 44: Write Mission

- This will save the mission to the AutoNav Plus™. It will stay saved until a new mission has be overwritten.

10. Using the RCU SF switch to toggle USV into Auto mode and run mission.

**Important Alert**

**Be aware, if your USV does NOT have CAA installed or installed but not powered on, the USV will head directly to the location where it was first armed. If there are objects in the way or it was armed on shore, the boat may run aground.**

### 3.12.2 Hypack

**Information**

Seafloor Systems AutoNav Plus™ requires two NMEA input GPS strings. GPS/GNSS system not provided by Seafloor, will need to be configured to output the required NMEA strings.

- GGA and RMC at 5Hz with a GP Talker ID(Prefix) at 38400 baud rate. RS232 Protocol with DB9 connector. USB to DB9 adapter does not work.
- Example:
  - $GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47
  - $GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

**Caution**

Important: The AutoNav Plus™ navigates using GPS waypoints, users should toggle to Manual mode to avoid objects and always maintain line of sight.
AutoNav Plus™ does have a Return to Home(Launch) function, it is not enabled on the RCU. To activate in Mission Planner, navigate to the Data tab and below the HUD. On the Actions tab, click RTL. (Return to Launch)

**Caution**

Below will show you how to setup a mission in Hypack. However, it's important to note that a mission can be started one of two ways.

- RCU - using the SF switch. (Refer to 3.5)
- Software - using Start Mission button.

*If started with software, the toggle switch will be in "Manual". To stop the survey, you must toggle the switch to "Auto" then back to "Manual". Same goes for the opposite scenario.*

**Hardware Setup:**

1. Open Hypack.
2. Open Hypack Hardware Setup.
3. Right click Hardware to add a Mobile.

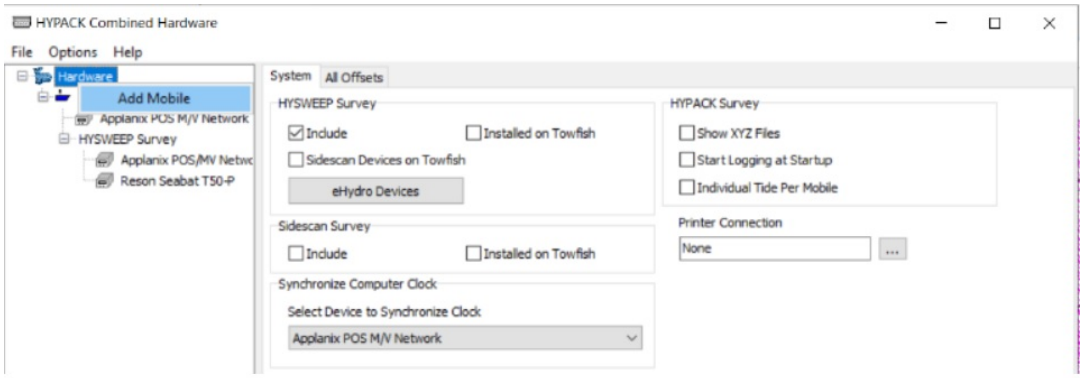



Figure 45: Add Mobile

4. Under the new Mobile, add Mavlink driver.

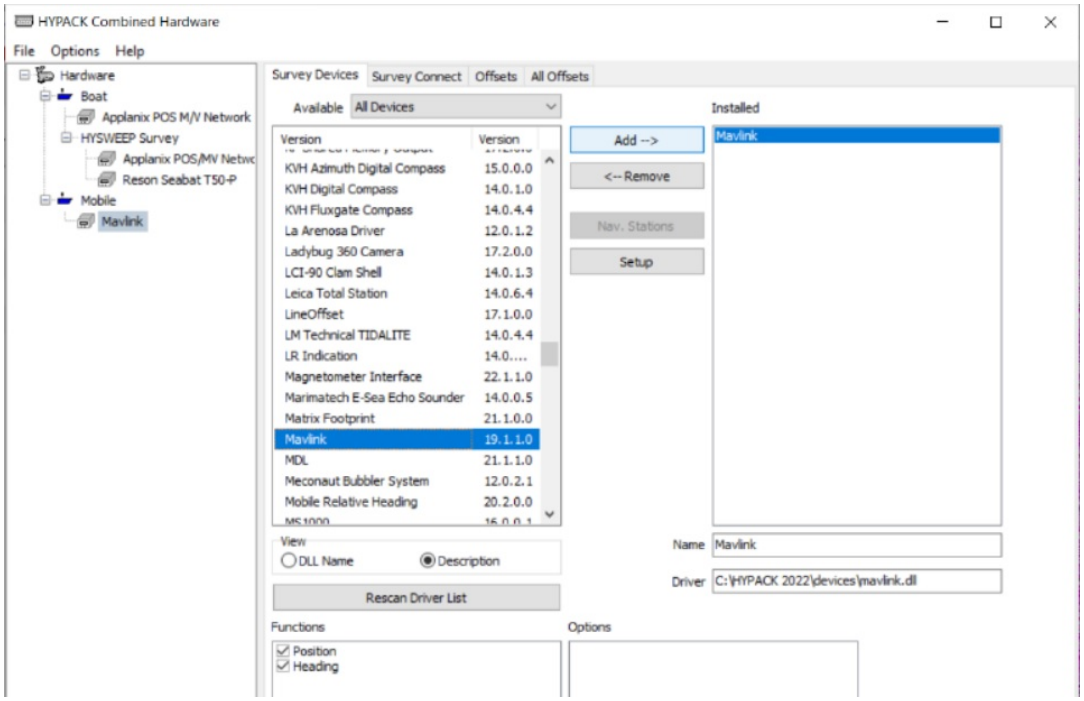



Figure 46: Add Mavlink Driver

5. Device Connection is Serial.

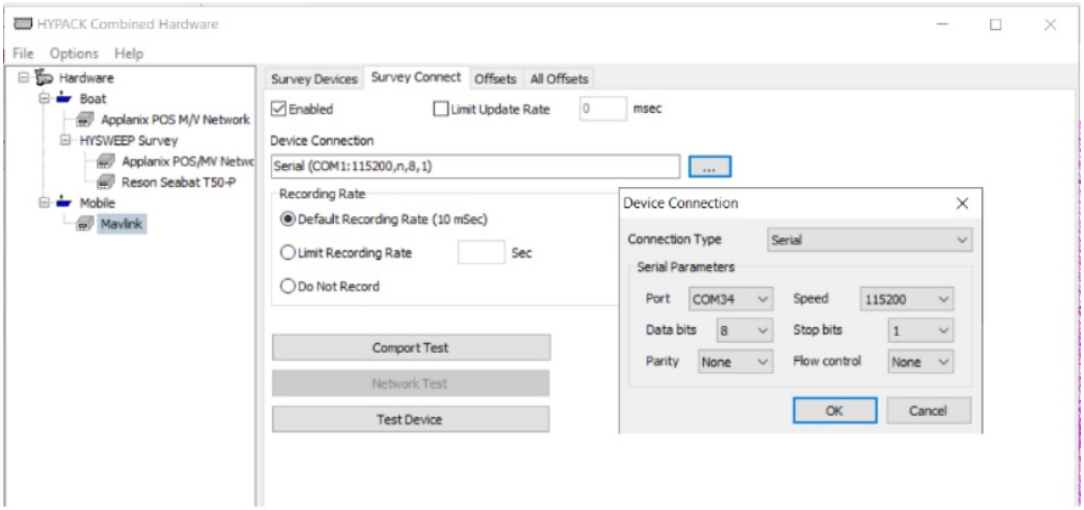



Figure 47: Set COM Port

6. Set COM number. Can be verified in Device Manager.
7. Set Baud Rate to 115200.
8. Use the Comport Test to verify data is coming through the selected COM port.

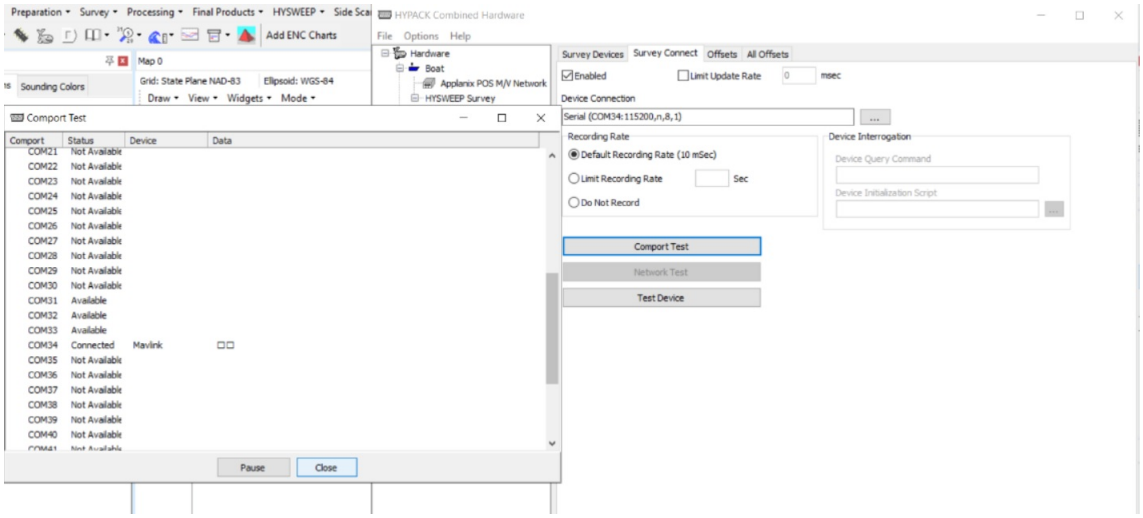



Figure 48: COM Test

**Line Planning:**

1. Create the line plan using Hypack's standard Line Plane Editor.

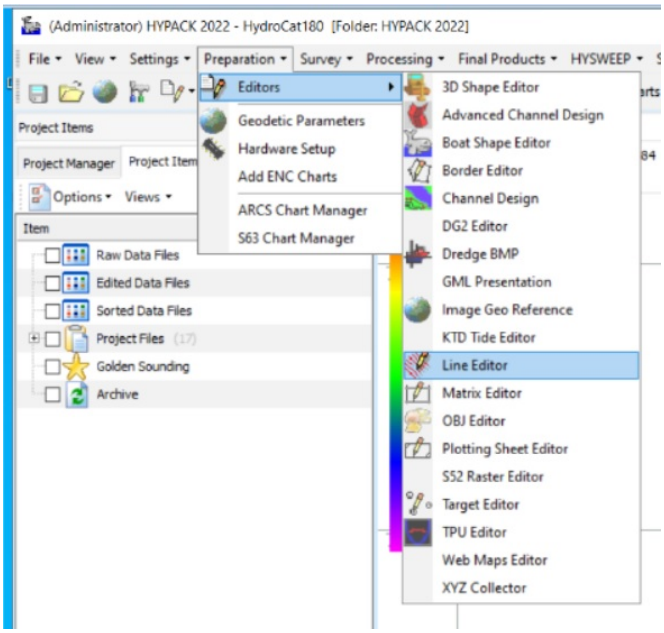



Figure 49: Line Editor

2. Right click every other line and select Reverse Order.

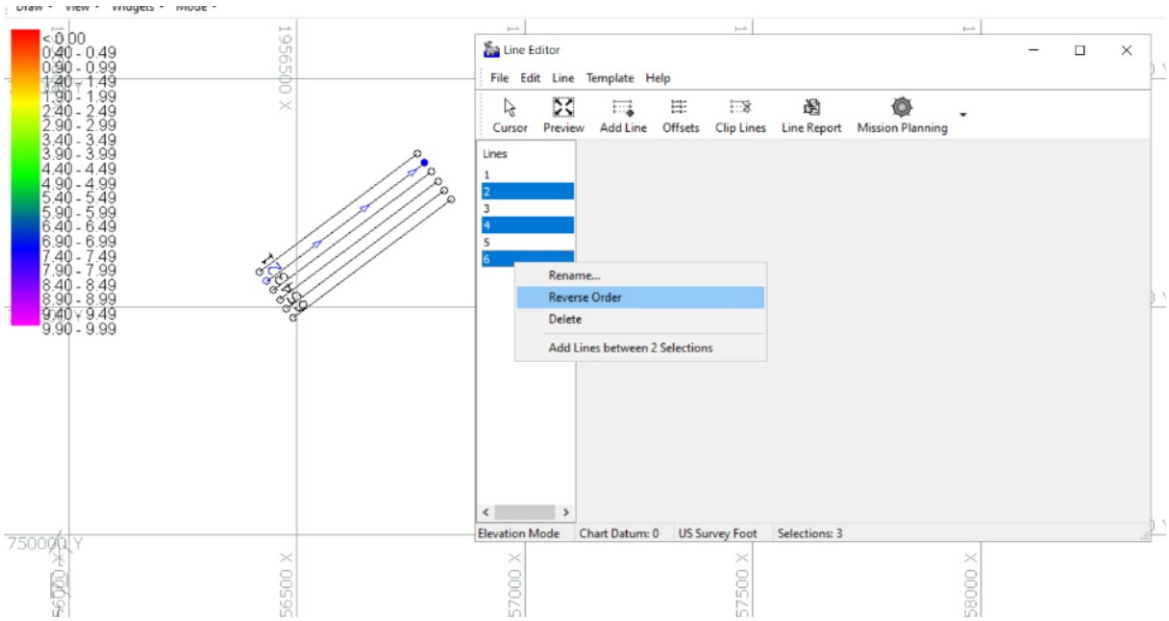



Figure 50: Reverse Every Other Line

3. Start Hypack Survey/Hysweep.
4. Mavlink Driver will say Armed or Unarmed. USV must be Armed to Start Mission.

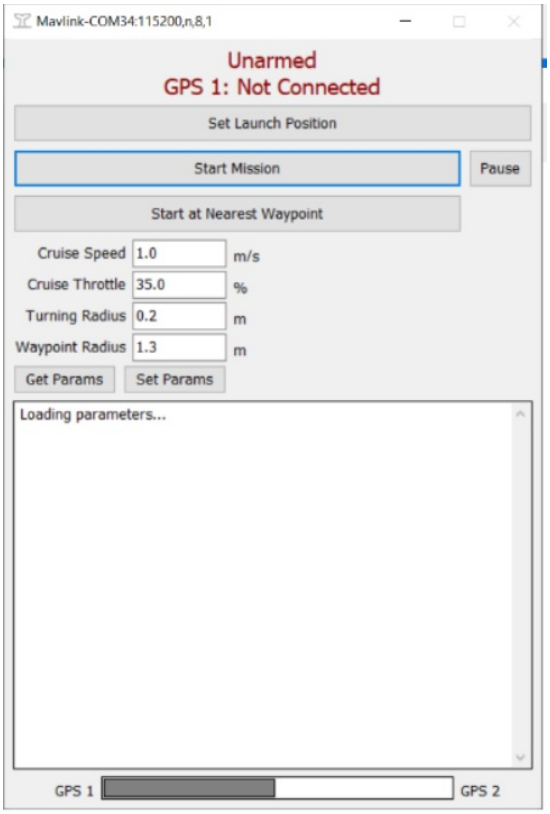



Figure 51: Mavlink Driver Control

- If the status flashes between Armed/Disarmed, it's a bug. System is Armed.

