HyDrone™ AutoNav Plus™

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™ 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™ offers advanced hydrographic surveying capabilities, flexible payload options, and real-time data viewing. The HyDrone™ AutoNav Plus™ 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™.

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	45.6in (1.2m)
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	Skid Steer
Communication Range	Line of Sight, Up to 0.6mi (1km) (Conditions Dependent)
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 110)
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™, 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™ 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™ 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™ 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:

Repairs & Support

- 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™.

<div style="background-color:red; text-align:center;">**Important Alert**</div>

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™, 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™ 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™ 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

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™:

- 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™ 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™ 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™ USV	
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™ 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™	
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™ System Overview

Figure 2: HyDrone™ AutoNav Plus™ Front View

GNSS Antenna

Survey Pole

AutoNav Plus
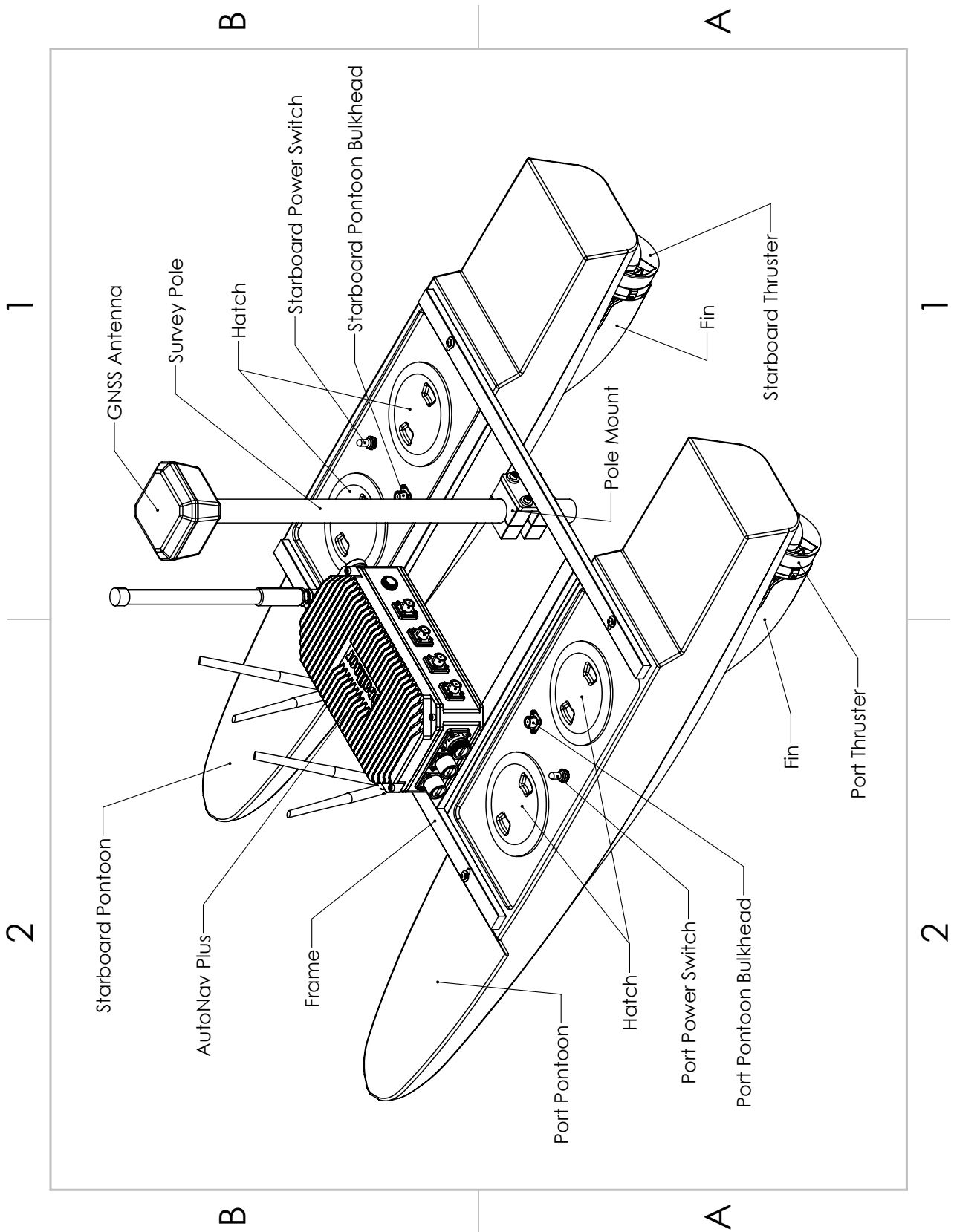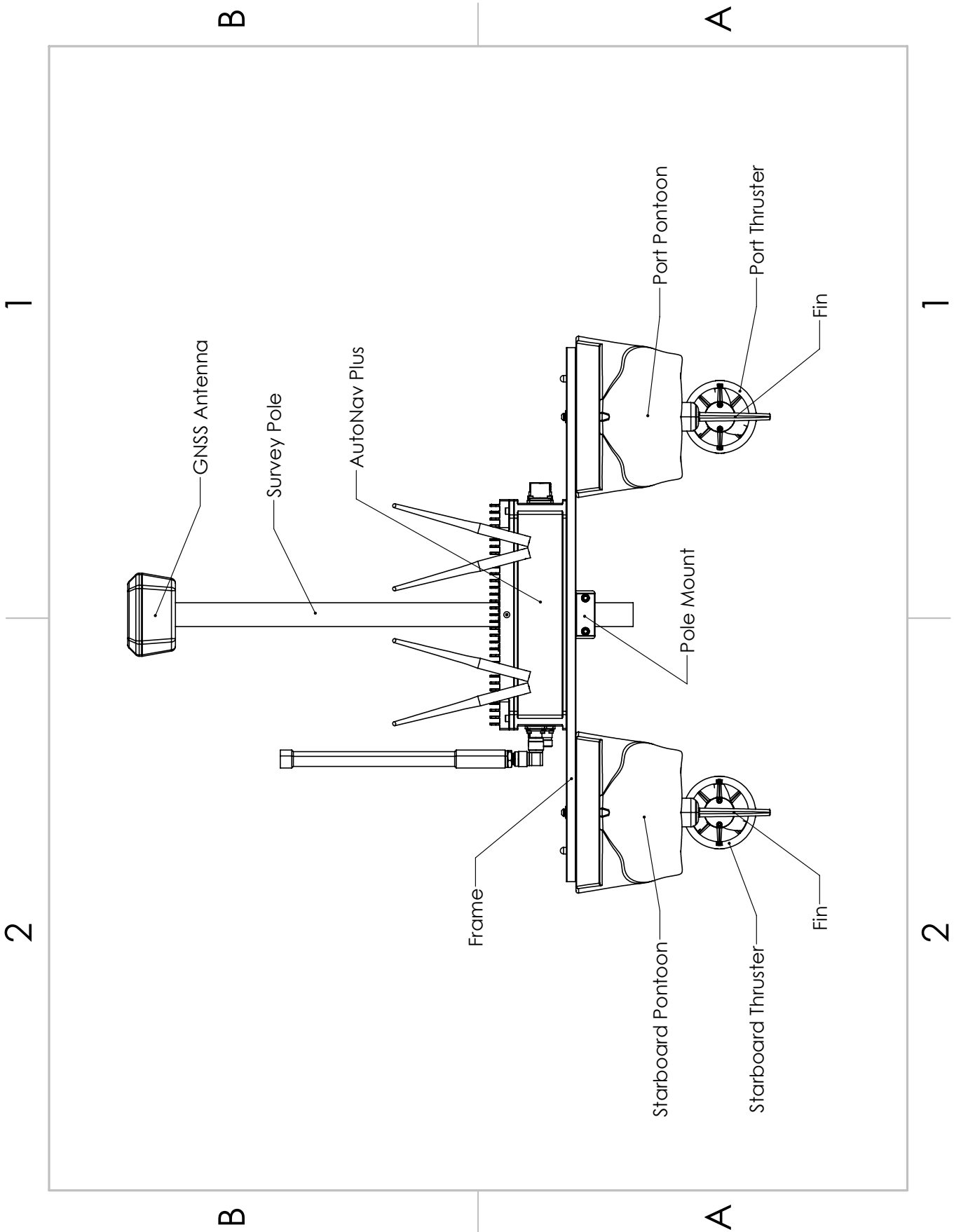
Port Pontoon

Port Thruster

Fin

Pole Mount

Frame

Starboard Pontoon

Starboard Thruster

Fin
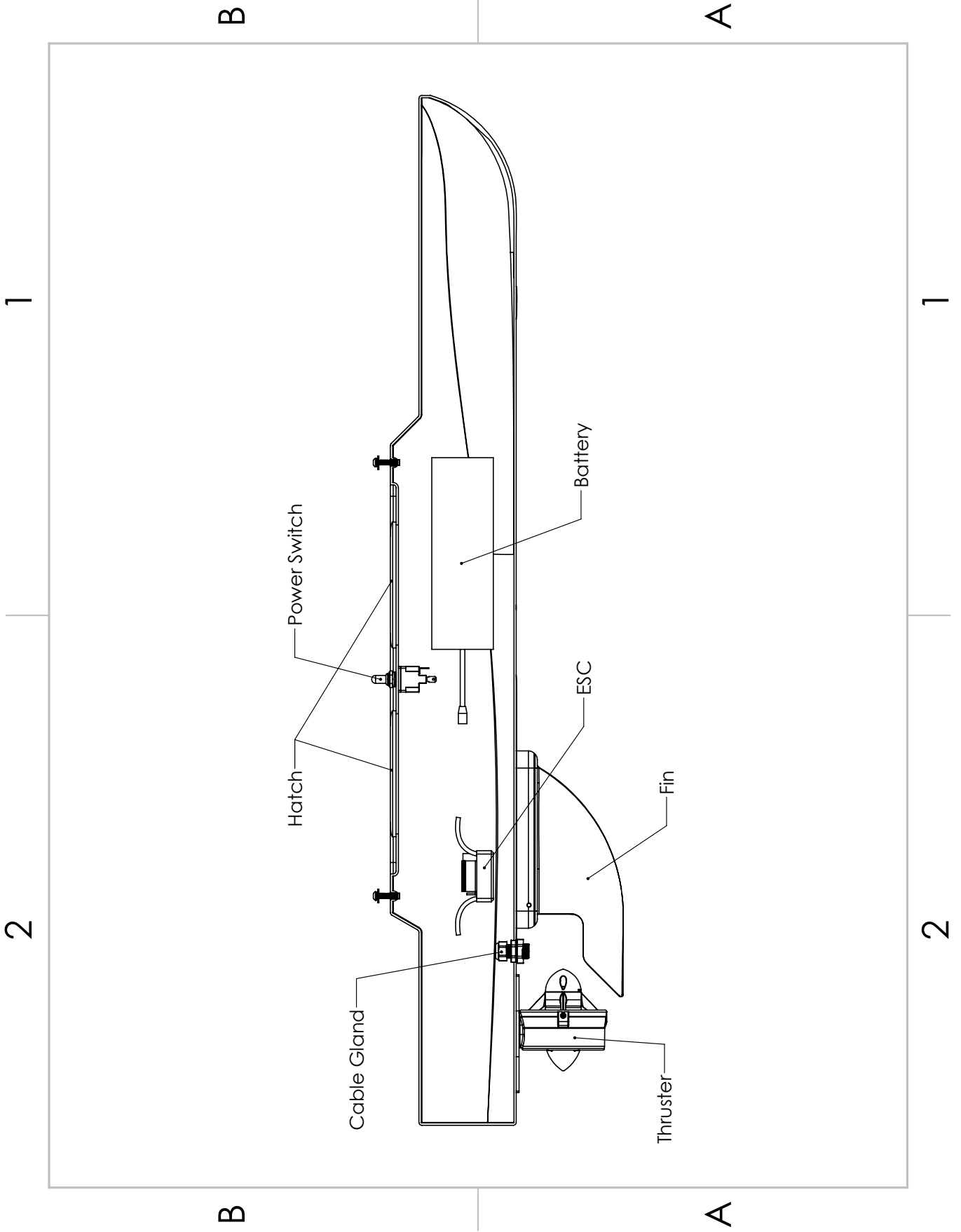
Figure 3: HyDrone™ AutoNav Plus™ Side View
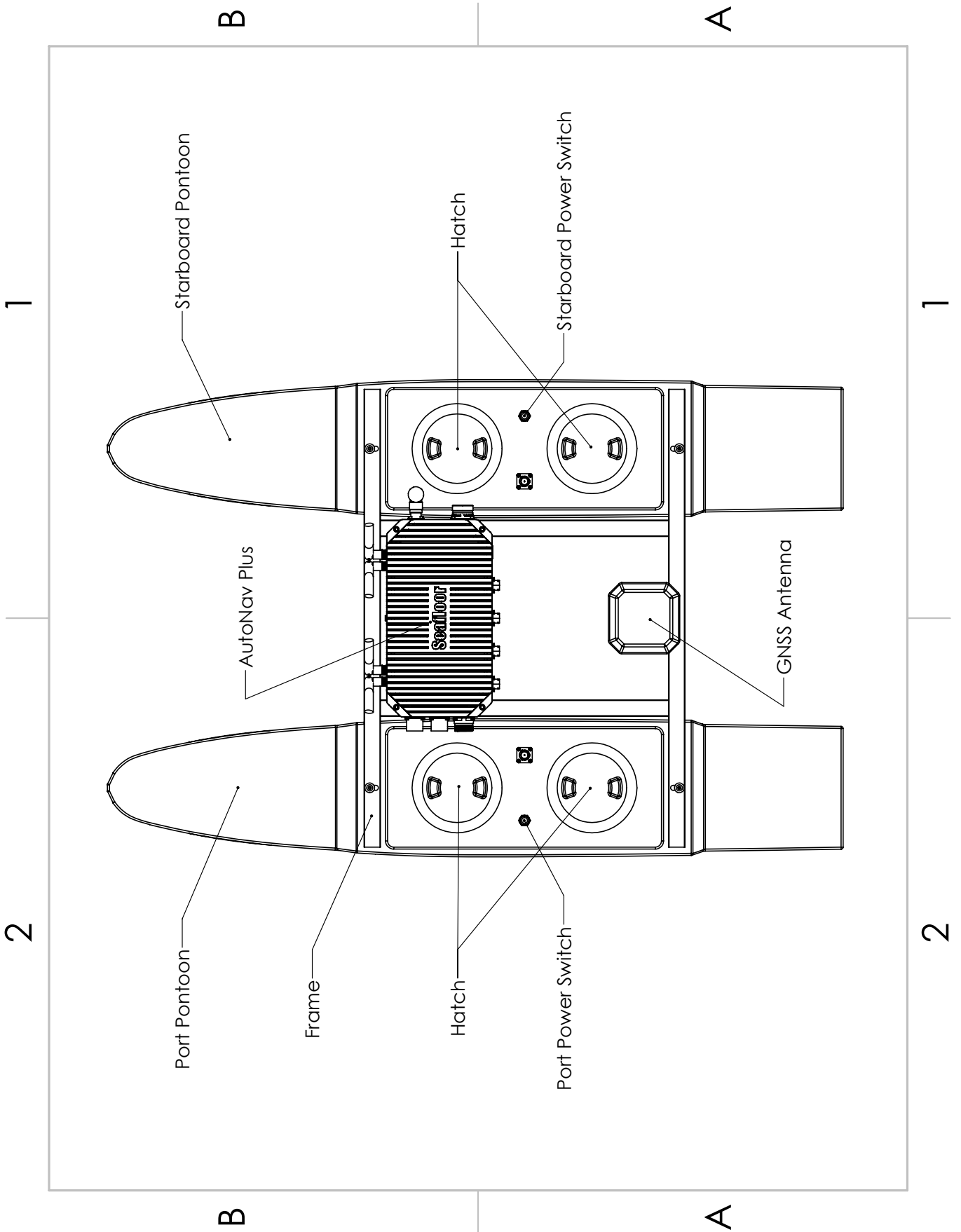
Figure 4: HyDrone™ AutoNav Plus™ Top View

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.
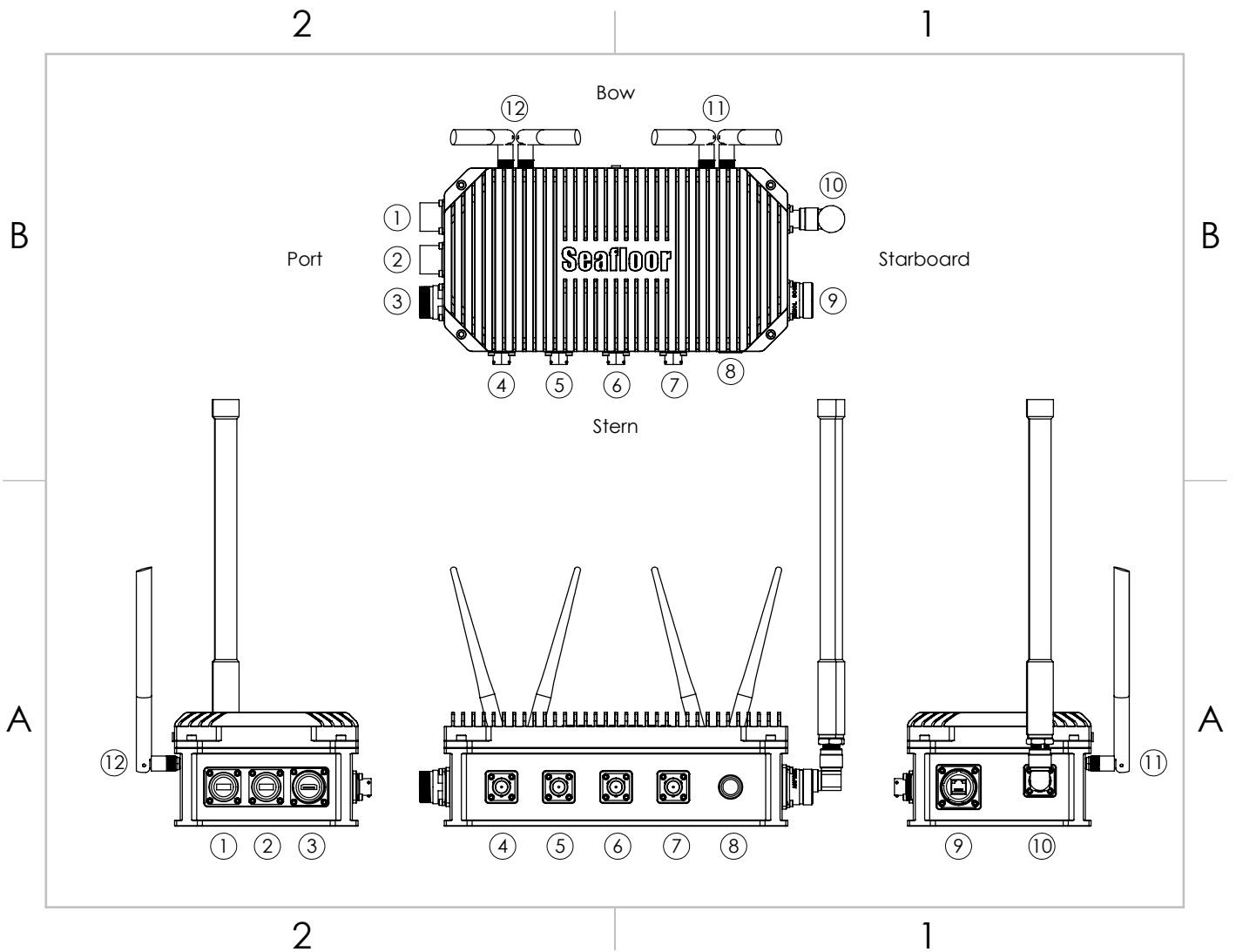
Figure 5: AutoNav Plus™ Layout

3.3 Assembling Your HyDrone™ AutoNav Plus™

1. Open the HyDrone™ AutoNav Plus™ 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™ Case
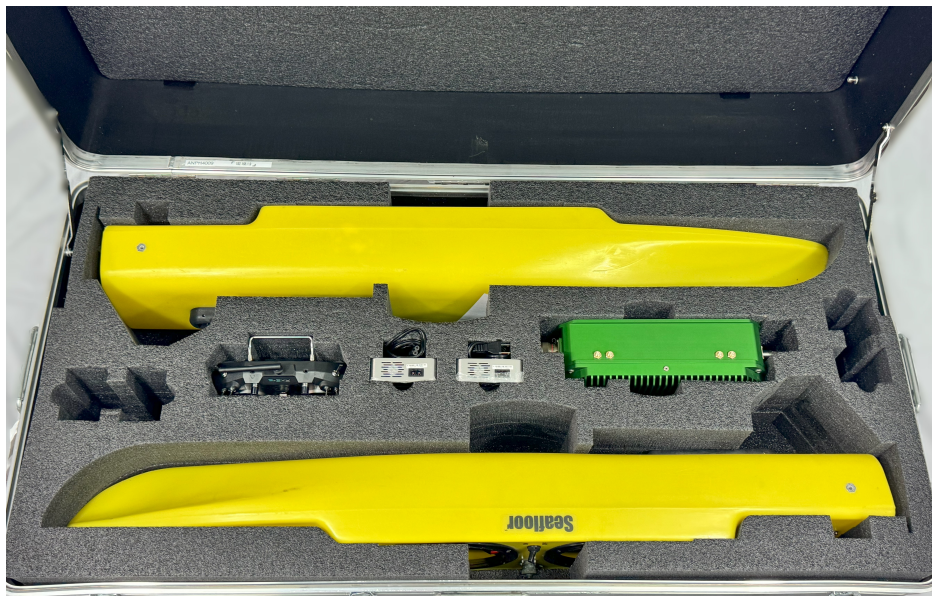
Figure 7: Removing Top Layer