5. Using the Mavlink Driver, you can toggle Auto mode by selecting Start Mission.

**Mavlink driver button functionality:**

- Start Mission
  - The Hydrone™ AutoNav Plus™ Servo will navigate the current line file.
  - 'Stop Mission' will appear once 'Start Mission' is selected.
- Stop Mission
  - Click 'Stop Mission' to end line navigation.
- Pause
  - Once the Mission is started use the 'Pause' to regain manual control.
  - 'Resume' will appear once 'Pause' is selected.
- Return to Launch
  - The boat will take a straight line back to where it was last armed.
  - Make sure the boat has an unobstructed path if using this function.

Mavlink driver window will say 'Flight mode set successfully' when each button is selected.

## 3.13 Hydrone™ AutoNav Plus™ Servo Power Off Procedure

1. Upon retrieval of the Hydrone™ AutoNav Plus™ Servo, disarm using the RCU SA and SH switch. (Refer to 3.5)
2. Shut down the onboard computer via Windows taskbar.

3. Power off the AutoNav Plus™.
4. Power off both pontoon switches. (Figure 1)
5. Disconnect each 4S battery. Disconnect the female XT90 connector of the battery to the male XT90 connector of the power switch.
6. Power off RCU by holding Power button until the 4 dots count down. Release at one dot. (Refer to 3.5)

**Information**

The AutoNav Plus™ features hot-swappable electronics, allowing you to seamlessly disconnect one pontoon battery and replace it with a fully charged one, ensuring uninterrupted power while keeping the AutoNav Plus™ operational using the other pontoon battery.

## 3.14 Fail-Safe

**Information**

If there's a failure, the Hydrone™ AutoNav Plus™ Servo is equipped with a built-in fail-safe.

- Outside of RCU range if loss of comms: The receivers will go into fail-safe mode.
  - The vessel will drift with no input. Move towards the Hydrone™ AutoNav Plus™ Servo to attempt to reconnect with the RCU.

## 3.15 Voltage Monitoring

### 3.15.1 RCU Voltage Monitor

Hydrone™ AutoNav Plus™ Servo has a built-in real-time voltage monitor of the system and RCU.

### To view RCU battery voltage:

1. Power on the RCU. (Refer to 3.5)
2. Press EXIT to get to the main screen.

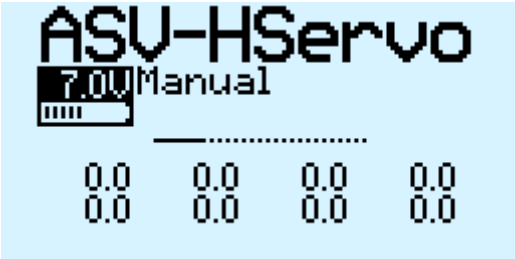



Figure 52: Main Screen

3. Battery icon and percentage is the RCU battery.
   - Battery Range is 6-8.5VDC.

### To view Hydrone™ AutoNav Plus™ Servo battery voltage:

1. Power on the RCU. (Refer to 3.5)
2. Power on a pontoon(Archer Plus R6 only).
   (a) Must power on starboard pontoon for older vessels (Archer R4 and older).
3. Hold down PAGE button to access the DISPLAY screen.

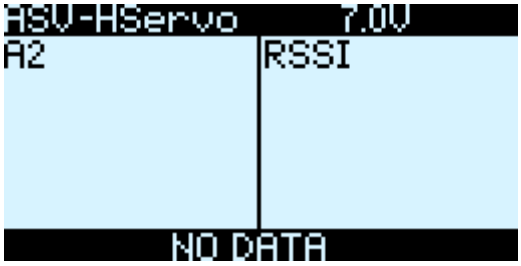



Figure 53: Display Page

- Left voltage(A2) is the starboard pontoon battery.
- Right number(Received Signal Strength Indicator (RSSI)) is the RCU signal strength.
- Top left name is the RCU model.
- Top right voltage is the RCU battery.

### 3.15.2 AutoNav Plus™ Voltage Monitor

**Caution**

- Disconnect the batteries of the Hydrone™ AutoNav Plus™ Servo at 12.8VDC (3.2VDC/Cell) to avoid irreversible damage. (Refer to 1.4)
- To extend the battery life of the Hydrone™ AutoNav Plus™ Servo, it is advisable to power it off when the voltage reaches 13.6VDC. (3.4VDC/Cell) (Refer to 1.4)

1. Open 'Battery Monitor' application icon on the desktop of the AutoNav Plus™.

Figure 54: Battery Monitor Application Icon

2. Select 'Connect' to see real-time voltage of port and starboard batteries.

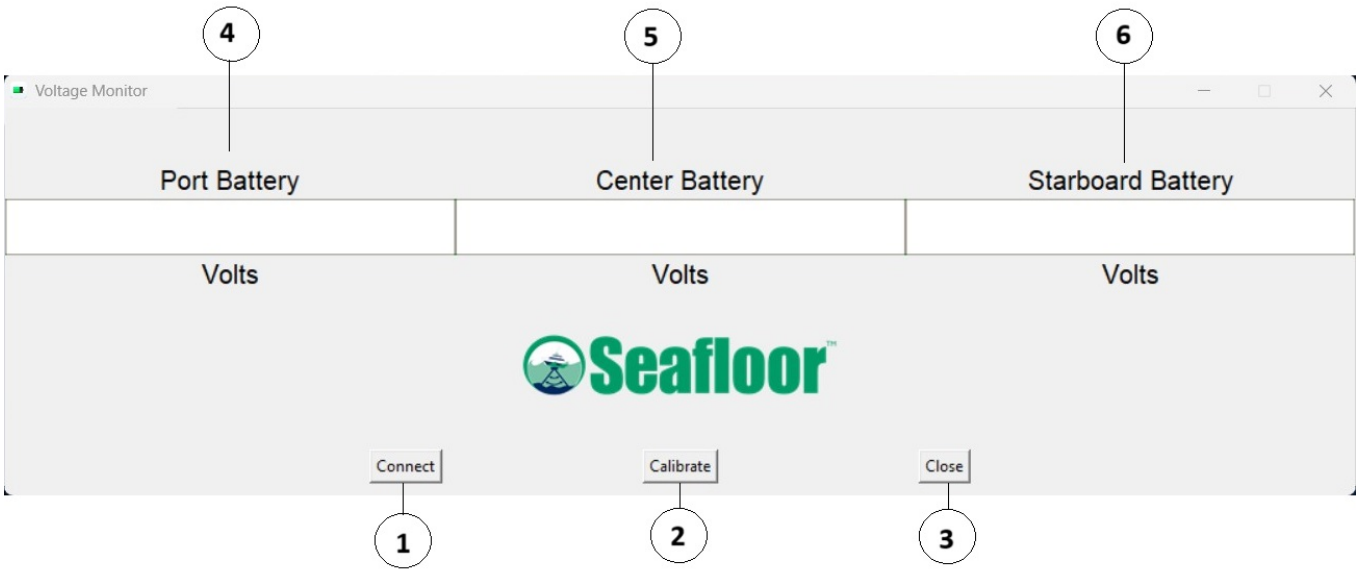



Figure 55: AutoNav Plus™ Voltage Monitor

Voltage Monitor Functions:

1. Connect: To connect to the Voltage Monitor application.
2. Calibrate: To calibrate the Voltage Monitor values to match real world values.
3. Close: To close the application.
4. Port Battery: Voltage value of the port pontoon.
5. Center Battery: Unused for the Hydrone™ AutoNav Plus™ Servo.
6. Starboard Battery: Voltage value of the starboard pontoon.

Calibration:

1. Select 'Calibration' on the application.
2. Connect the supplied Voltage Tester in the battery you're calibrating.
3. Default ratio is setup as 1. Adjust in increments of 0.01 until the Voltage Monitor matches the Voltage Tester total value.

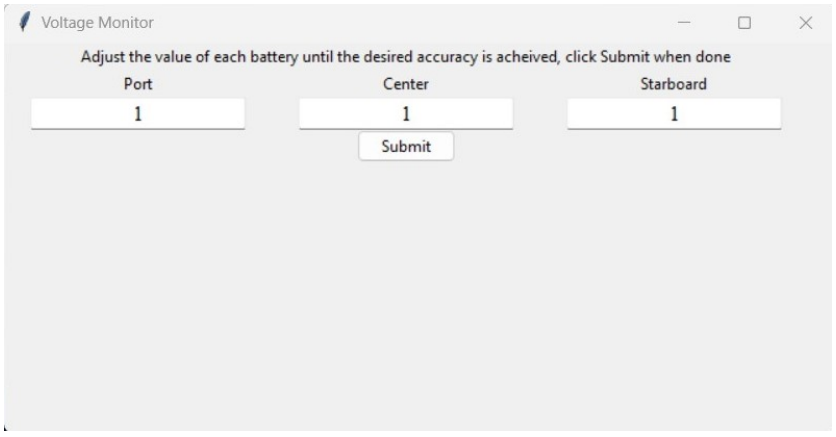



Figure 56: Caption

# 4 Frequently Asked Questions (FAQ)

- Why does the prop not spin in reverse?
  - The ESC is not programmed to "Forward and Reverse" running mode. Refer to 6.6 for ESC Programming.
- Why does the thruster motor not respond while the Hydrone™ AutoNav Plus™ Servo is powered? Alert tone of beep-, beep- (1 second interval) is heard.
  - There is no signal from the receiver. Verify that the RCU is powered and that the RCU and receiver are bound. Verify all connections are clean and fully seated.
- Why is the hatch leaking?
  - Verify the condition of the hatch seal. Lubricate or replace as necessary.
- Why is the prop spinning without engaging the throttle?
  - Verify that the throttle trim is centered. Calibrate if necessary, refer to 6.5.
- Why is the Hydrone™ AutoNav Plus™ Servo still powered when the main switch is in the off position?
  - Disconnect the battery.
- Why does the Hydrone™ AutoNav Plus™ Servo have a limited turning radius or only turns in one direction?
  - Verify that the props are clean of debris. If issue still persists, calibrate ESC. (Refer to 6.5)
- Why is the pontoon not powering on?
  - Power switch on ESC is off or not fully seated in the on position.
- Why is the receiver not powered?
  - Connector is not fully seated or inadvertently disconnected.
- Why do I need to keep programming the ESC?
  - RCU joysticks are not in the neutral position when the pontoon is powered up.
- Why isn't the thruster functioning while the servo can still rotate? An alert tone of beep-, beep- (1 second interval) can be heard.
  - No signal from receiver. Verify RCU is powered. Verify RCU and receiver are paired. Calibrate ESC. (Refer to 6.5)

# 5 Troubleshooting

## 5.1 Propeller Orientation And Rotation

If the propellers on a Hydrone™ AutoNav Plus™ Servo are rotating in the wrong direction, it will cause the boat to move in circles when attempting to go forward. Similarly, installing the wrong propeller will also lead to same issue. If you recently installed a new thruster or propeller, please use the below information to check proper orientation and rotation.

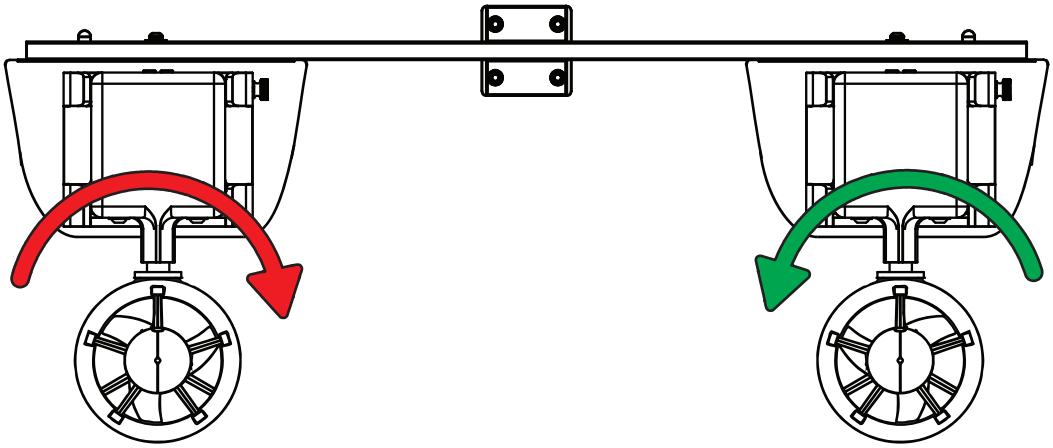


Figure 57: Hydrone™ AutoNav Plus™ Servo Prop Rotation
(Colors Illustrate Maritime Navigation Lights)

- Port Thruster:
  - Motor must rotate clockwise(CW) (Figure 57)
  - Prop is CCW

Figure 58: W30 CCW Prop

- Starboard Thruster:
  - Motor must rotate counter-clockwise(CCW) (Figure 57)
  - Prop is CW

Figure 59: W30 CW Prop

### 5.2 AutoNav Errors

#### Common Errors:

If the Autonomous Operation is not behaving as expected, open and connect to Mission Planner. The HUD will show errors.

- EKF3 waiting for GPS config data
  - No GPS input. Check GNSS output. Use a Null Modem if needed.
- Bad Gyro Health
  - Can be ignored. The USV was powered on and moving while initializing.
- Unhealthy AHRS
  - Incorrect NMEA GPS strings or an accelerometer calibration is needed. (Refer to 6.7)
- RC Failsafe
  - RCU powered off or out of RCU range.
- EKF Failsafe
  - GPS position issue. Check GNSS system and NMEA outputs.
- Internal Error
  - Powered on incorrectly, reboot.
- 'EKF' will be red
  - Normally red upon power up or Compass issue. Let stabilize or see above for Compass Variance.
- Compass Variance with single antenna GPS system
  - Incorrect NMEA GPS strings or compass calibration required.

## 6 Configure Procedure

### 6.1 RCU Receiver Binding Procedure

#### Archer Plus R6 Binding:

Registration is only required if the RCU or Receiver (RCVR) was replaced. Skip to step 7 to bind for either receivers.

1. Refer to 3.5 for button or switch location on RCU.
2. Power on the RCU, power off the Archer Plus R6.

3. Quick press 'Menu' on the RCU.

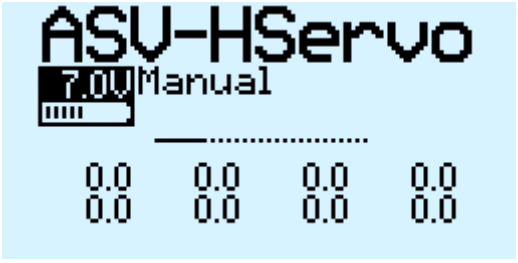



Figure 60: Model Select Screen

4. Quick press 'Page' to switch to SETUP Page 2/13.

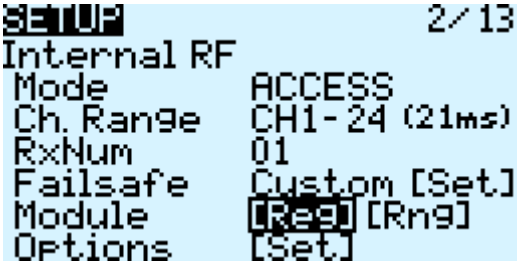



Figure 61: Internal RF

5. Using the ENT knob, scroll down to INTERNAL RF. (Figure 61)
   (a) Archer Plus R6 Registration: (Registration ID is the vessel serial number)
      i. Under Internal RF, Click Reg. A menu will pop up with 'Waiting...'
         - **If you are changing to a new RCU and know the REG ID, you can scroll up and change ID. Once changed, skip to Step 7 below.**

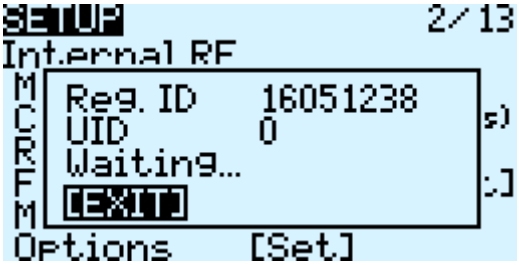



Figure 62: Waiting To Register

      ii. On the Archer Plus R6, hold down the receiver button while powering up the Archer Plus R6. (Figure 63)

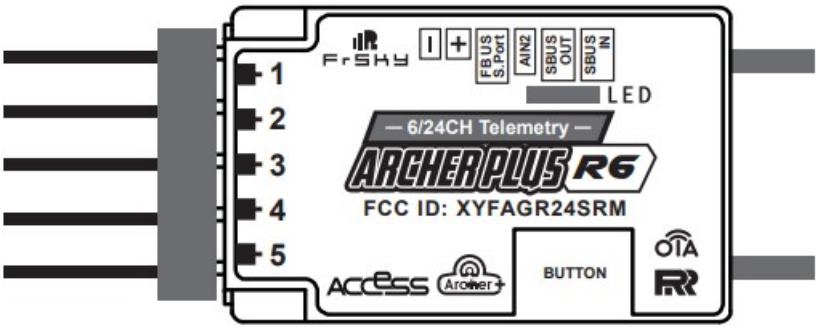



Figure 63: Archer Plus R6

- It is suggested to disconnect the main cable to remove power and reconnect when power is needed.

iii. On the RCU, 'Waiting...' will be replaced with the model name.

iv. Press Enter to confirm, registration complete.

v. Power off the receiver.

6. Scroll to Receiver 1 and select Bnd.

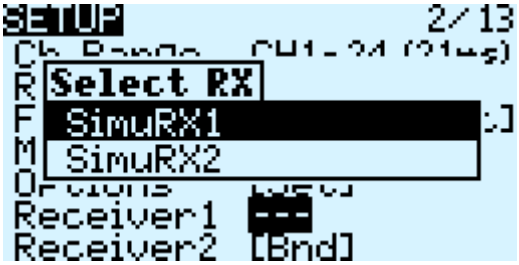



Figure 64: Binding Screen - SimuRX1/2 Is Only Used For Simulation

7. Power on the Archer Plus R6

8. Press OK once bind is successful.

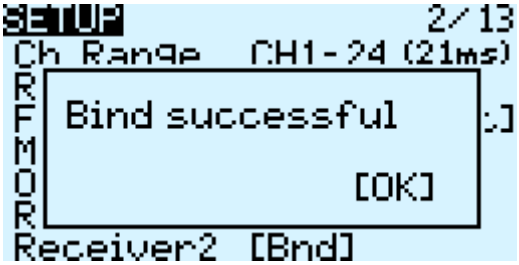



Figure 65: Bind Successful

## 6.2 RCU Telemetry Configuration Procedure

**Information**

Telemetry configuration is only required if the RCU or Receiver (RCVR) was replaced. RCU and Receiver must be bound.

1. Refer to 3.5 for button or switch location on RCU.

2. Power on the RCU, power on the Hydrone™ AutoNav Plus™ Servo.

3. Quick press 'Menu' on the RCU.

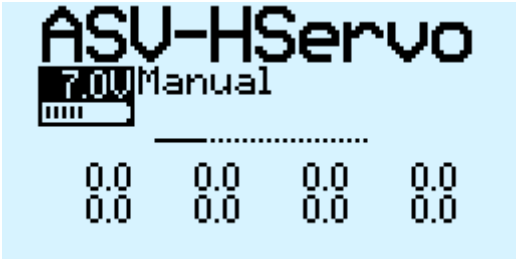



Figure 66: Model Select Screen

4. Quick press 'Page' to switch to TELEMETRY Page 12/13.

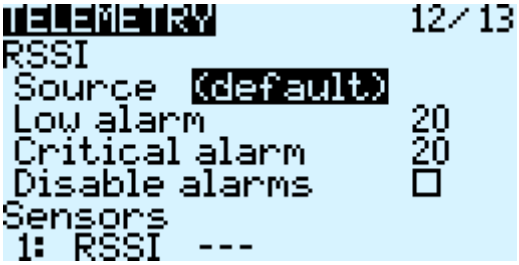



Figure 67: Telemetry Page

5. Scroll down and select "Delete all sensors".

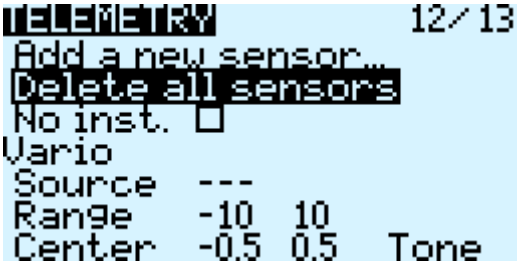



Figure 68: Delete All Sensors

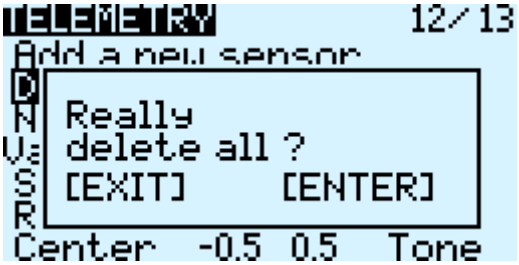



Figure 69: Delete All Sensors Pop-Up

6. Scroll up and select "Discover new sensors".

Figure 70: Discover New Sensors

7. A2 sensor will be active.
8. Select the A2 sensor.

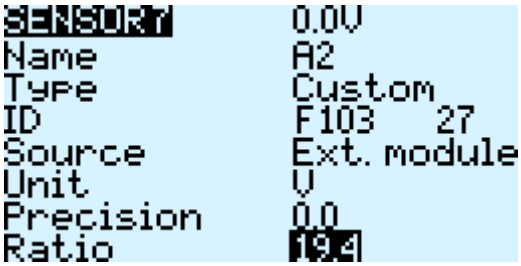



Figure 71: A2 Sensor Page

9. At the top of the screen is the pontoon voltage.
10. Scroll down to the Ratio. Modify the value to set the pontoon voltage. Use the supplied Voltage Checker to check the pontoon voltage.
11. Press 'Exit' and the A2 sensor is setup.
12. Quick press 'Page' to switch to DISPLAY page 13/13.

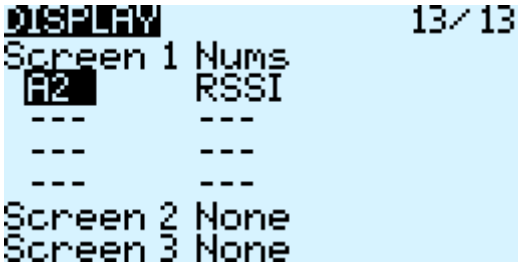



Figure 72: Display Page

13. The A2 will be removed when the sensors were deleted. Select the empty spot and scroll to A2. Do not use A2+ or A2- as they will show higher or lower voltages.
14. Press 'Exit' to complete the configuration.

## 6.3 RCU Calibration Procedure

Calibrations should only be initiated if the Hydrone™ AutoNav Plus™ Servo demonstrates a delayed response or excessively quick response, while the remainder of the joystick throw remains unchanged.

**Information**

All calibrations must be done in the correct order. Please refer to 3.5 to familiarize yourself with the RCU controls.

1. **Hydrone™ AutoNav Plus™ Servo must be powered off.**
2. Power on the RCU. (Refer to 3.5)

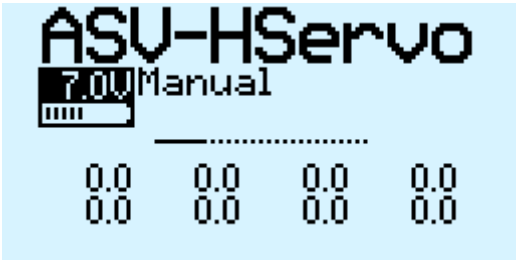



Figure 73: Main Screen

3. Hold down 'Menu' button.

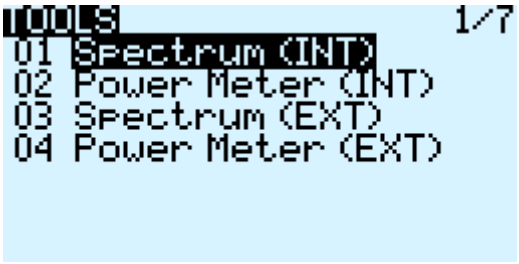



Figure 74: RCU Settings

4. Quick press 'Page' to switch to HARDWARE to Page 6/7.

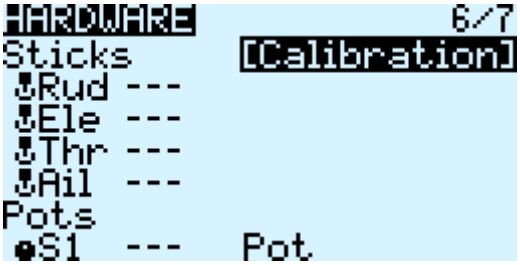



Figure 75: Hardware Page

5. Highlight 'Calibration' and select.
6. Follow the onscreen instructions.

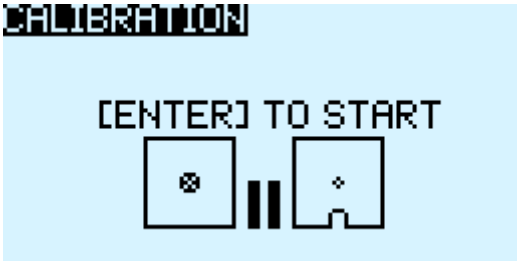



Figure 76: Start Of Calibration

7. Once calibration is complete, screen will cycle back to start of calibration page.
8. Press Exit twice to exit back to main screen.

## 6.4 RCU AutoNav Calibration

1. Power on the RCU.
2. Power on the AutoNav Plus™.
3. Connect to the AutoNav Plus™. (USB Cable is 115200 baud rate)
4. Vessel **MUST** be disarmed.
5. Select Setup tab.

Figure 77: Setup Tab

6. Select Mandatory Hardware.
7. Select Radio Calibration.

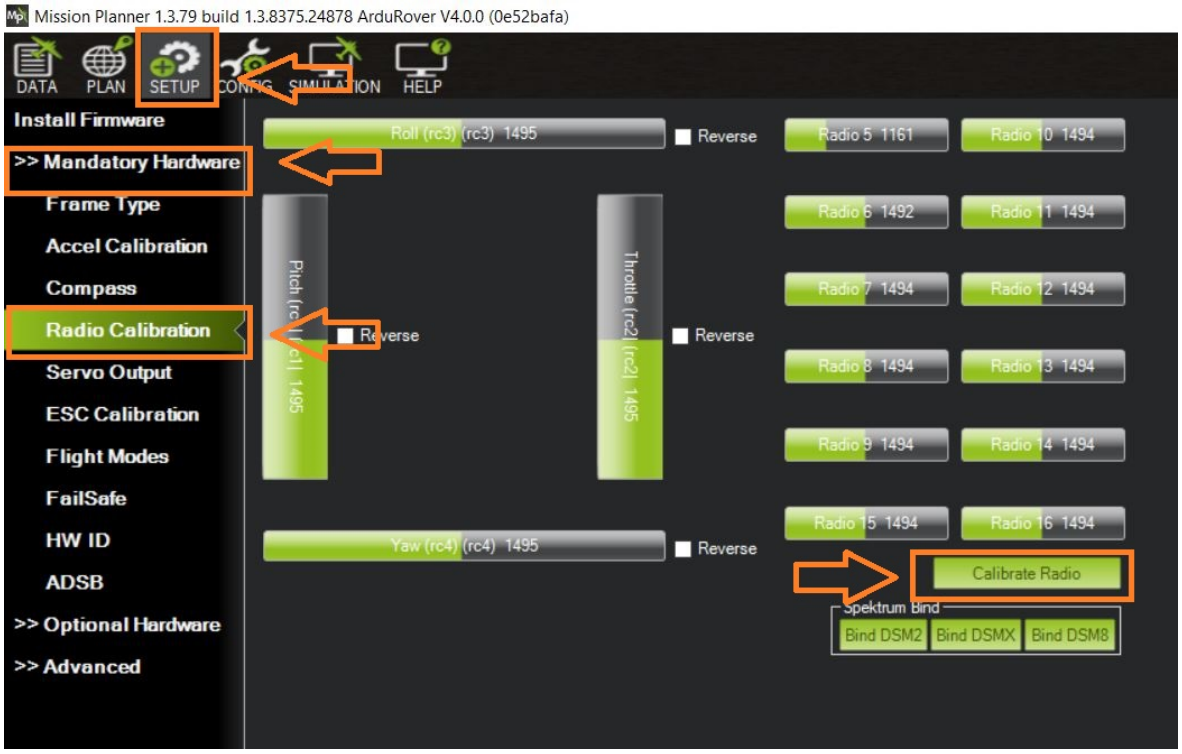
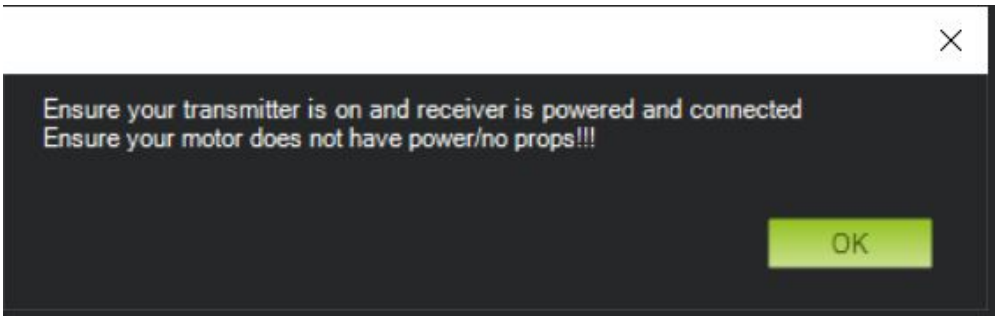
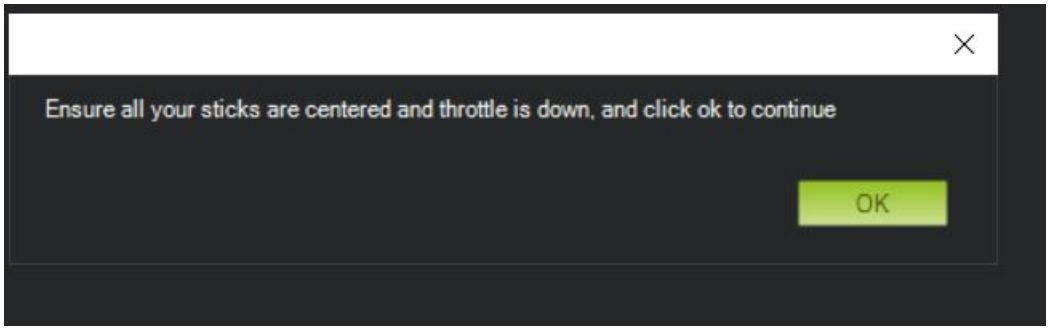



Figure 78: Radio Calibration Steps

8. Select Calibrate Radio.




(a) Power Warning




(b) Radio Cal Instructions

Figure 79: Pop Ups

9. Move all joystick to their min and max positions.
10. Move all switches to each position. Be sure to arm and disarm.
11. You will notice each active channel will have a red line indicating the received min and max signal.