3. Arrange an elevated platform for positioning the HyDrone™ AutoNav Plus™ 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.
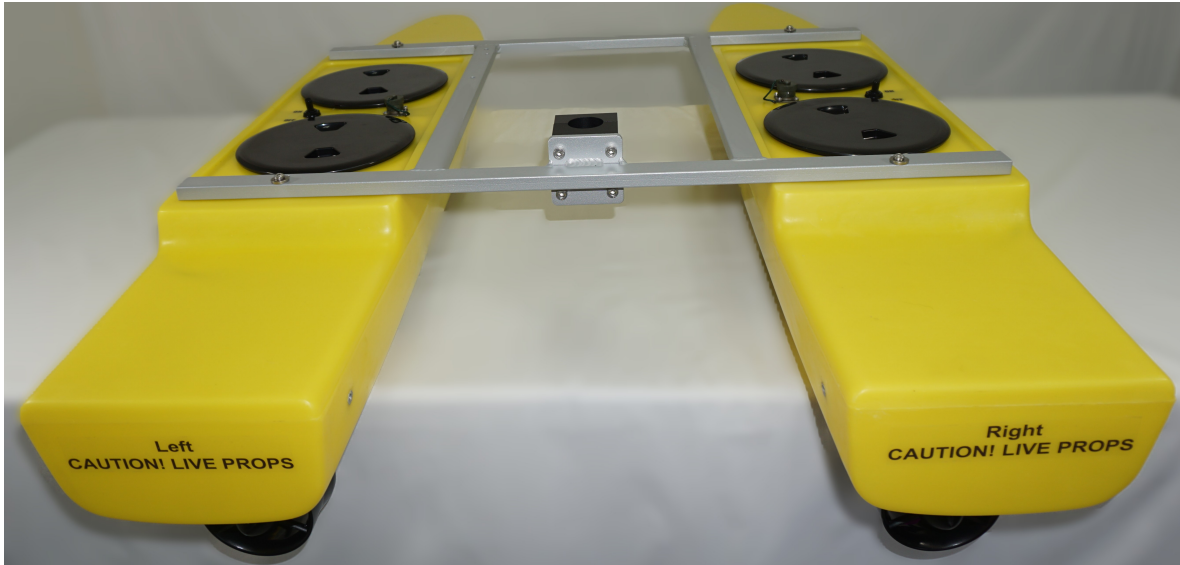
Figure 12: Frame Attached

9. Flip the Hydrone™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 to hold the fin in place.

Figure 13: Fin Installation

12. Flip the Hydrone™ right side up.

13. Place the AutoNav Plus™ on the Hydrone™frame. Power button facing the stern. (Figure 5)

14. Install the 4x M5x30 thumbscrew through frame into the AutoNav Plus™ box.

Figure 14: AutoNav Plus™ Mounted

15. Screw in the 4x 2.4GHz Antennas into SMA bulkheads on the front of the AutoNav Plus™.

16. Screw in the N-Type right angle with the antenna.
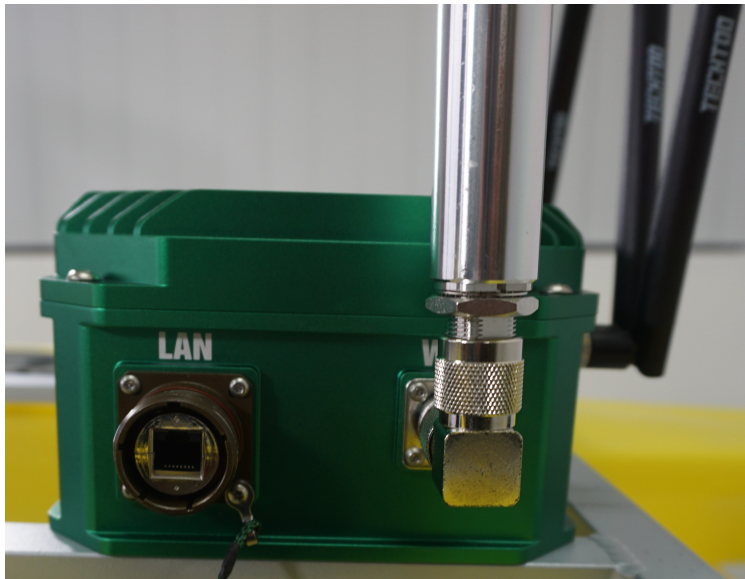
Figure 15: Antennas Installed

17. 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.

18. 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 16 below: The center same length cables are Pontoon Power Data Cables. The longer cable is for the Hydrolite Plus integration.

Figure 16: Pontoon Power Data Cables and Hydrolite Plus Cable
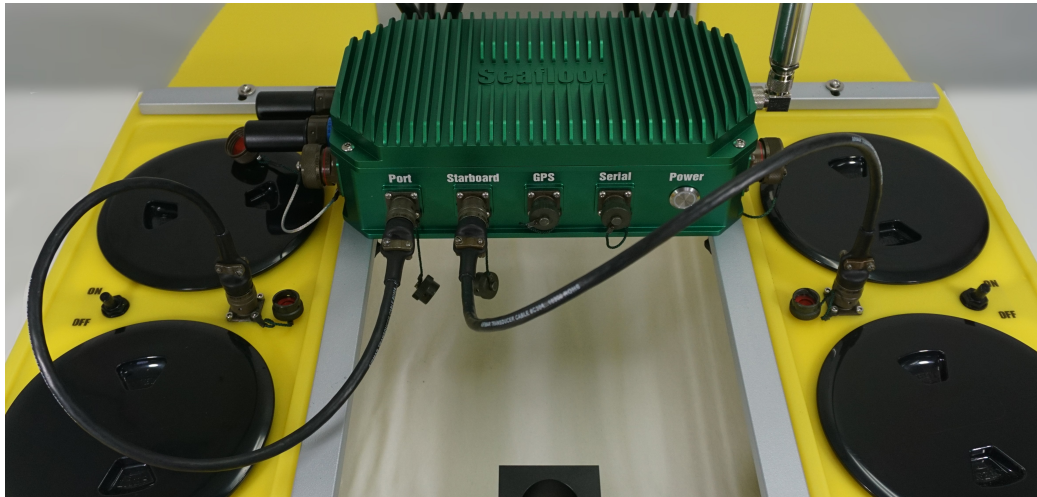
Figure 17: AutoNav Plus™ Installed

19. If using a software USB dongle, the USB cover can be installed now.
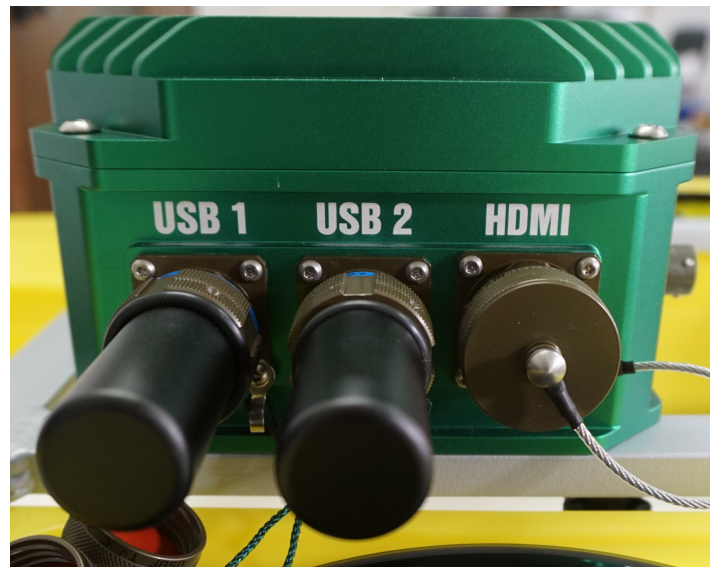
Figure 18: USB Covers Installed

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

USB Cover Software Dongle Installation:
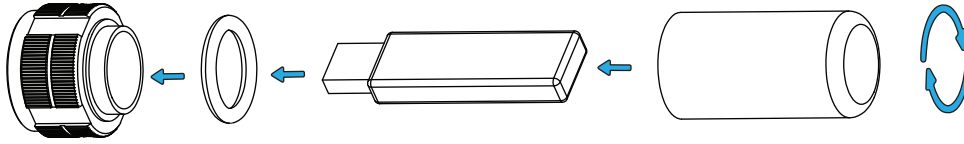
Figure 19: USB Cover Exploded View

3.4 HyDrone™ AutoNav Plus™ Endurance Chart
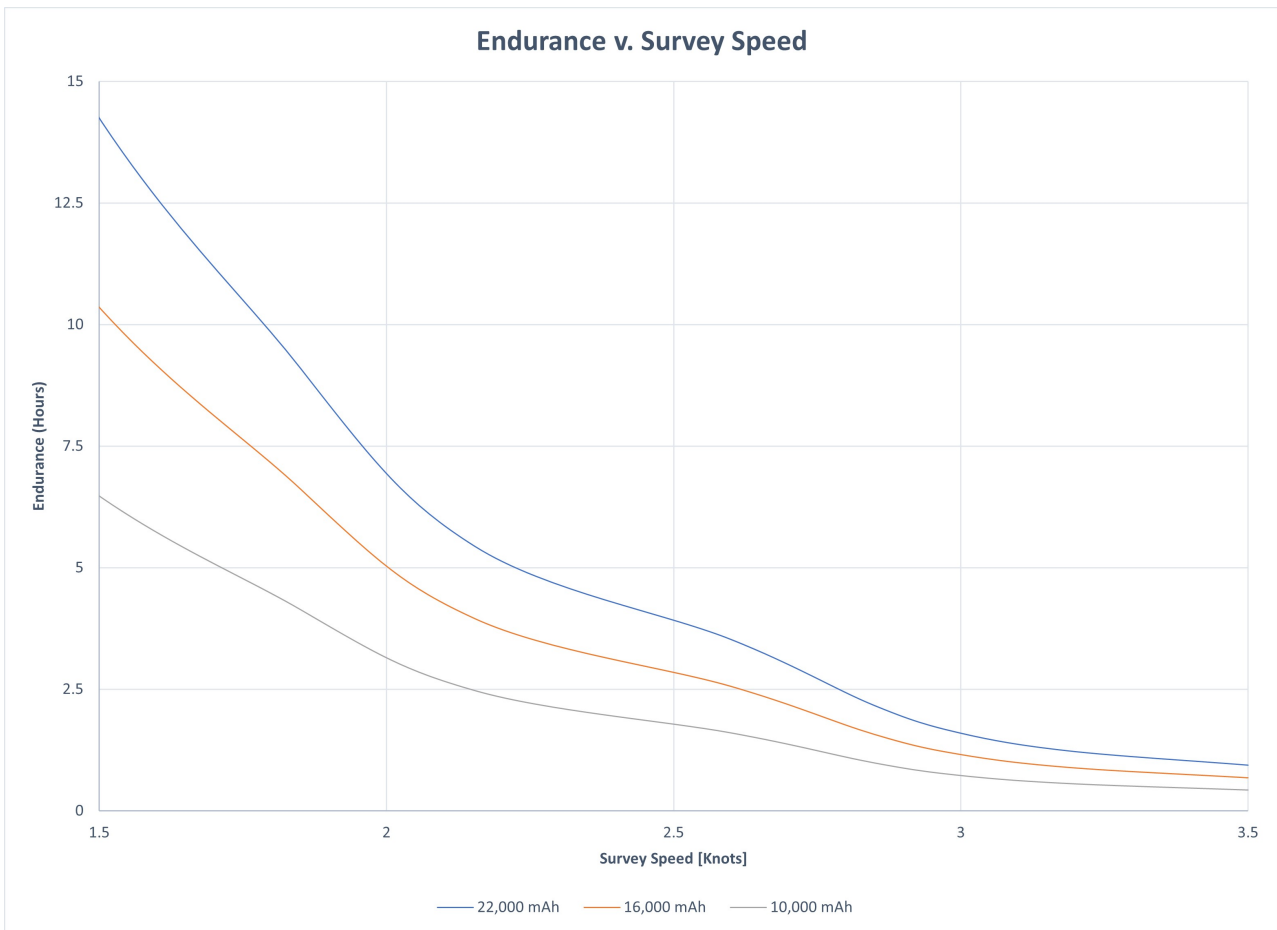
Figure 20: HyDrone™ AutoNav Plus™ Endurance Chart