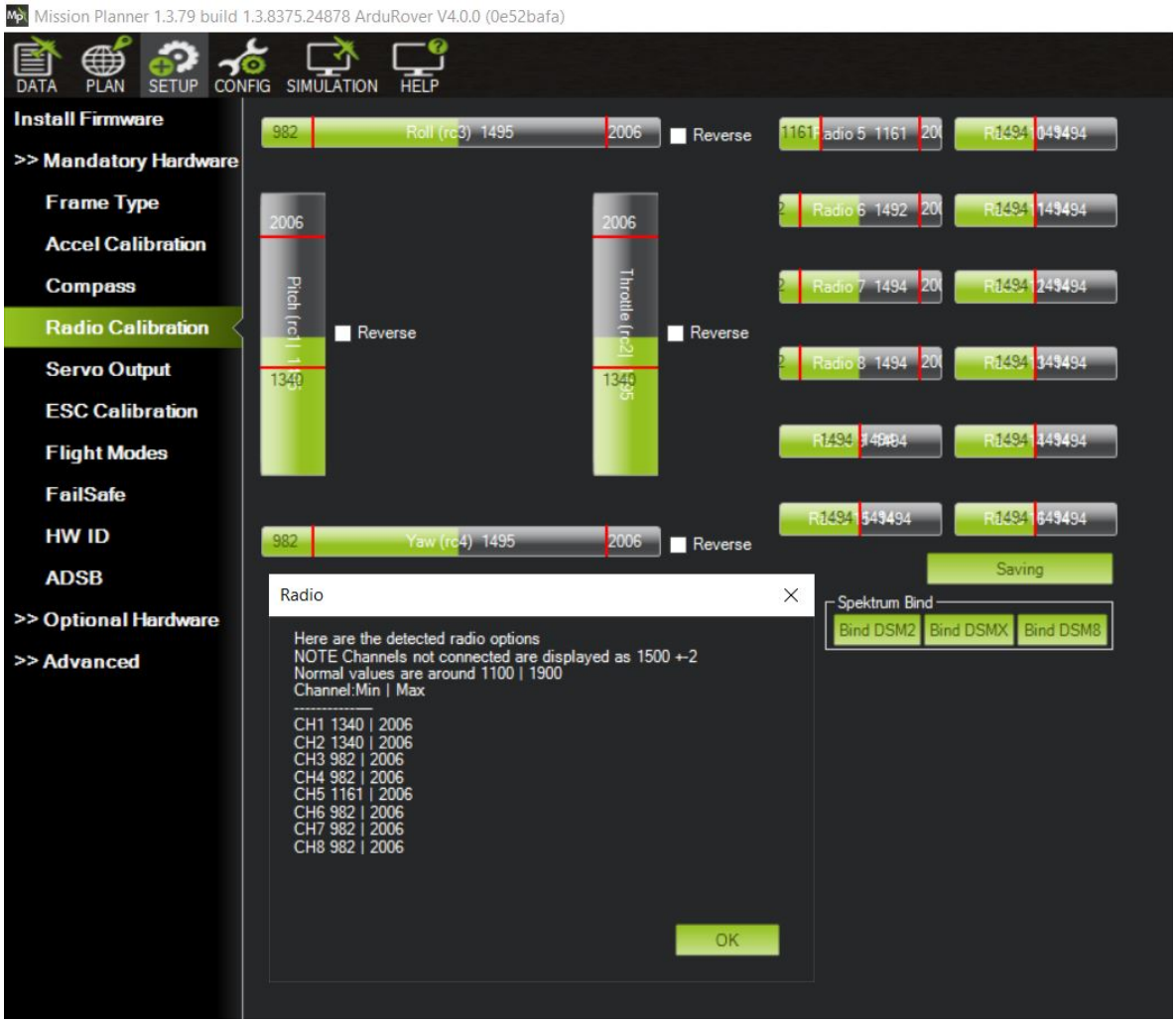



Figure 80: Radio Calibration Verification

12. Select Click when Done.

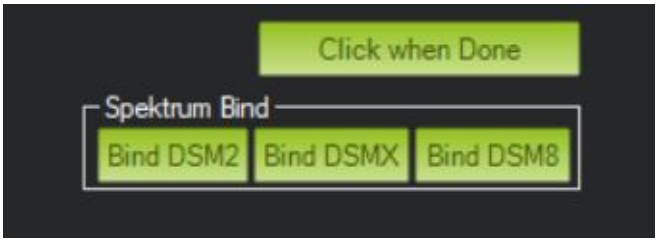



Figure 81: Click When Done

13. A page will popup indicating the new min and max values. Press OK. (Refer to Figure 80)

## 6.5 ESC Calibration Procedure

1. Calibrate one ESC at a time.
2. Power on the RCU. (Refer to 3.5)
3. Push the Throttle Control to full throttle on the pontoon you are calibrating.
4. Power on the Hydrone™ AutoNav Plus™ Servo.

5. Two short Beep- Beep- tones will be heard, confirming the full throttle position.
6. Immediately release the Throttle Control to the neutral position.
7. A steady and long beep— can be heard, confirming the neutral position.

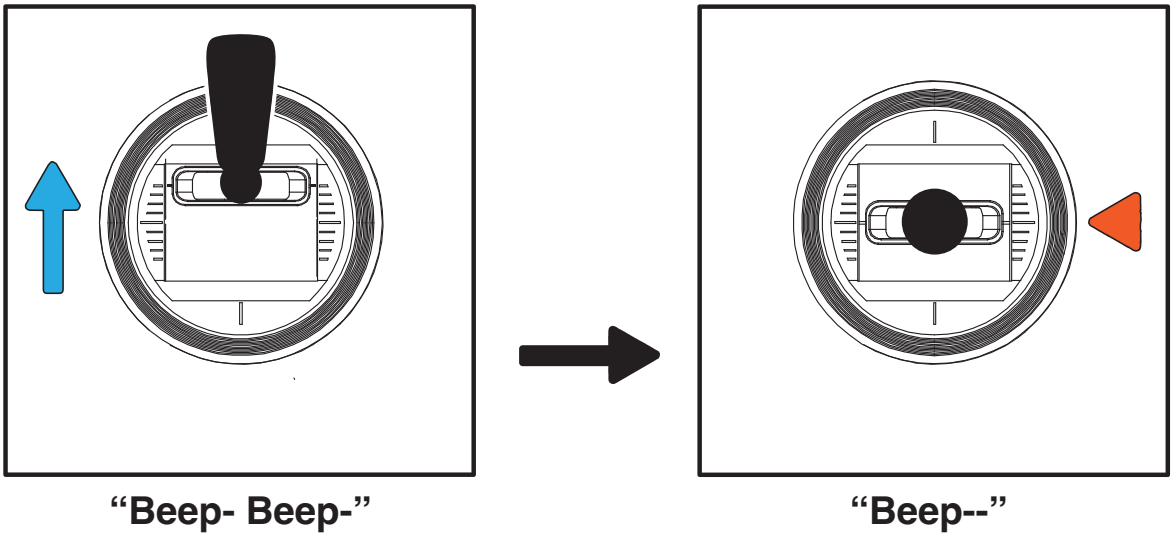



Figure 82: Joystick Position

8. Finalization tones can be heard. Calibration complete.
9. Repeat for the opposite side.

## 6.6 ESC Programming Procedure

**LED Indications**

| | |
|---|---|
| Solid Red | Throttle |
| Solid Red and Green | Full throttle |
| Flashing Red | Low Voltage Cutoff Protection is activated |
| Flashing Green | Overheat protection is activated |

### ESC Programming

1. Connect the included ribbon cable into the programming slot on the programming card.

Figure 83: ESC Programming Card Ports

2. Connect the ribbon cable to the ESC. Pay attention to the connector orientation.

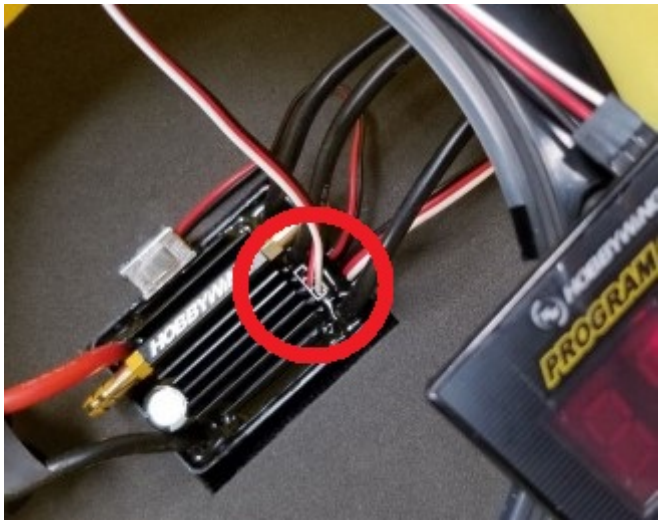



Figure 84: ESC Programming Card Connection

3. Power on the Hydrone™ AutoNav Plus™ Servo. The Programming Card will power on.
4. Using the chart below, match the Items with the Values.
5. Press Item to cycle Items. Press Value to cycle Values. Press 'OK' to save for each Item.

| Item | Value | Description |
|---|---|---|
| 1 | 2 | Forward & Reverse Mode |
| 2 | 1 | Auto Calc LiPo Cells |
| 3 | 4 | 3.2V/cell Low Voltage Cut Off |
| 4 | 5 | 15° Timing |
| 5 | 4 | 100% Reverse |

Table 11: ESC Programming Values

## 6.7 AutoNav Plus™ Accel Calibration Procedure

1. Remove AutoNav Plus™ from the HyDrone™. Disconnect all cables.

2. Install DC Power Cable and a 4S LiPo battery.
3. Open Mission Planner.
4. Connect to the AutoNav Plus™ with 115200 baud rate.
5. AutoNav Plus™ must be disarmed.
6. Select Setup tab.

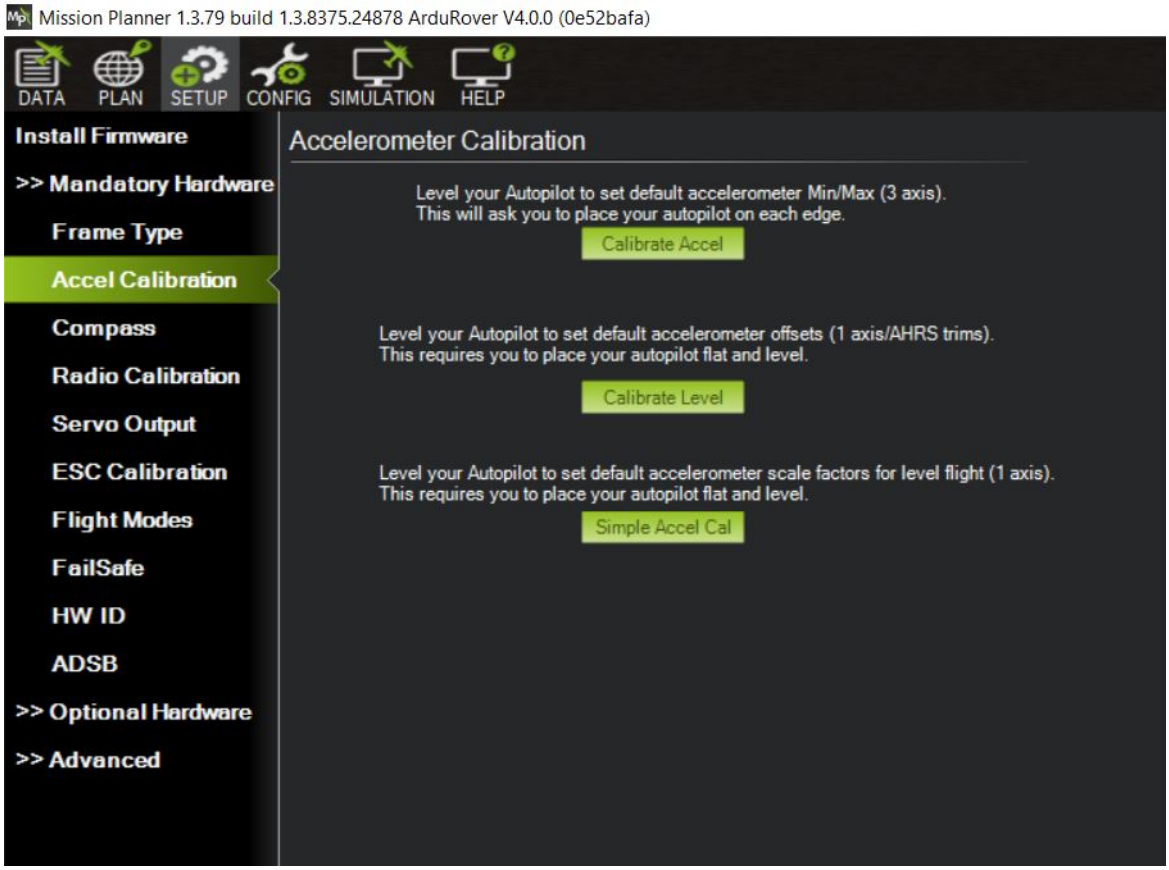



Figure 85: Accel Calibration

7. Select Mandatory Hardware.
8. Select Accel Calibration.

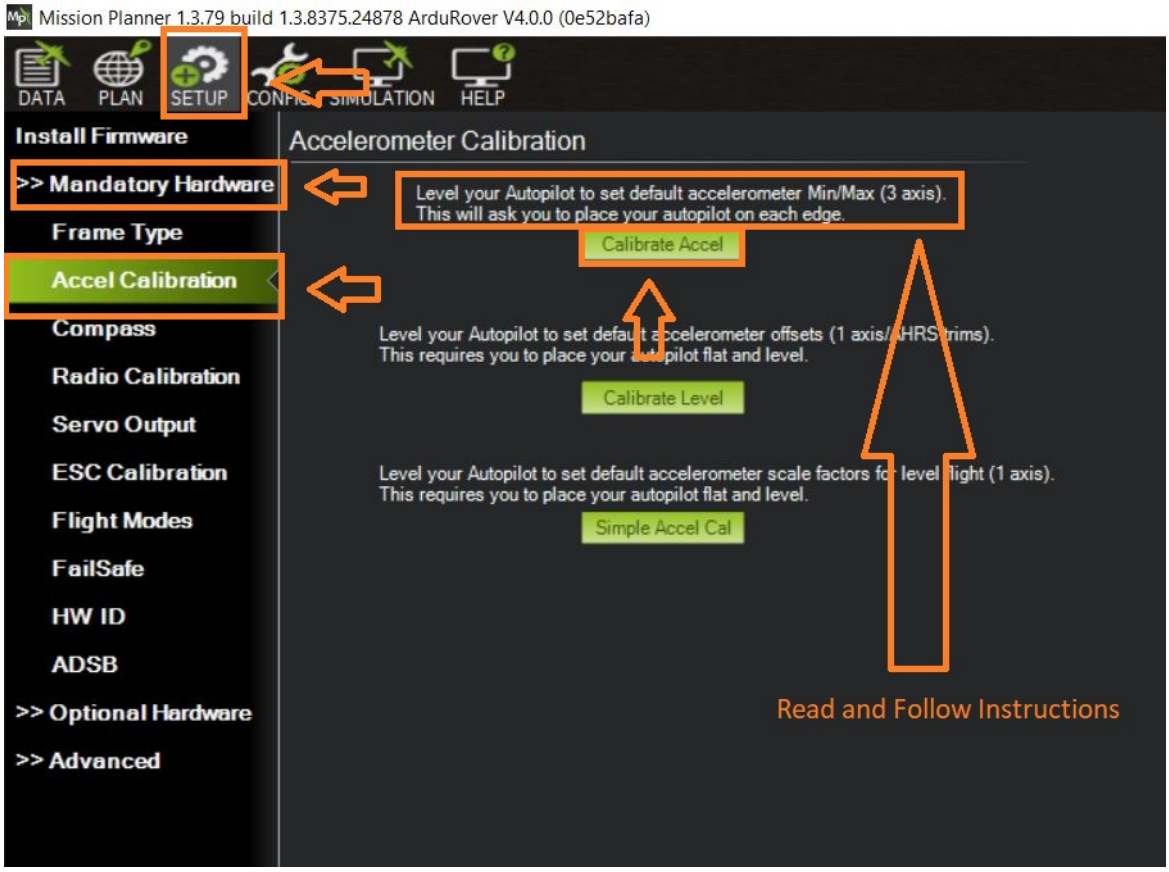



Figure 86: Accel Calibration Steps

9. Set the AutoNav Plus™ on a level surface.
10. Select Calibrate Accel(3 axis). You will rotate and hold the AutoNav Plus™ on each axis. Instructions will be present during the process. **Bulkheads are always facing backwards(stern).**

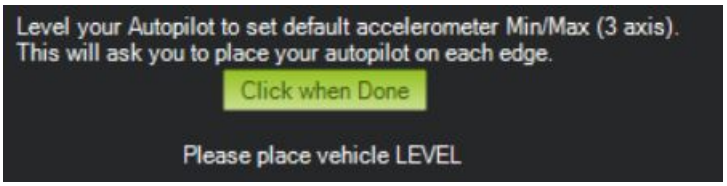



Figure 87: Accel Calibration In Process

   (a) First is a level surface. Click button when done.
   (b) Rotate on it's left side. Click button when done.
   (c) Rotate on it's right side. Click button when done.
   (d) Rotate nose down. (Bulkheads facing the sky) Click button when done.
   (e) Rotate nose up. (Bulkheads facing the ground) Click button when done.
   (f) Rotate it upside down. Click button when done.

11. 3 axis calibration is complete.

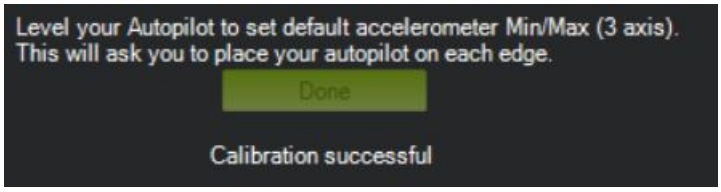



Figure 88: Accel Calibration Complete

12. Set the AutoNav Plus™ on a level surface again.
13. Select Calibration Level. (See Figure 85)

## 6.8 AutoNav Plus™ Compass Calibration Procedure

**Information**

Compass calibration should be performed away from metal buildings and any electronic equipment.

1. Remove AutoNav Plus™ from the HyDrone™. Disconnect all cables.
2. Install DC Power Cable.
3. Connect a 4S LiPo battery.
4. Open Mission Planner.
5. Connect to the AutoNav Plus™ with 115200 baud rate.
6. AutoNav Plus™ must be disarmed.
7. Select Setup tab.
8. Select Mandatory Hardware.
9. Select Compass.
10. Select Start.

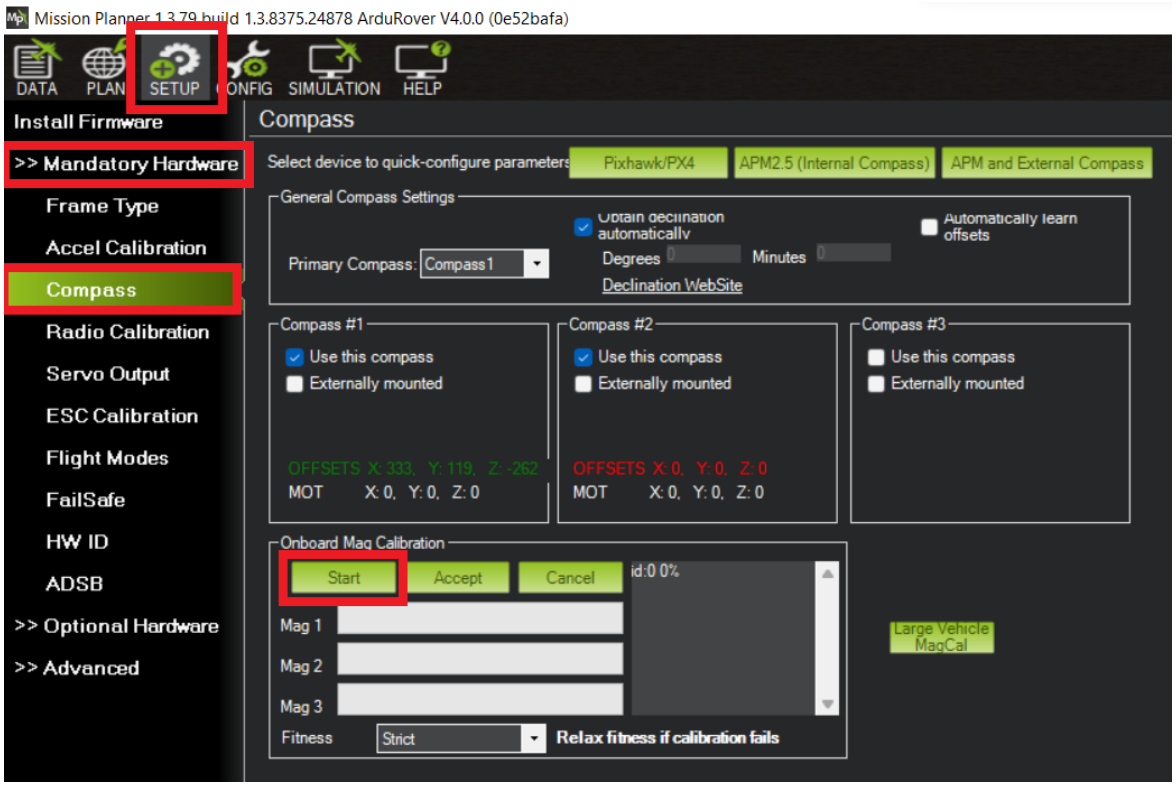



Figure 89: Compass Calibration Steps

11. Rotate the AutoNav Plus™ 360 degrees on the X, Y, and Z axis.

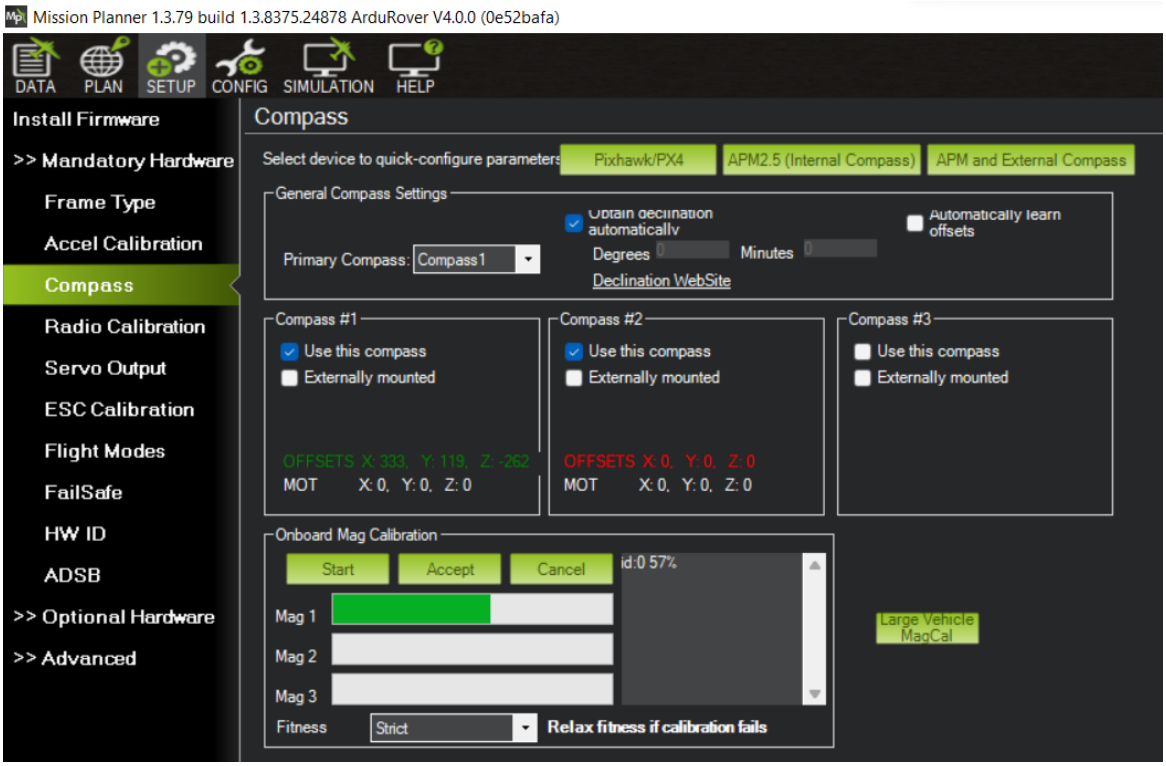



Figure 90: Compass Calibration Progress

12. Mag 1 green progress bar will start increasing.

13. A "Please reboot the autopilot" popup will indicate compass calibration is complete.

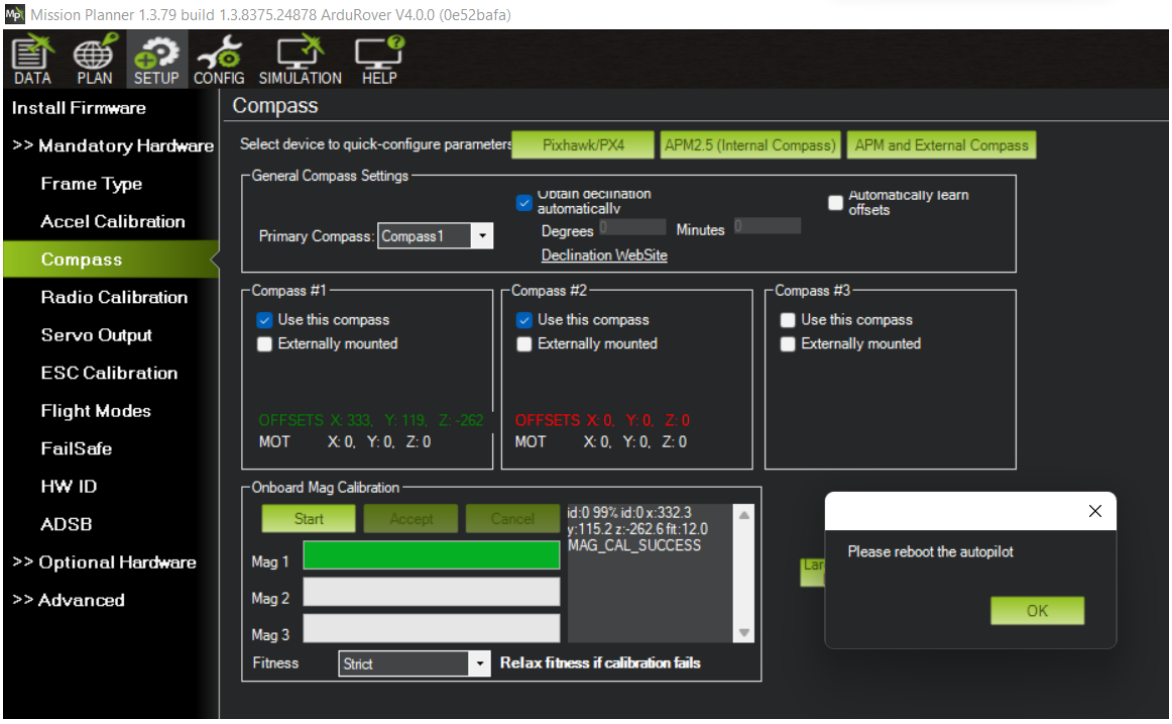



Figure 91: Compass Calibration Complete

14. Select 'OK'.

15. Press CTRL and F keys to reboot the autopilot hardware separately from the entire AutoNav Plus™ system.

16. Select 'reboot pixhawk'.

Figure 92: CTRL-F Screen

17. The autopilot hardware will reboot. Mission Planner will disconnect and automatically reconnect. (If it does not, you can manually connect)

Figure 93: Reboot Complete

18. Calibration complete.

# 7 Service And Maintenance

## 7.1 Maintaining Your Investment

Maintaining your Hydrone™ AutoNav Plus™ Servo asset is essential for its reliable performance. Regular maintenance includes routine checks of propulsion system, sensor, and electronics to ensure they are in optimal working condition. Keeping the hull clean as well as verifying the integrity of communication links and power sources, is crucial. By adhering to a proactive maintenance regimen, the USV remains mission-ready, maximizing its effectiveness and longevity.

## 7.2 Storage

- Store indoors with all hatches open for air circulation.
- LiPo batteries stored at 3.75-3.85V a cell - check every month.
- Pontoon internals are dry

## 7.3 Service

### 7.3.1 Thruster Replacement

Servo Thruster Removal:

1. Disconnect the connector from the pontoon bulkhead.
2. Unscrew locking thumbscrew.
3. Slide the servo housing up to remove from mount.

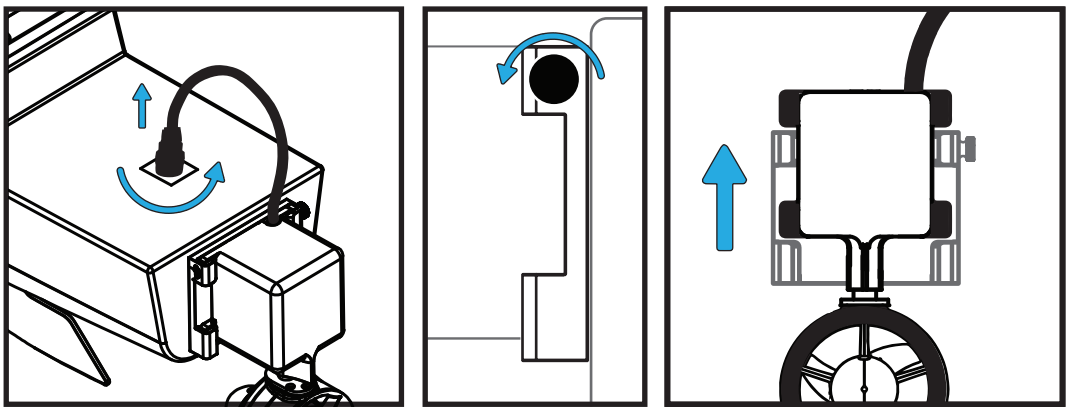


Figure 94: Servo Thruster Removal

Servo Thruster Installation:

1. Slide the servo housing down into the mount.
2. Tighten locking thumbscrew.
3. Connect the connector into the pontoon bulkhead.