3.5 Remote Control Unit (RCU)

The HyDrone™ AutoNav Plus™ is controlled by a Taranis Q-X7 Access Transmitter.
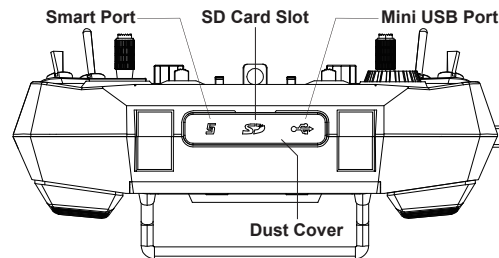
Figure 21: Bottom View

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)
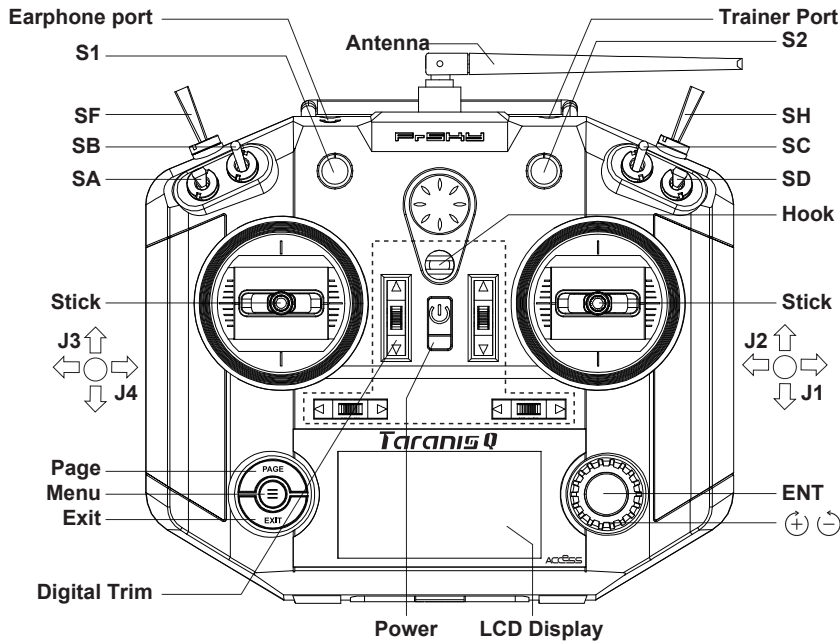
Figure 22: RCU Front View

Remote Control Unit Functions

Power	Press and hold
	Release when the fourth loading dot appears - to power on
	Release when the last loading dot shows - to power off
J1/J2	Throttle (Up/Down
	Steering (Left/Right)
J3/J4	Unused
S1	Volume
	Clockwise to turn up
	Counter-Clockwise to turn down
S2	Unused
SA	Arm (Up) (+ SH down/pull)
	Unused (Center)**(Default Position)**
	Disarm (Down) (+ SH down/pull)
SB	Loiter (Up)
	Unused (Center)**(Default Position)**
	Unused (Down)
SC	Unused
SD	Unused
SF	Manual (Up/Push)**(Default Position)**
	Auto (Down/Pull)
SH	Unused (Up)**(Default Position)**
	Send Command (Down/Pull) Hold for 5 seconds.
	To **Arm** SA up + SH down
	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 23)

Table 4: RCU Functions
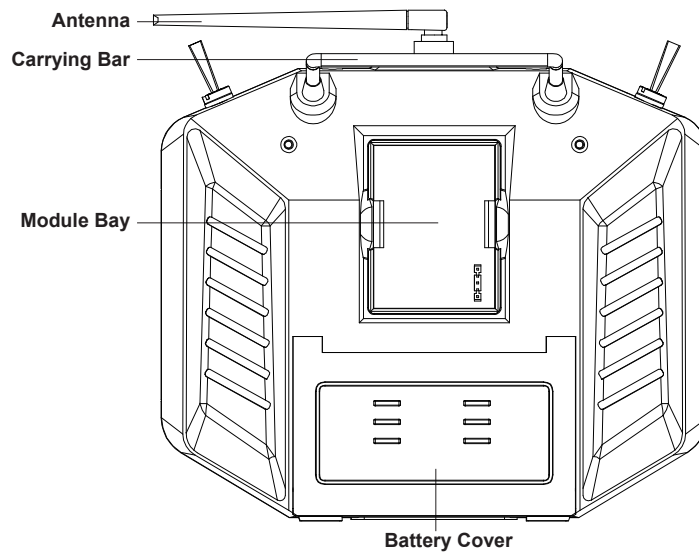
Figure 23: RCU Back View

To arm HyDrone™ AutoNav Plus™:

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 22

To disarm HyDrone™ AutoNav Plus™:

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 22

3.6 Voltage Tester

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 24: 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

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

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

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.
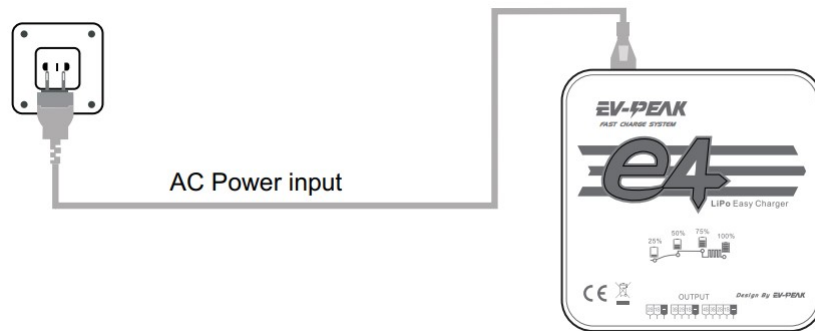
Figure 25: Cube Balance Charger Power

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.
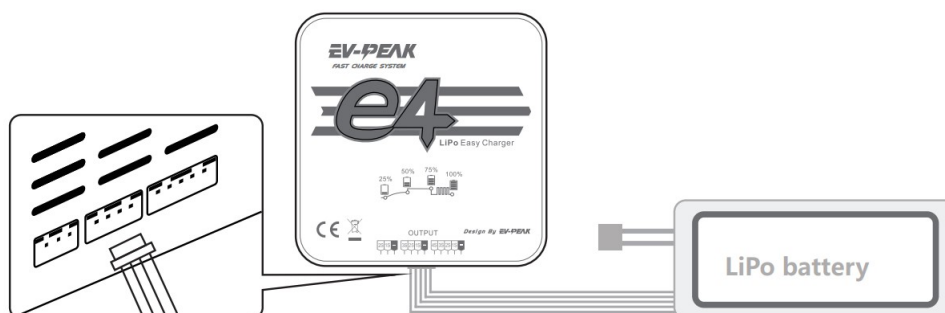
Figure 26: Cube Balance Charger Connection

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

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
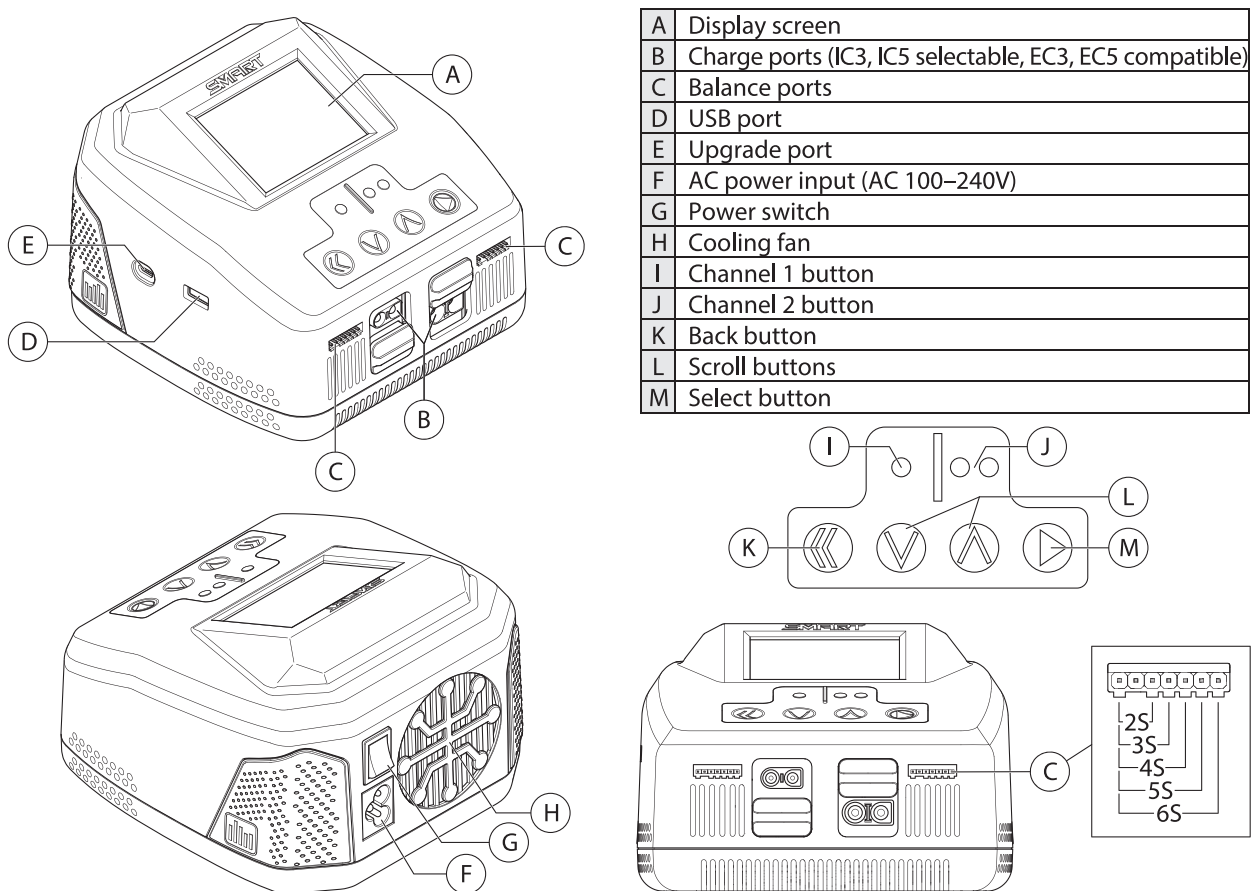
Figure 27: Spektrum Charger Layout

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.

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 71)

- 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 (3.4-4.2VDC/Cell)

- Check propulsion system functions properly with manual control.

- Check the thruster cable gland is tightened to the cable. (Figure 3)

- 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™ Power On Procedure

- Disconnect the batteries of the HyDrone™ AutoNav Plus™ at 12.8VDC (3.2VDC/Cell) to avoid irreversible damage. (Refer to 1.4)

- To extend the battery life of the HyDrone™ AutoNav Plus™, it is advisable to power it off when the voltage reaches 13.6VDC (3.4VDC/Cell). (Refer to 1.4)

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™ 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.

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™.

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

- 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.

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 Hy-Drone™ AutoNav Plus™.

   - 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 28: Shoreside Hardware Setup

Software setup (Windows 11):

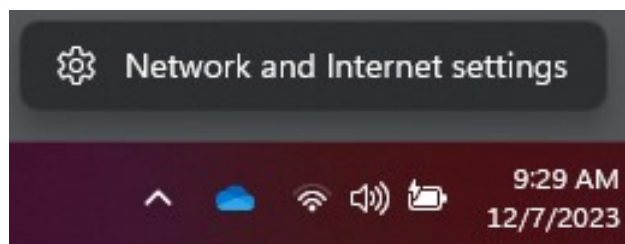1. Right click the WiFi icon on the taskbar.

Figure 29: Network And Internet Settings

2. Open Network and Internet Settings.

3. Open Advanced Network Settings.

Figure 30: Advanced Network Settings

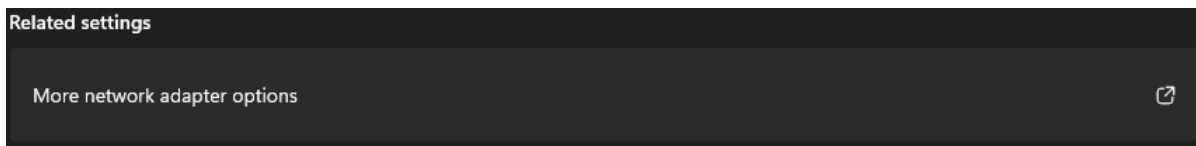4. Open More Network Adapter Options.

Figure 31: Network Adapters

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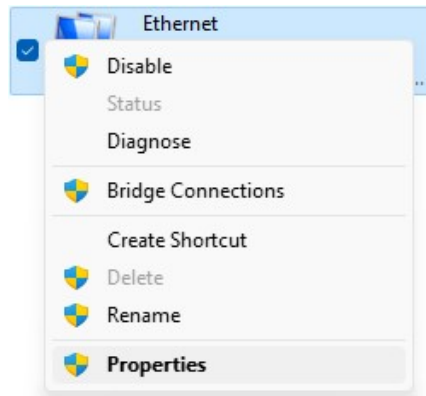

Figure 32: Ethernet Properties

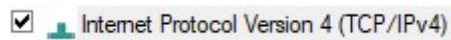6. Double click "Internet Protocol Version 4 (TCP/IPv4).

Figure 33: Internet Protocol
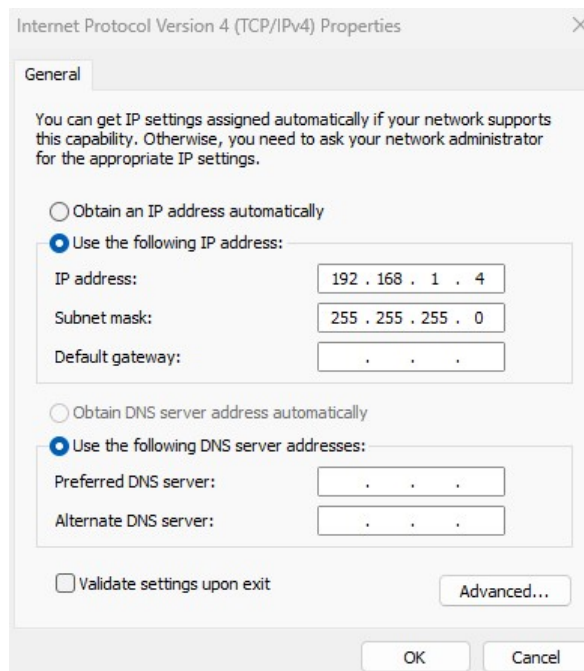
7. Change the follow settings:

Figure 34: 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:

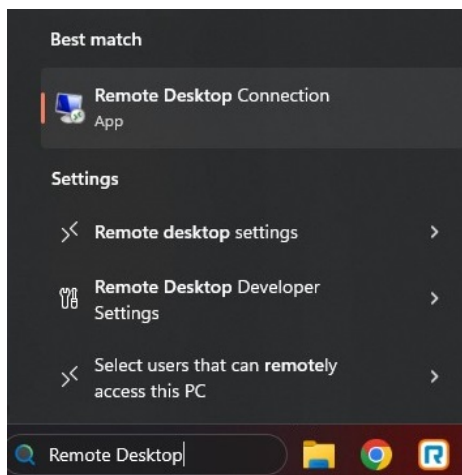1. Search "Remote Desktop" in the windows task bar and select it.

Figure 35: Taskbar Search

2. Type in 192.168.1.8 for the Computer.

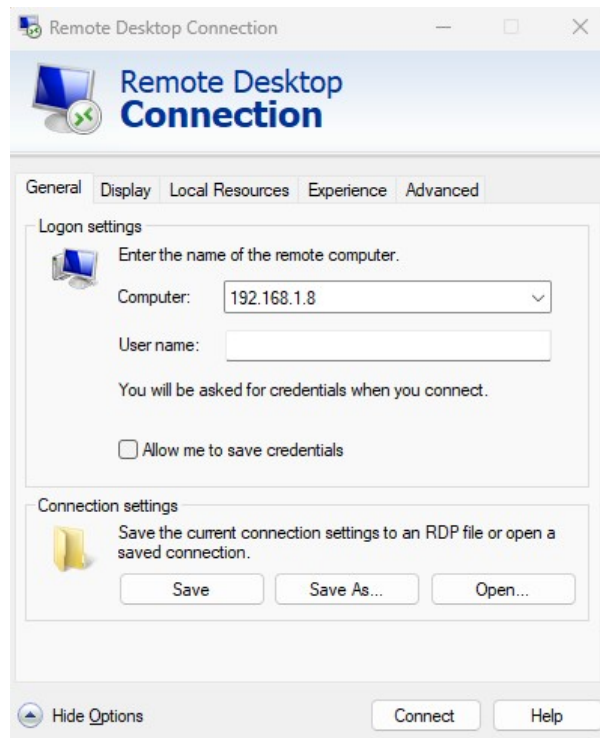3. Using "Show Options", change User name to "ANP".

Figure 36: Remote Desktop Connection

4. Click Connect.

5. Password is "Seafloor".

3.11 Manual Operation

HyDrone™ AutoNav Plus™ is a skid steered vessel. The right joystick controls both throttle and 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™ is headed toward you.

3.12 Autonomous Operation

3.12.1 Mission Planner

<div style="background:blue;color:white;text-align:center">**Information**</div>

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

<div style="background:orange;color:white;text-align:center">**Caution**</div>

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)

<div style="background:orange;color:white;text-align:center">**Caution**</div>

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.

<div style="background:blue;color:white;text-align:center">**Information**</div>

Internet connection is required to view satellite background images.

<div style="background:orange;color:white;text-align:center">**Caution**</div>

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

Mission Planner:

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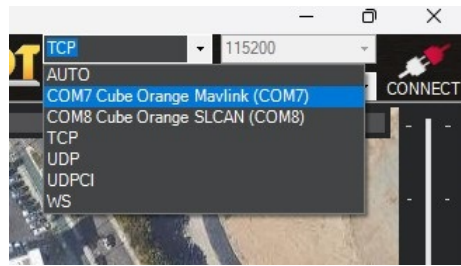
2. Connect to the AutoNav Plus™.

Figure 37: COM Port

- Choose Mavlink COM port
- 115200 baud rate

3. Click PLAN.

4. Find your survey area.

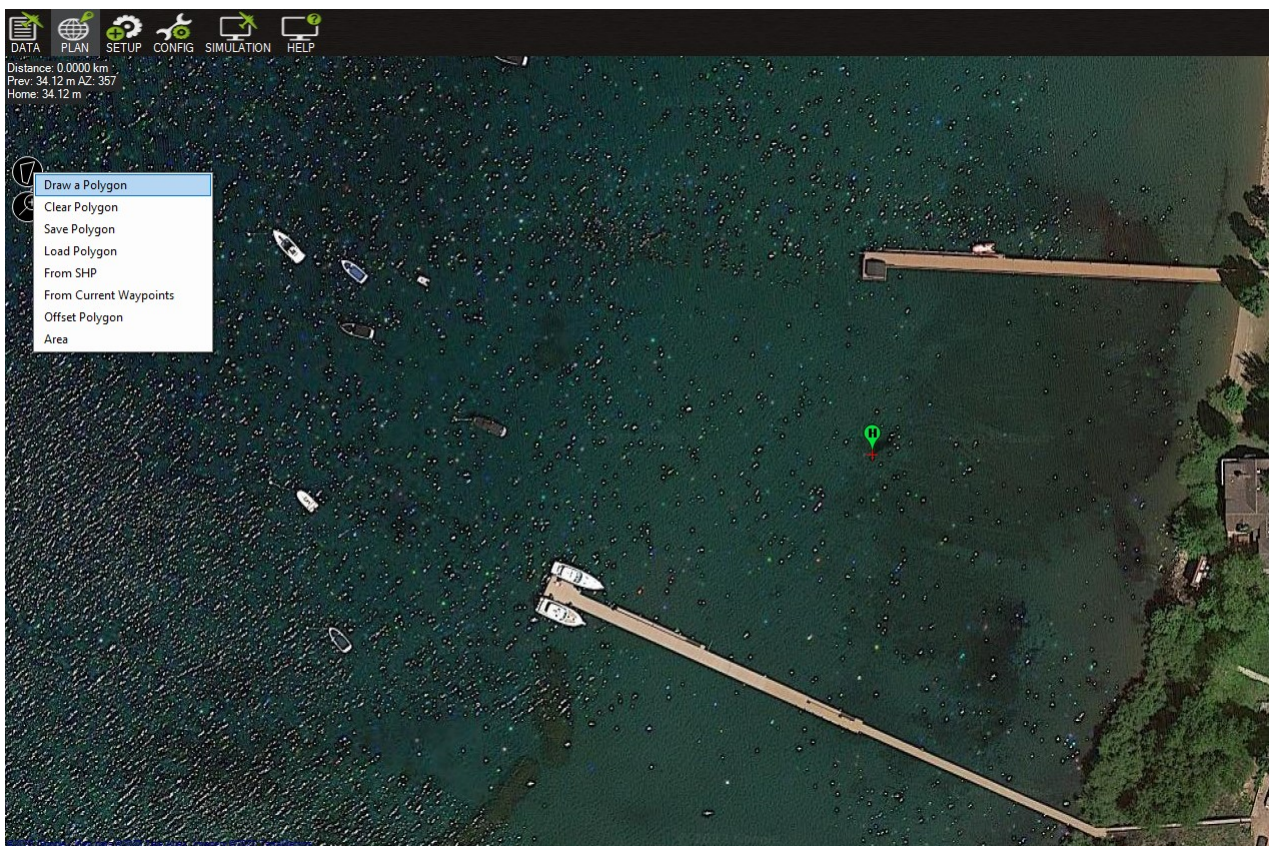5. Click the circled polygon in the top left and select 'Draw a Polygon'.

Figure 38: 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™ to desired location and drop polygon points at each extent.