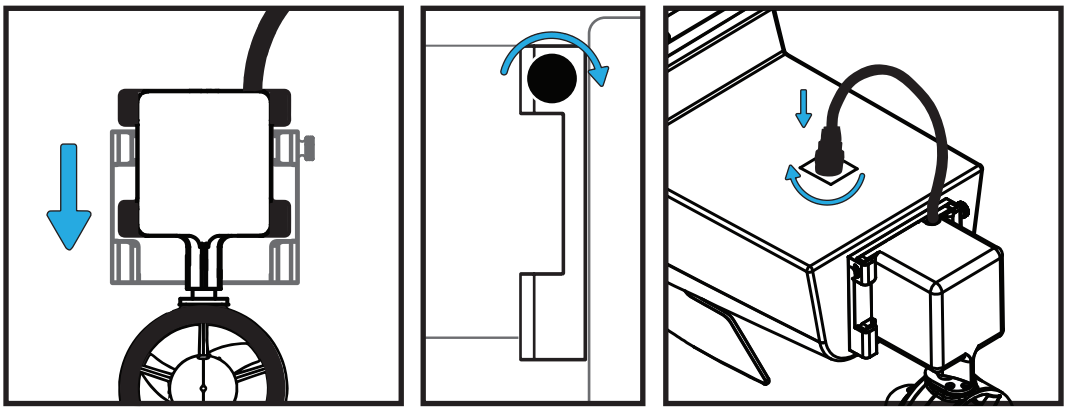


Figure 95: Servo Thruster Installation

### 7.3.2 Propeller Replacement

**Caution**

**Use Vibra-tite with all hardware. Plastic may become damaged if Vibra-tite instructions are not properly followed.**

1. Remove the Servo Thruster from the pontoon. (Figure 14)
2. Flip over the Servo Thruster to access the back panel.
3. Remove the 2x Philip screws with a #3 screwdriver.

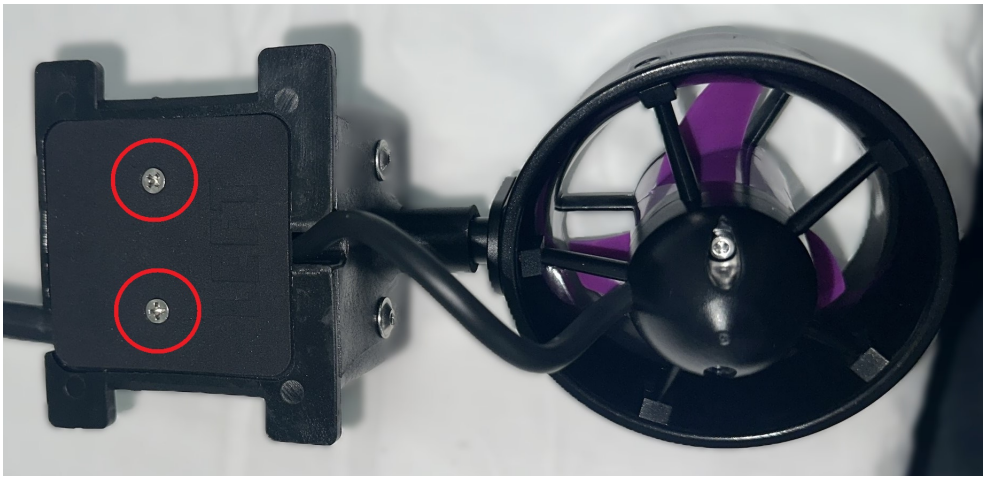


Figure 96: Servo Thruster Access Panel

4. Rotate the thruster to gain access to the thruster shaft bolt.
5. Use a 7m socket to remove the M4 bolt.

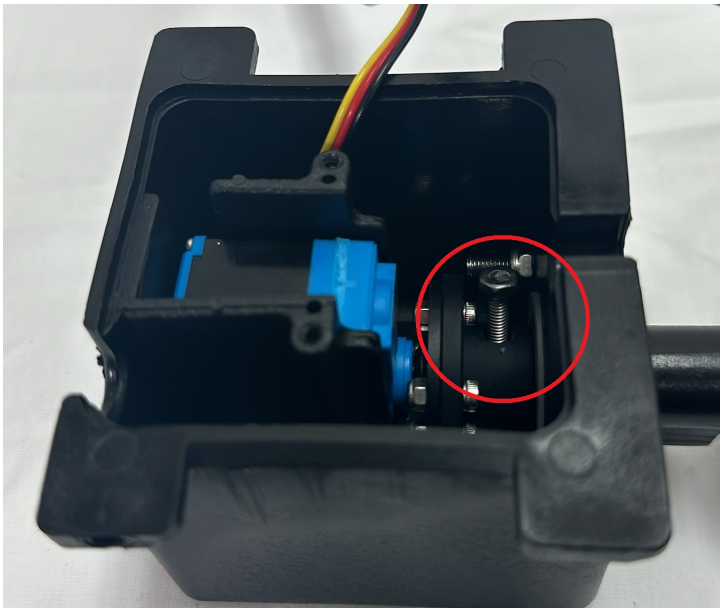


Figure 97: Servo Thruster Shaft

6. Slide the thruster shaft out from the housing.
7. Remove the 3x M3x6 bolts with a 2mm Allen driver.

8. Remove the 1x screw with a #3 Philips screwdriver.

Figure 98: Servo Thruster Adapter Shaft Removal

9. Remove the 4x screws with a #3 Philips screwdriver.

Figure 99: Thruster Housing Removal

10. Remove the 2x screws with a #3 Philips screwdriver.

Figure 100: Prop Removal

11. Remove the prop. The prop may be suctioned to the motor housing. Use care when removing.

Figure 101: Prop Removed

12. Install the replacement W30 prop.
13. Follow the instructions in reverse order for reassembly.

**Caution**

Be careful not to pinch any wires when installing the access panel cover.

### 7.3.3 Motor Cleaning

**Caution**

**Use Vibra-tite with all hardware. Plastic may become damaged if Vibra-tite instructions are not properly followed.**

1. Remove the Servo Thruster from the pontoon. (Figure 14)
2. Flip over the Servo Thruster to access the back panel.
3. Remove the 2x Philip screws with a #3 screwdriver..

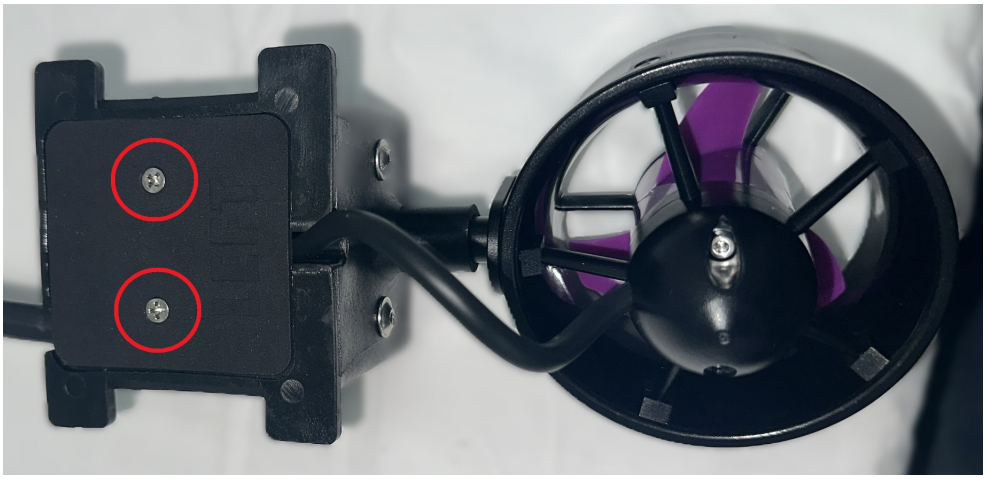


Figure 102: Servo Thruster Access Panel

4. Rotate the thruster to gain access to the thruster shaft bolt.
5. Use a 7m socket to remove the M4 bolt.

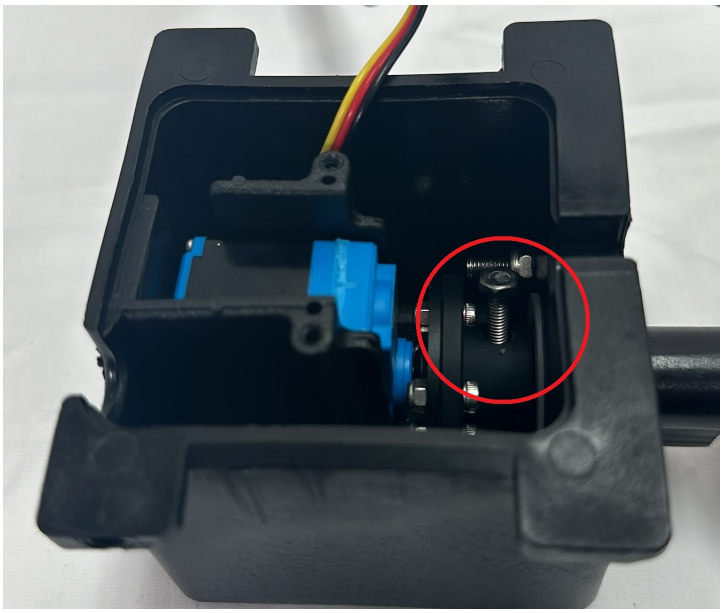


Figure 103: Servo Thruster Shaft

6. Slide the thruster shaft out from the housing.
7. Remove the 3x M3x6 bolts with a 2mm Allen driver.
8. Remove the 1x screw with a #3 Philip screwdriver.

Figure 104: Servo Thruster Adapter Shaft Removal

9. Remove the 4x screws with a #3 Philips screwdriver.

Figure 105: Thruster Housing Removal

10. Remove the 2x screws with a #3 Philips screwdriver.

Figure 106: Prop Removal

11. Remove the prop. The prop may be suctioned to the motor housing. Use care when removing.

Figure 107: Prop Removed

12. Remove the 2x M3 bolts with a 2.5mm Allen driver

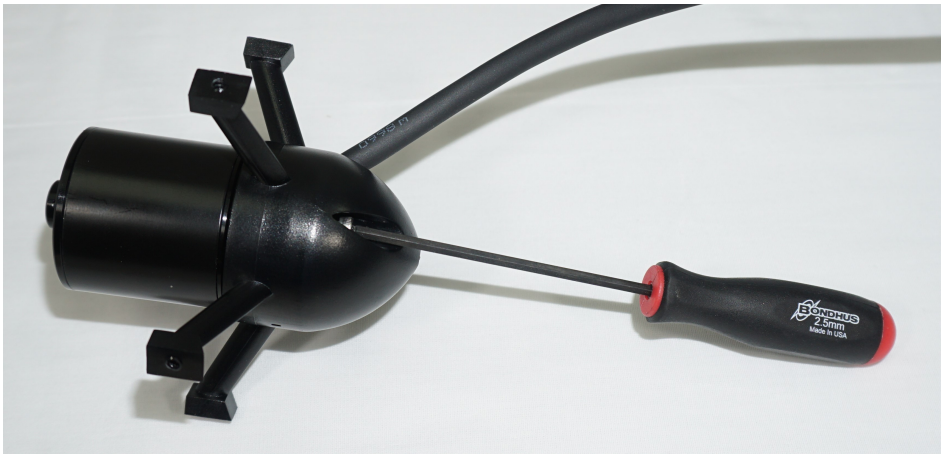



Figure 108: Motor Housing Removal

13. Loosen the 2x set screws on the collar towards the bow using a 1.5mm driver(not supplied).

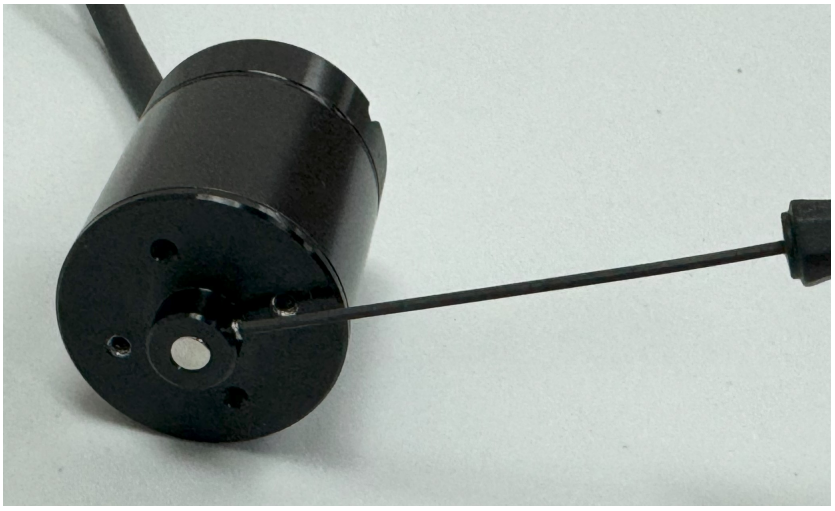


Figure 109: Rotor Removal

14. The motor rotor and stator are magnets. To remove, pull on the motor rotor to slide off.

Figure 110: Stator And Rotor

15. Inspect the magnets and protective coverings. Clean with mild soap and water.
16. Follow the instructions in reverse order for reassembly.

**Caution**

Be careful not to pinch any wires when installing the access panel cover.

### 7.3.4 RCU RTC Battery Replacement

Replace the RTC battery when you receive "Battery Warning: RTC Battery Low".

Part Required:

- CR21220 Coin Battery

Tool Required:

- Phillips Screwdriver

1. Power off and flip over the RCU.
2. Remove the two visible Phillip screws.

Figure 111: RCU 2x Screw Locations

3. Remove the module bay cover.
4. Remove the battery cover. (Figure 25)
5. Disconnect the battery.

Figure 112: RCU Additional Screw Locations

6. Remote the additional two Phillip screws.
7. Carefully split case of the RCU.

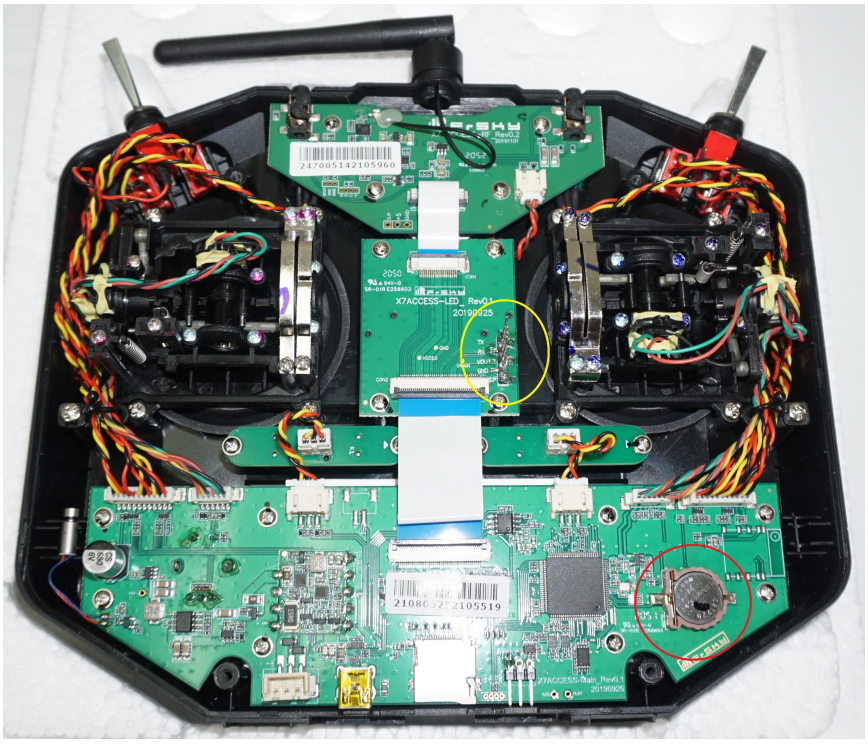


Figure 113: RCU RTC Location

8. Locate the RTC battery(circled red in Figure 113) and remove it.
9. Replace it with a new CR1220 battery.

10. Carefully put the two case halves together. Verify the module bay pins (circled yellow in Figure 113) slide through the slot (Figure 25).
11. Screw in the four Philip screws.
12. Connect the battery.
13. Install battery spacing foam.
14. Install the battery and module bay covers.

## 7.4 Maintenance Schedule

### 7.4.1 Pre-launch

- Hull inspection for damage, cracks, or signs of wear.
- Seals are lubricated with silicone-based lubricants.
- Anti-seize on hardware.
- Electronics are functioning.
- Batteries are fully charged.
- Check all hardware is tight.
- Check that cable connections are screwed tight.
- Confirm full insulation of all cables.

### 7.4.2 After Recovery

- Hull inspection for damage, cracks, or signs of wear.
- Seals are lubricated with silicone-based lubricants.
- Anti-seize on hardware.
- Electronics are functioning.
- Batteries are fully charged.
- Check all hardware is tight.
- Cleaned with fresh water and mild soap.
- Dried off.
- Stored with hatches open for circulation.

### 7.4.3 Monthly

- Hull inspection for damage, cracks, or signs of wear.
- Check for loose or corroded electrical connections.
- Lubricate seals with silicone-based lubricants.
- Anti-seize on hardware.
- Electronics are functioning.
- Battery maintenance.
  - LiPo batteries should be stored at 3.6V a cell.
- Replenish any parts that were pulled from the spares kit.
- Stored with hatches open for circulation.

# 8 Technical Diagrams

## 8.1 Beaufort Sea State Chart

| Estimating Wind Speed and Sea State with Visual Clues | | | | |
|---|---|---|---|---|
| Beaufort number | Wind Description | Wind Speed | Wave Height | Visual Clues |
| 0 | Calm | 0 knots | 0 feet | Sea is like a mirror. Smoke rises vertically. |
| 1 | Light Air | 1-3 kts | < 1/2 | Ripples with the appearance of scales are formed, but without foam crests. Smoke drifts from funnel. |
| 2 | Light breeze | 4-6 kts | 1/2 ft (max 1) | Small wavelets, still short but more pronounced, crests have glassy appearance and do not break. Wind felt on face. Smoke rises at about 80 degrees. |
| 3 | Gentle Breeze | 7-10 kts | 2 ft (max 3) | Large wavelets, crests begin to break. Foam of glassy appearance. Perhaps scattered white horses (white caps). Wind extends light flag and pennants. Smoke rises at about 70 deg. |
| 4 | Moderate Breeze | 11-16 kts | 3 ft (max 5) | Small waves, becoming longer. Fairly frequent white horses (white caps). Wind raises dust and loose paper on deck. Smoke rises at about 50 deg. No noticeable sound in the rigging. Slack halyards curve and sway. Heavy flag flaps limply. |
| 5 | Fresh Breeze | 17-21kts | 6 ft (max 8) | Moderate waves, taking more pronounced long form. Many white horses (white caps) are formed (chance of some spray).<br><br>Wind felt strongly on face. Smoke rises at about 30 deg. Slack halyards whip while bending continuously to leeward. Taut halyards maintain slightly bent position. Low whistle in the rigging. Heavy flag doesn't extended but flaps over entire length. |
| 6 | Strong Breeze | 22-27 kts | 9 ft (max 12) | Large waves begin to form. White foam crests are more extensive everywhere (probably some spray).<br><br>Wind stings face in temperatures below 35 deg F (2C). Slight effort in maintaining balance against wind. Smoke rises at about 15 deg. Both slack and taut halyards whip slightly in bent position. Low moaning, rather than whistle, in the rigging. Heavy flag extends and flaps more vigorous. |
| 7 | Near Gale | 28-33 kts | 13 ft (max 19) | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of wind. Necessary to lean slightly into the wind to maintain balance. Smoke rises at about 5 to 10 deg. Higher pitched moaning and whistling heard from rigging. Halyards still whip slightly. Heavy flag extends fully and flaps only at the end. Oilskins and loose clothing inflate and pull against the body. |
| 8 | Gale | 34-40 kts | 18 ft (max 25) | Moderately high waves of greater length. Edges of crests begin to break into the spindrift. The foam is blown in well-marked streaks along the direction of the wind. Head pushed back by the force of the wind if allowed to relax. Oilskins and loose clothing inflate and pull strongly. Halyards rigidly bent. Loud whistle from rigging. Heavy flag straight out and whipping. |
| 9 | Strong Gale | 41-47 kts | 23 ft (max 32) | High waves. Dense streaks of foam along direction of wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility. |
| 10 | Storm | 48-55 kts | 29 ft (max 41) | Very high waves with long overhanging crests. The resulting foam, in great patches is blown in dense streaks along the direction of the wind. On the whole, the sea takes on a whitish appearance. Tumbling of the sea becomes heavy and shock-like. Visibility affected. |
| 11 | Violent Storm | 56-63 kts | 37 ft (max 52) | Exceptionally high waves (small and medium-sized ships might be for time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere, the edges of the wave crests are blown into froth. Visibility greatly affected. |
| 12 | Hurricane | 64+ kts | 45+ ft | The air is filled with foam and spray. The sea is completely white with driving spray. Visibility is seriously affected. |

Figure 114: Beaufort Sea State

## 8.2 Block Diagrams

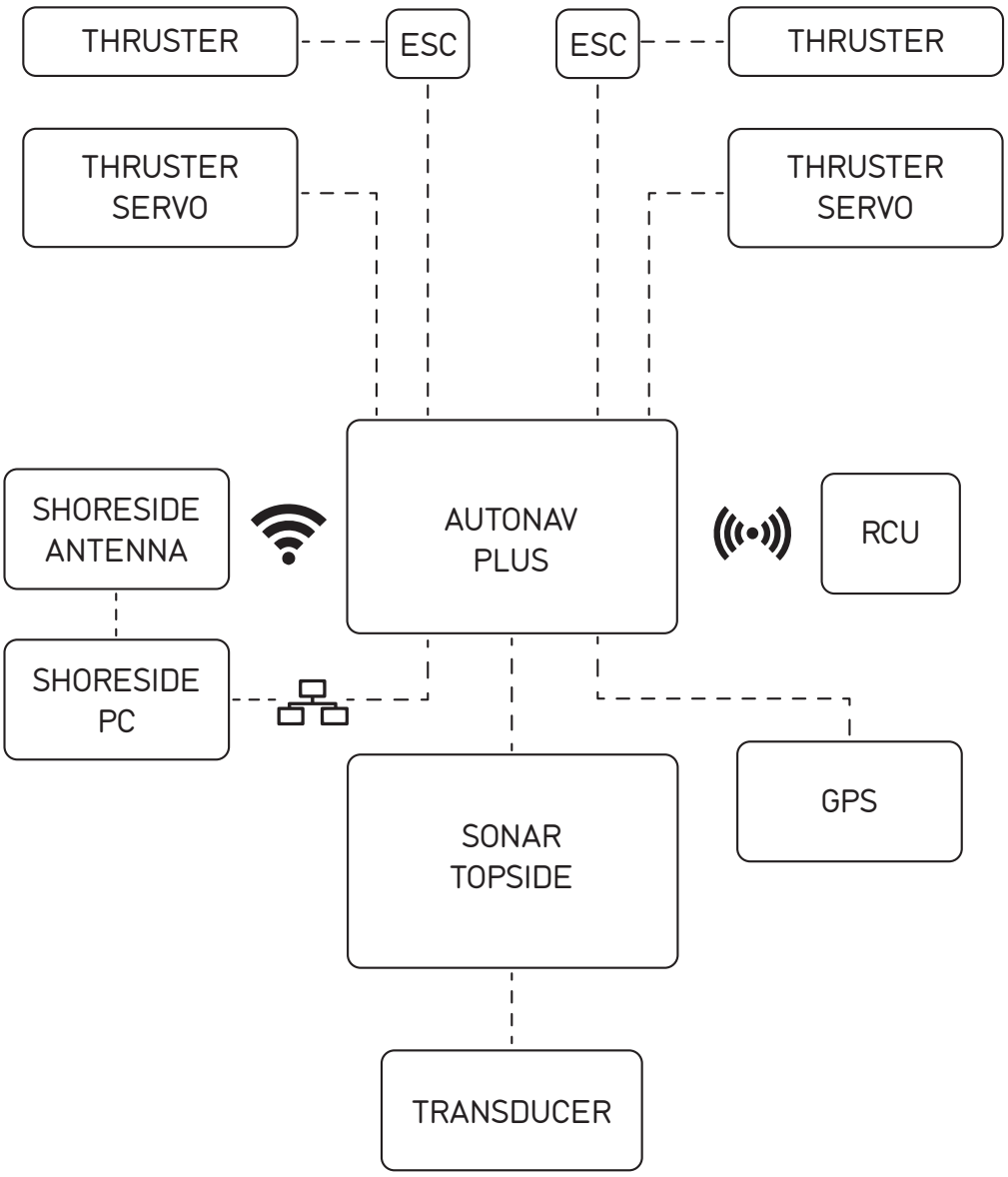



Figure 115: Block Diagram

## 8.3 Electrical Diagrams

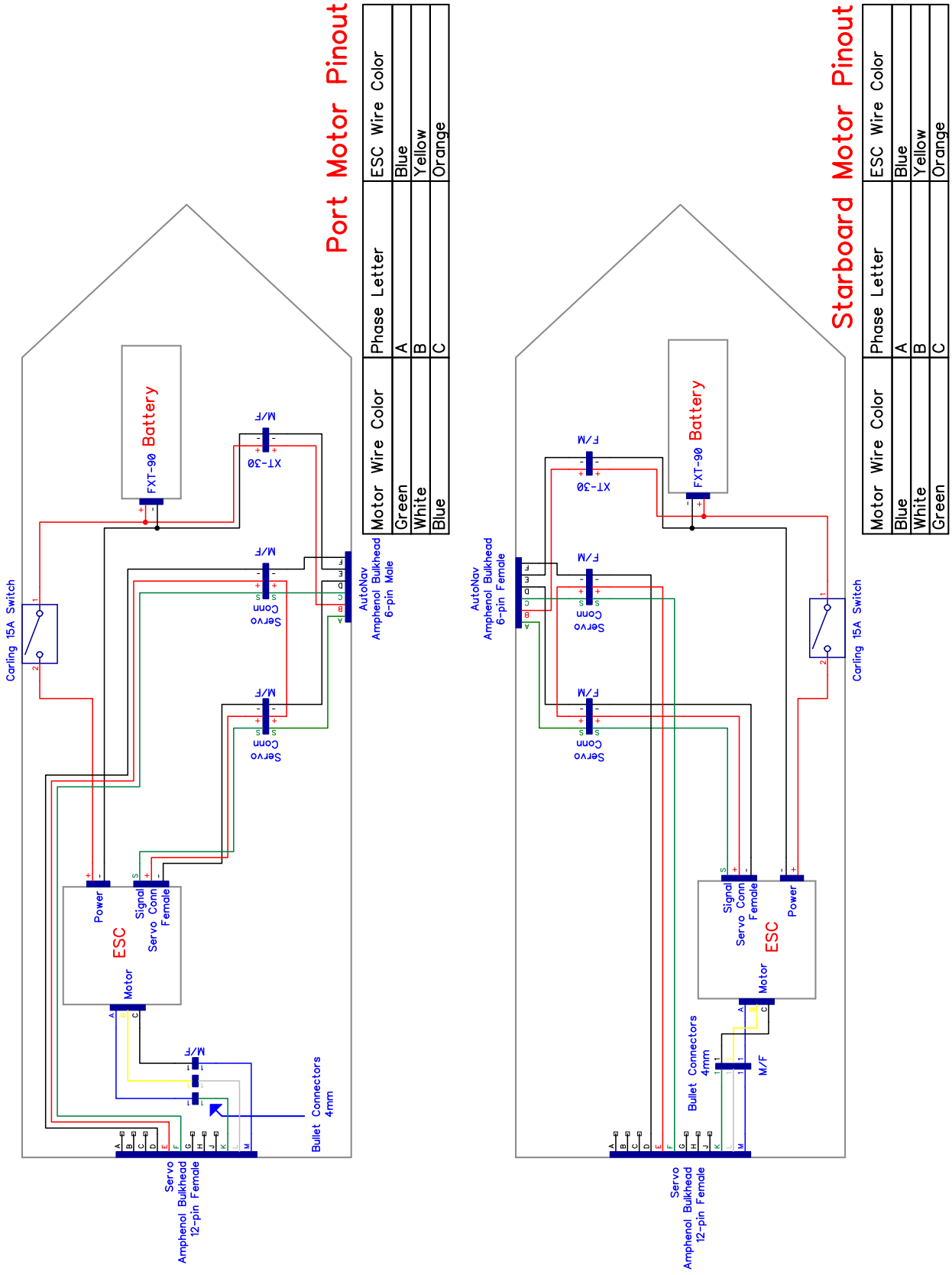



Figure 116: HyDrone™ Electrical Diagram

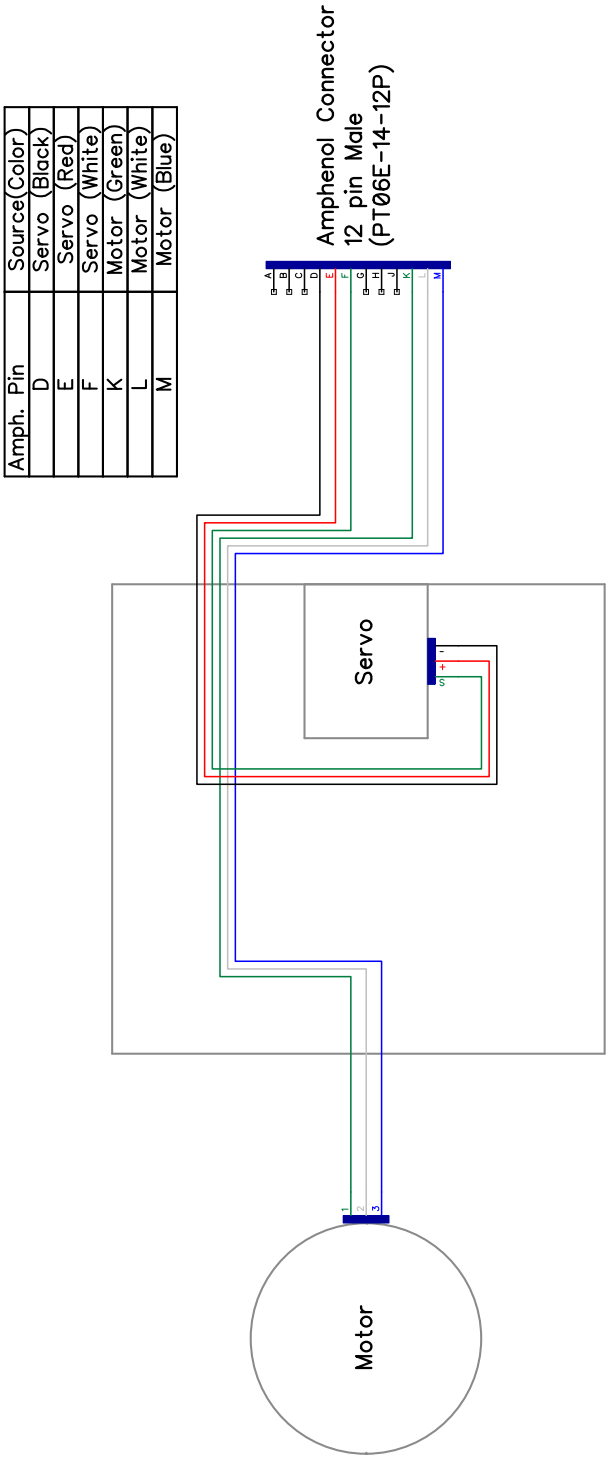



Figure 117: Servo Thruster Electrical Diagram

**Port**

| Amphenol Pin | Function |
|---|---|
| A | ESC Signal |
| B | Battery + |
| C | Servo Signal |
| D | ESC Ground |
| E | Battery - |
| F | Servo Ground |