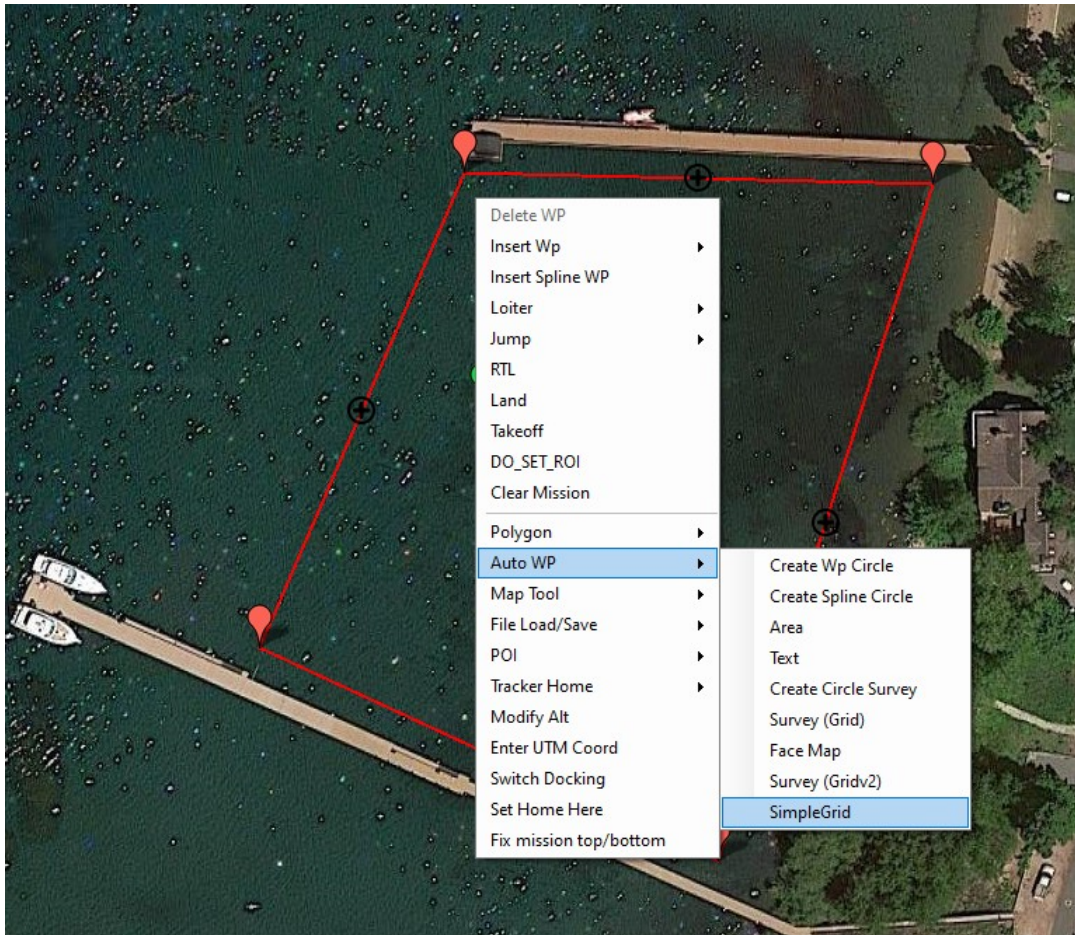7. Right click survey area. Highlight 'Auto WP' and select 'SimpleGrid'.

Figure 39: SimpleGrid Select

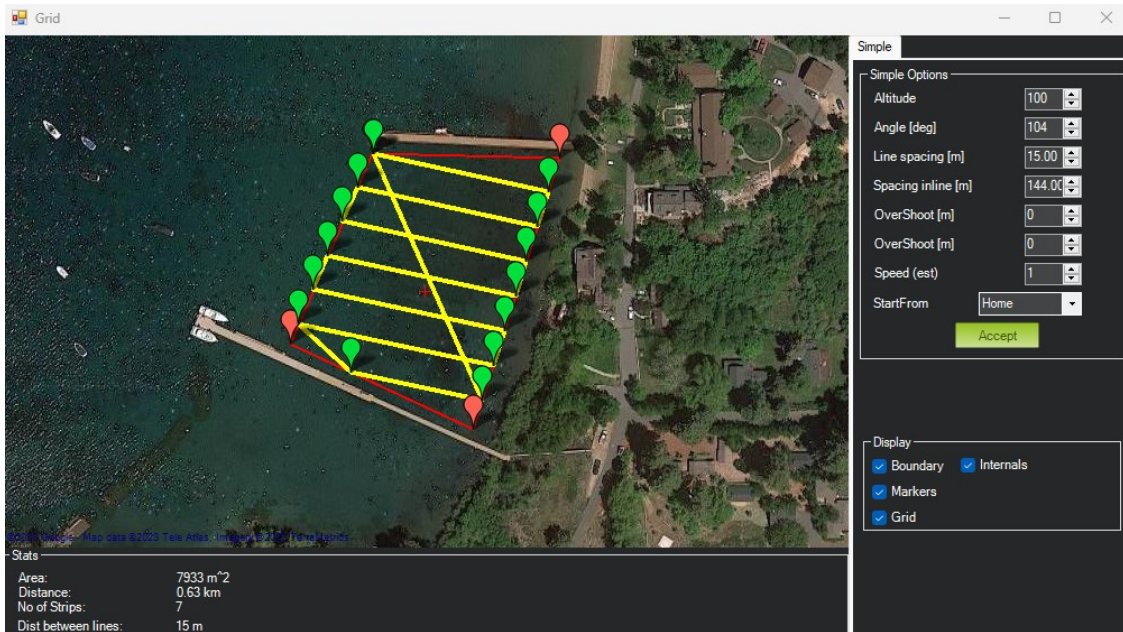| Altitude	Leave as is
Angle	Change the angle of the survey
Line spacing	Distance between lines, dependant on your swath width
Spacing inline	Increase until only start/end are present
Overshoot	Leave as is
Overshoot	Leave as is
Speed	Drop down to survey speed or delete later
Start From	Leave as is

Table 10: SimpleGrid Settings

Figure 40: SimpleGrid Settings

8. Delete the first command, speed change.

Figure 41: Delete DO_CHANGE_SPEED

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

9. Click 'Write' on the right panel.

Figure 42: 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.

<div style="background-color:red; color:white; text-align:center; font-weight:bold;">Important Alert</div>

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

<div style="background-color:blue; color:white; text-align:center; font-weight:bold;">Information</div>

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

<div style="background-color:orange; color:white; text-align:center; font-weight:bold;">Caution</div>

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)

<div style="background-color:orange; color:white; text-align:center; font-weight:bold;">Caution</div>

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.

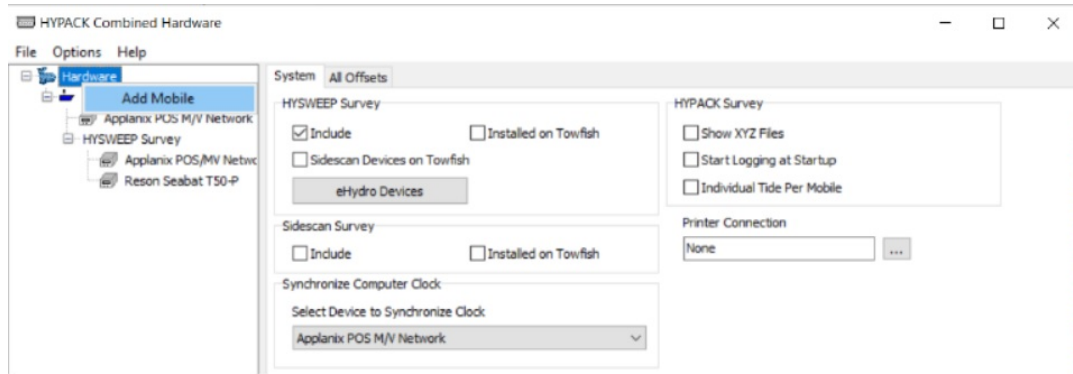3. Right click Hardware to add a Mobile.

Figure 43: Add Mobile

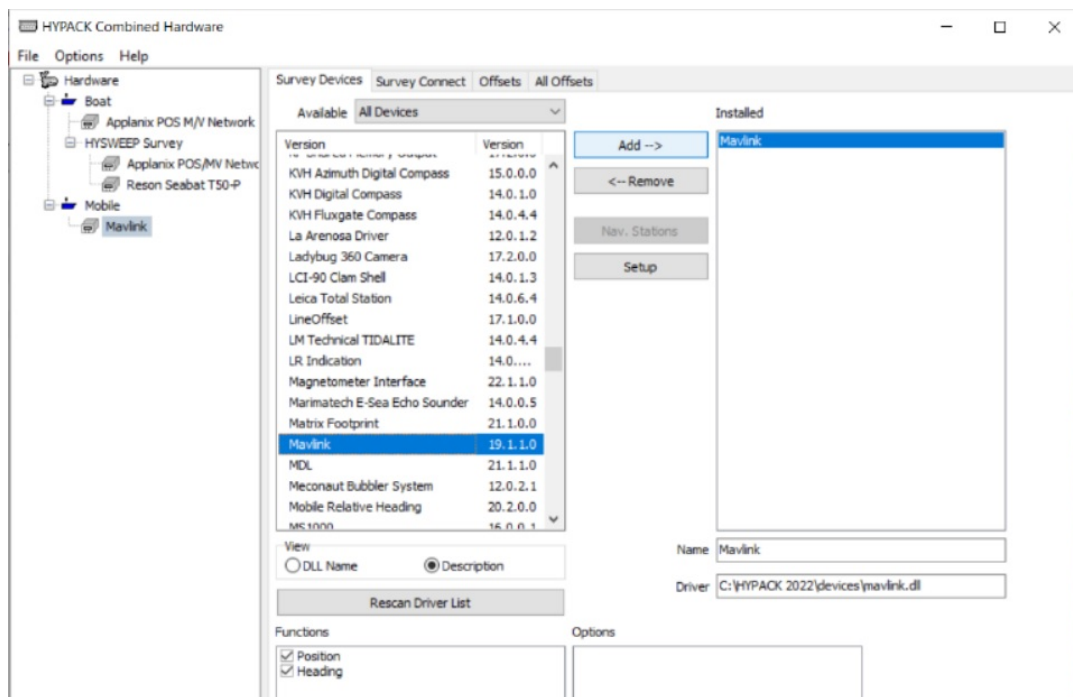4. Under the new Mobile, add Mavlink driver.

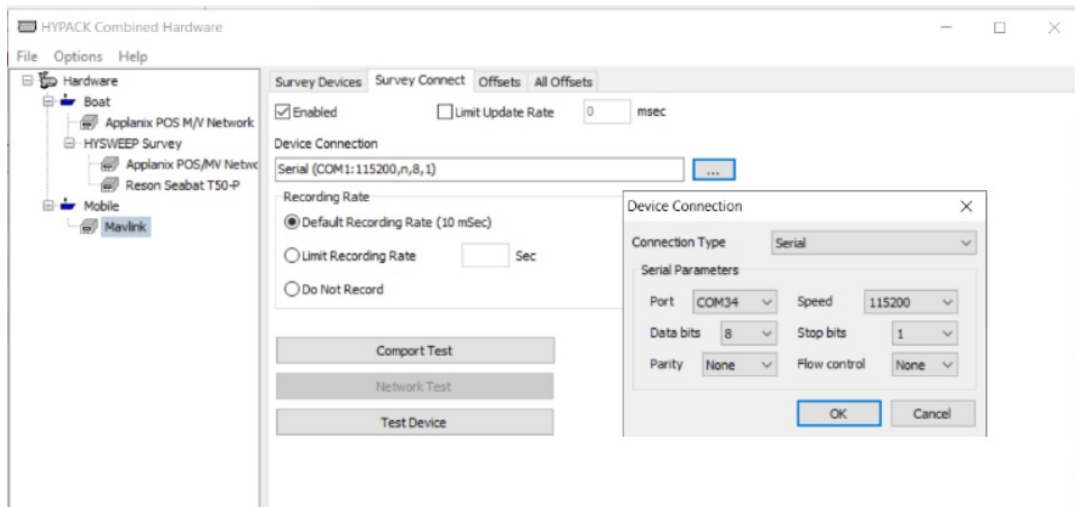Figure 44: Add Mavlink Driver

5. Device Connection is Serial.

Figure 45: Set COM Port

6. Set COM number. Can be verified in Device Manager.

7. Set Baud Rate to 115200.

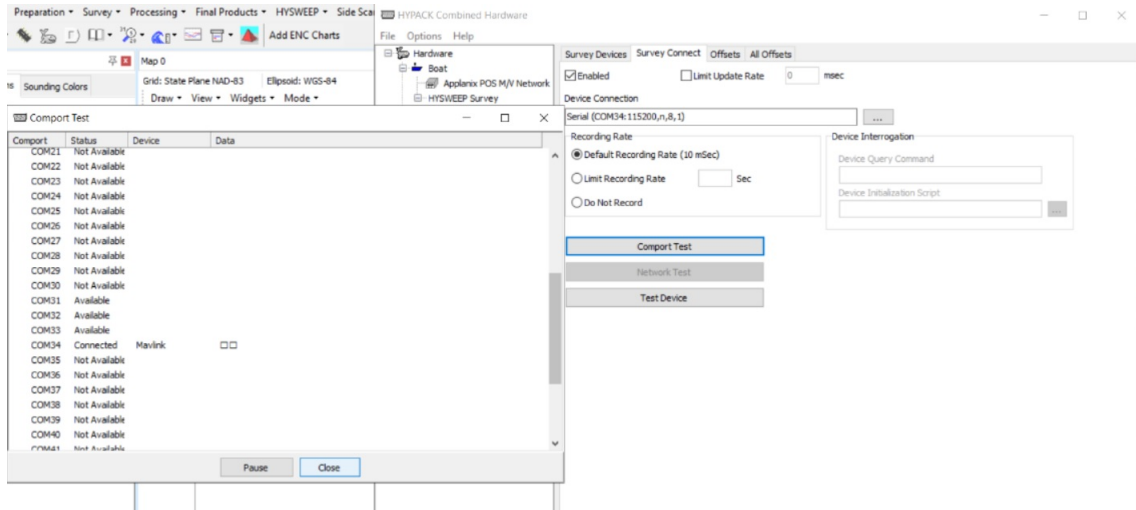8. Use the Comport Test to verify data is coming through the selected COM port.

Figure 46: COM Test

Line Planning:

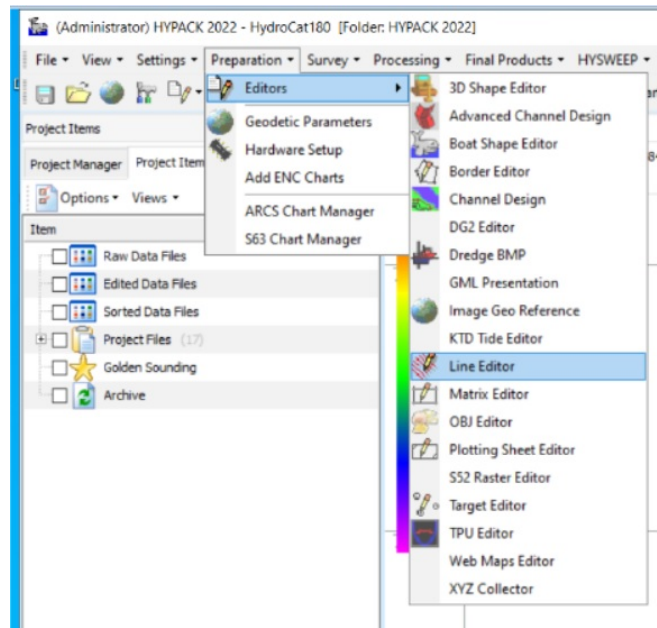1. Create the line plan using Hypack's standard Line Plane Editor.

Figure 47: Line Editor

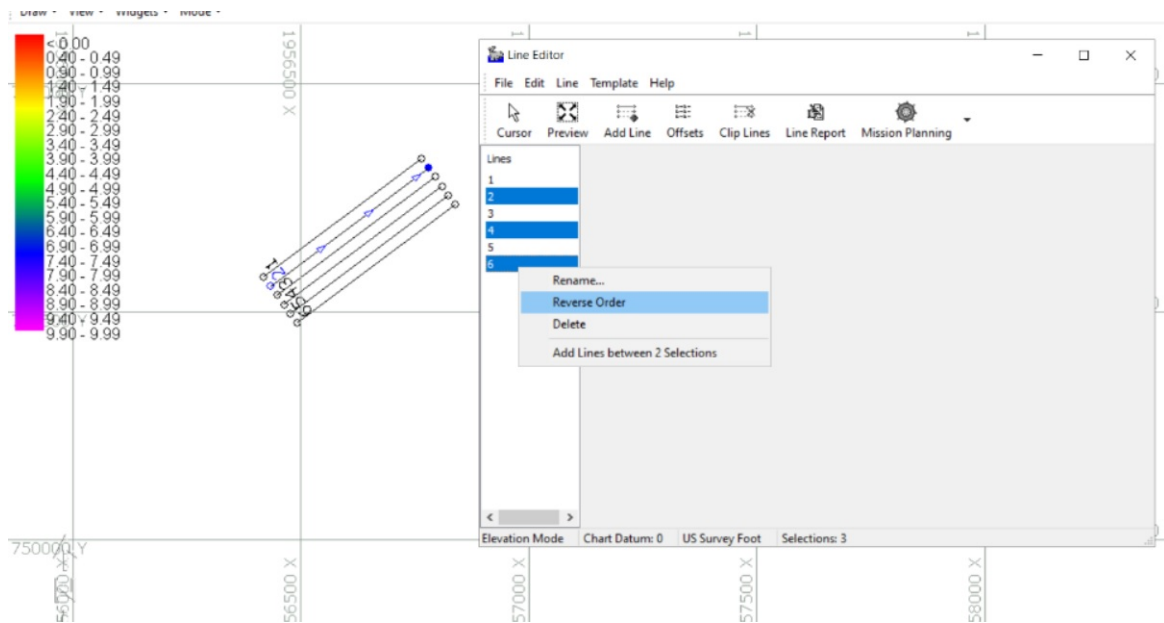2. Right click every other line and select Reverse Order.

Figure 48: Reverse Every Other Line

3. Start Hypack Survey/Hysweep.

4. Mavlink Driver will say Armed or Unarmed. USV must be Armed to Start Mission.
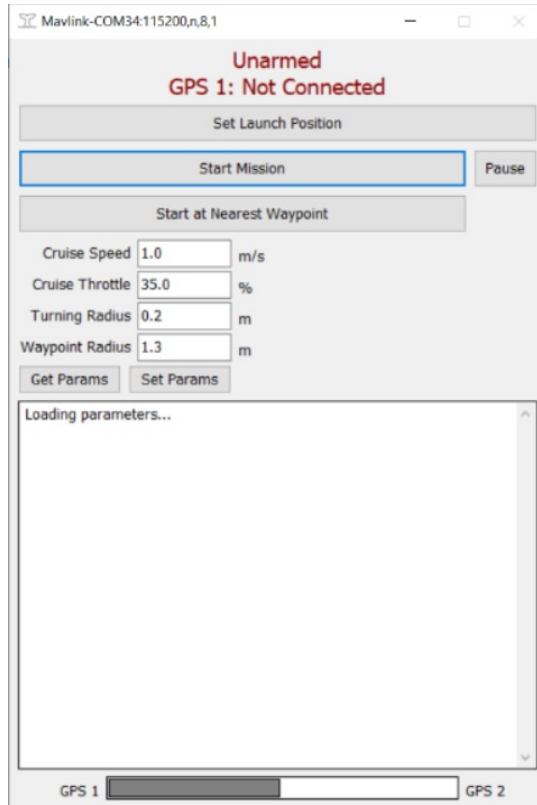
Figure 49: Mavlink Driver Control

- 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™ 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™ Power Off Procedure

1. Upon retrieval of the HyDrone™ AutoNav Plus™, 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)

<div style="background-color:blue; color:white; text-align:center; font-weight:bold;">Information</div>

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

<div style="background-color:red; color:white; text-align:center; font-weight:bold;">Important Alert</div>

If there's a failure, the HyDrone™ AutoNav Plus™ is equipped with integrated fail-safes to address emergency situations if necessary.

- Within RCU range you can disarm the USV to stop or prevent throttle commands to the thrusters.

- Outside of RCU range if loss of comms:
    - Manual mode: The vessel will drift with no input. Attempt to reconnect by moving shoreside position and set RTL.
    - Autonomous mode: The vessel will continue on it's mission. It is best practice to always survey within the RCU range.

- It is possible to program other fail safe parameters. By default these are all disabled as there is a potential to interrupt the survey plan. Please contact Seafloor Systems if you wish to enable.

3.15 Voltage Monitoring

3.15.1 RCU Voltage Monitor

HyDrone™ AutoNav Plus™ 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)

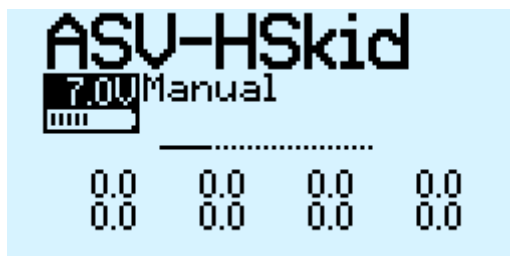2. Press EXIT to get to the main screen.

Figure 50: Main Screen

3. Battery icon and percentage is the RCU battery.

- Battery Range is 6-8.5VDC.

To view HyDrone™ AutoNav Plus™ 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).

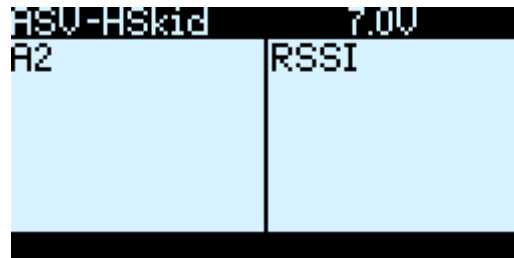3. Hold down PAGE button to access the DISPLAY screen.