**Starboard**

| Amphenol Pin | Function |
|---|---|
| A | ESC Signal |
| B | Battery + |
| C | Servo Signal |
| D | ESC Ground |
| E | Battery - |
| F | Servo Ground |

**GPS**

| Amphenol Pin | Function |
|---|---|
| A | Battery + |
| B | N/C |
| C | GPS RX |
| D | Battery - |
| E | GPS GND |
| F | GPS TX |

**Serial**

| Amphenol Pin | Function |
|---|---|
| A | Power Out + |
| B | N/C |
| C | Serial RX |
| D | Power Out - |
| E | Serial GND |
| F | Serial TX |

Figure 118: AutoNav Plus™ Bulkhead Pinout
(See Figure 5 for Bulkhead Locations)

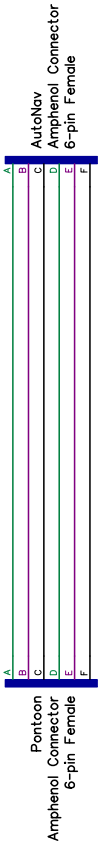



Figure 119: Port Pontoon Power Data Cable Diagram

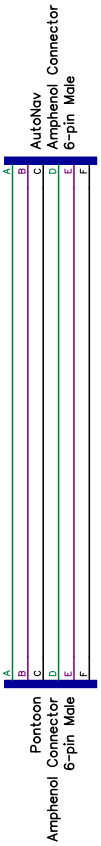



Figure 120: Starboard Pontoon Power Data Cable Diagram

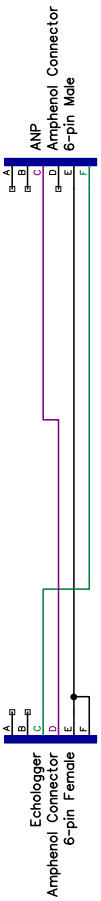



Figure 121: AutoNav Plus™ To Hydrolite Plus Echo Sounder Data Cable Diagram

## 8.4 Mechanical Diagrams

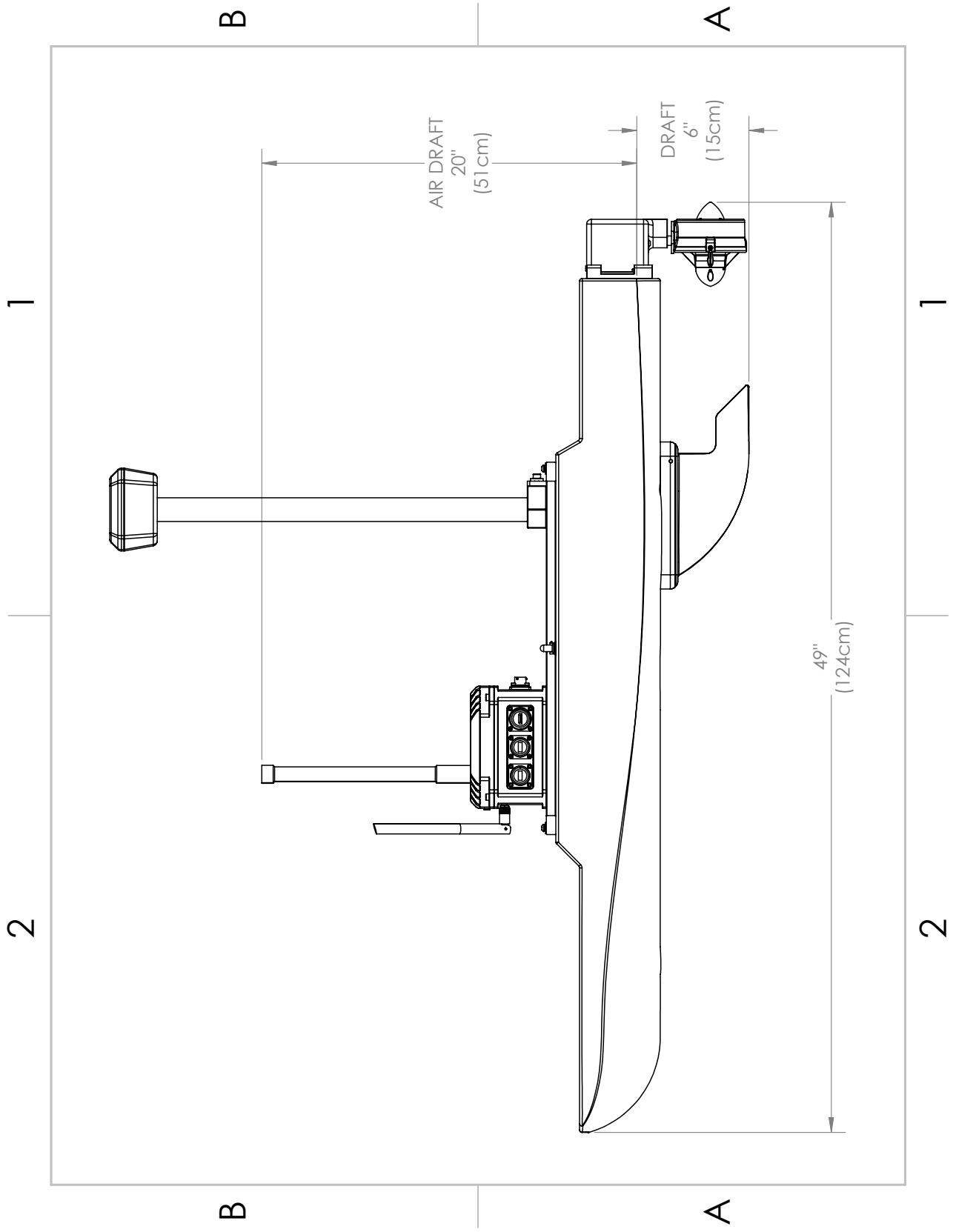



Figure 122: Side View Diagram

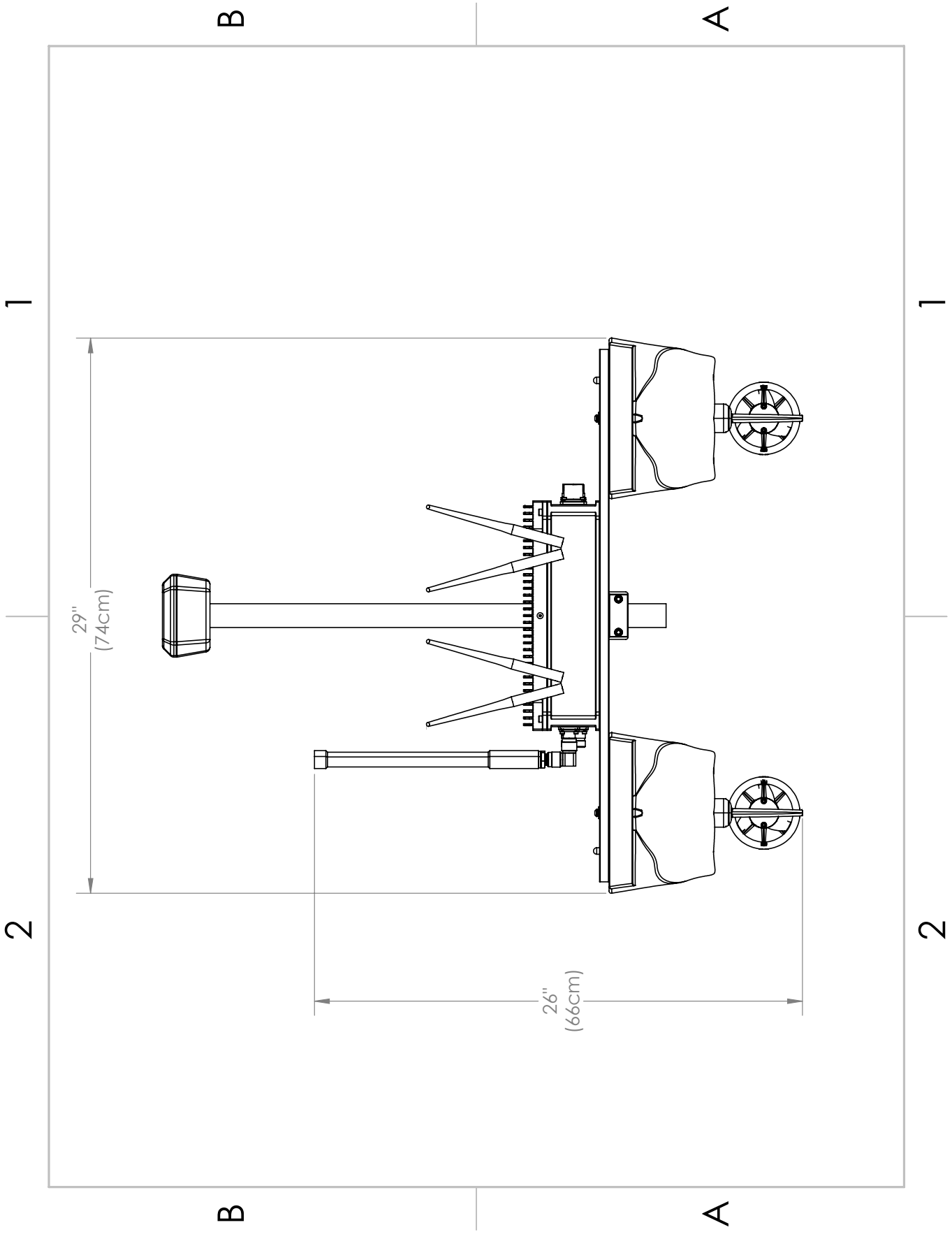



Figure 123: Front View Diagram

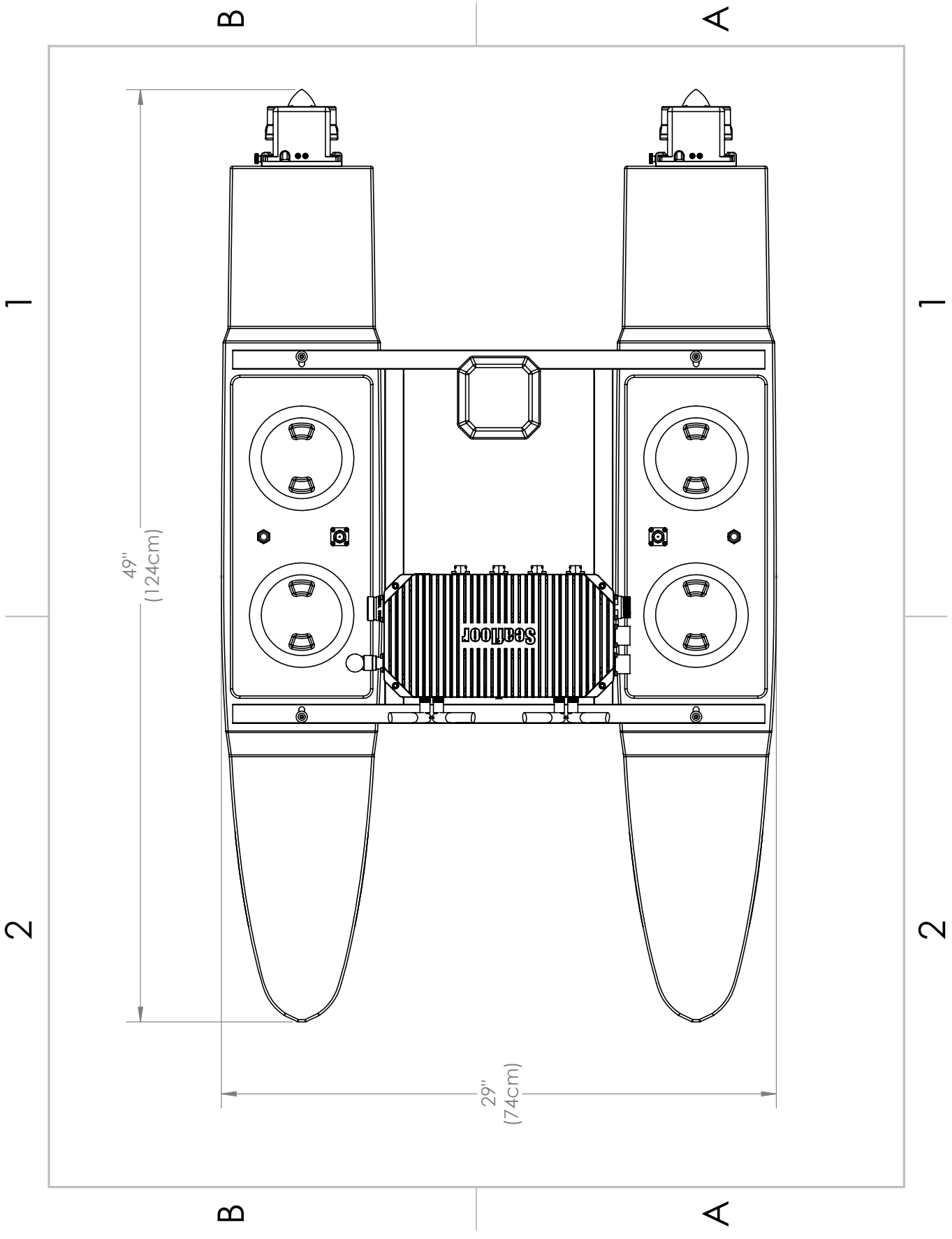



Figure 124: Top View Diagram

## Revision History

| Revision | Date | Author(s) | Description |
|---|---|---|---|
| 1.0 | 3.27.2024 | BA | Created |