Figure 51: 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

<div align="center">Caution</div>

- Disconnect the batteries of the HyDrone™ AutoNav Plus™ at 12.8VDC (3.2VDC/Cell) to avoid irreversible damage. (Refer to 1.4)

- To extend the battery life of the HyDrone™ AutoNav Plus™, 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 52: Battery Monitor Application Icon

2. Select 'Connect' to see real-time voltage of port and starboard batteries.
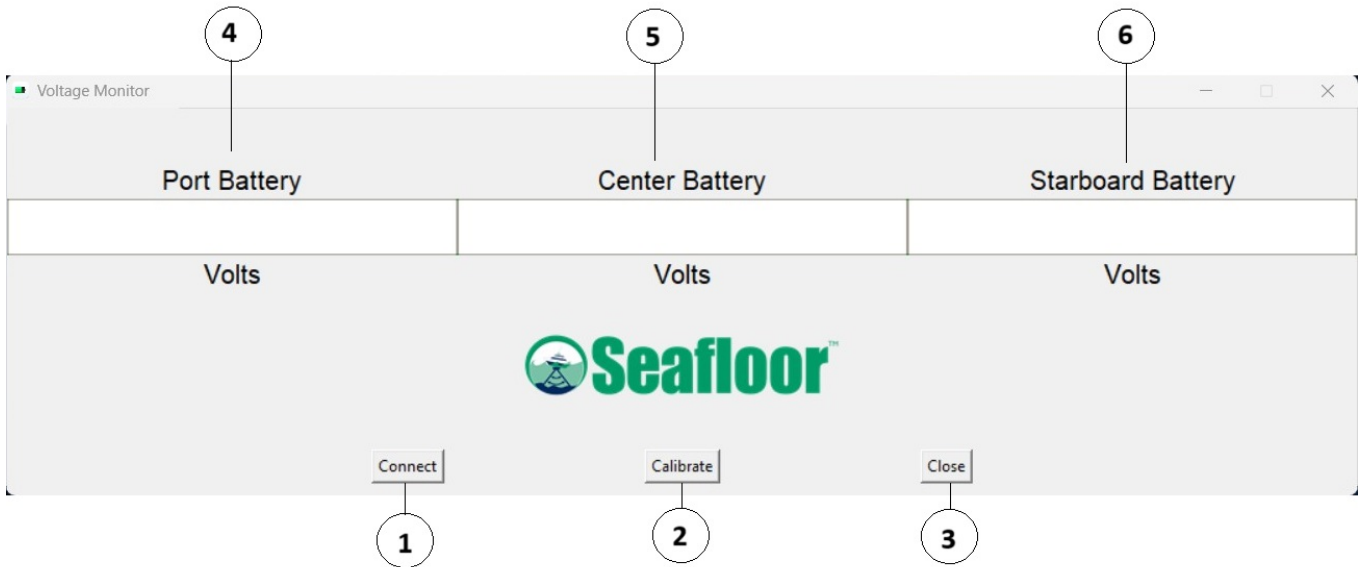
Figure 53: AutoNav Plus™ Voltage Monitor

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™.

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.
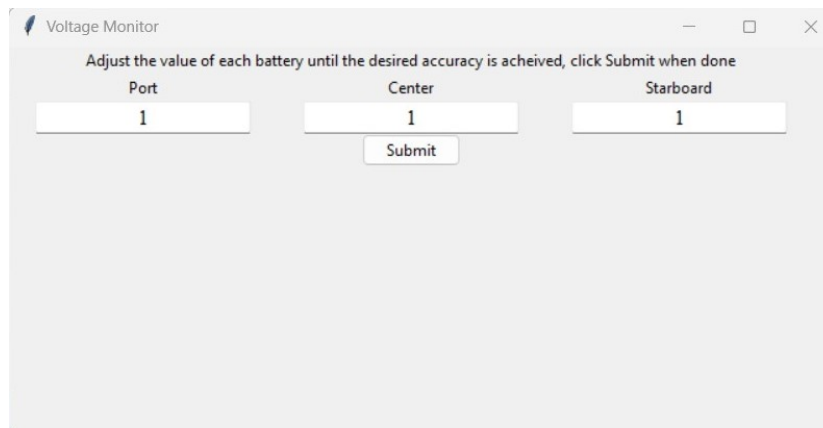

Figure 54: Caption

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™ 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™ still powered when the main switch is in the off position?

  - Disconnect the battery.

- Why does the HyDrone™ AutoNav Plus™ 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.

5 Troubleshooting

5.1 Propeller Orientation And Rotation

If the propellers on a HyDrone™ AutoNav Plus™ 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.
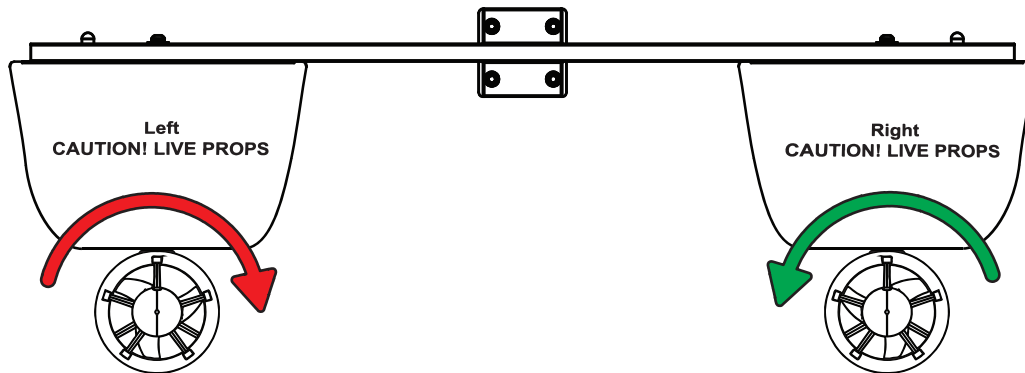

Figure 55: HyDrone™ AutoNav Plus™ Prop Rotation
(Colors Illustrate Maritime Navigation Lights)

- Port Thruster:
    - Motor must rotate clockwise(CW) (Figure 55)
    - Prop is CCW

Figure 56: W30 CCW Prop

- Starboard Thruster:
    - Motor must rotate counter-clockwise(CCW) (Figure 55)
    - Prop is CW

Figure 57: 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.
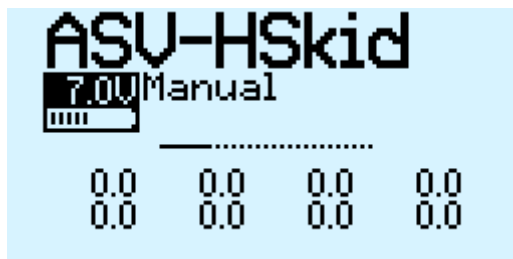
3. Quick press 'Menu' on the RCU.

Figure 58: Model Select Screen
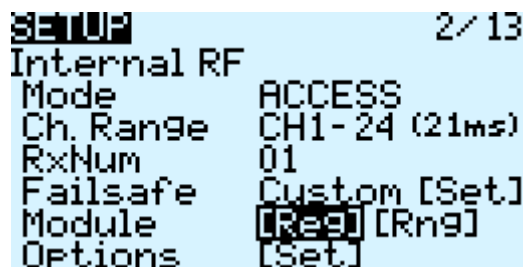
4. Quick press 'Page' to switch to SETUP Page 2/13.

Figure 59: Internal RF

5. Using the ENT knob, scroll down to INTERNAL RF. (Figure 59)

   (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.**
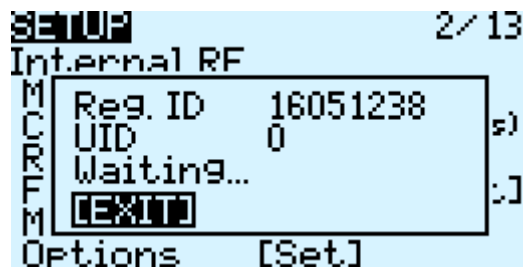

Figure 60: Waiting To Register

      ii. On the Archer Plus R6, hold down the receiver button while powering up the Archer Plus R6. (Figure 61)
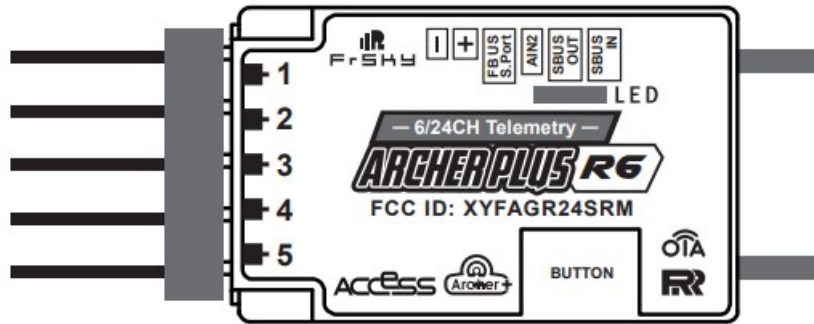
50

Figure 61: 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 62: Binding Screen - SimuRX1/2 Is Only Used For Simulation

7. Power on the Archer Plus R6
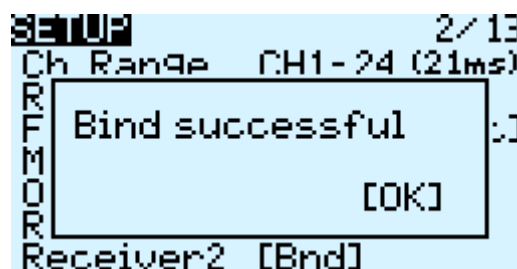
8. Press OK once bind is successful.

Figure 63: 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™.
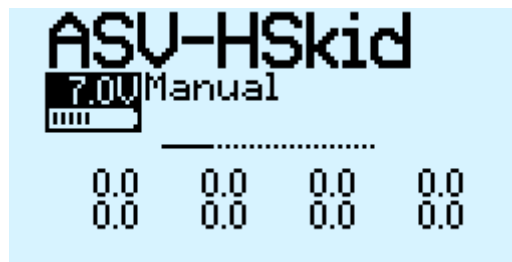
3. Quick press 'Menu' on the RCU.

Figure 64: Model Select Screen

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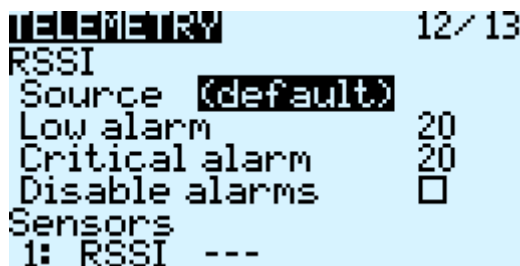

Figure 65: Telemetry Page

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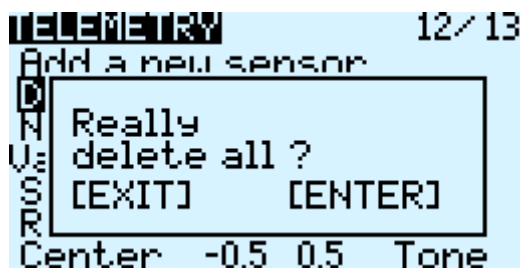

Figure 66: Delete All Sensors

Figure 67: Delete All Sensors Pop-Up

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

Figure 68: Discover New Sensors

7. A2 sensor will be active.

8. Select the A2 sensor.

Figure 69: 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 70: 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™ 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™ must be powered off.**
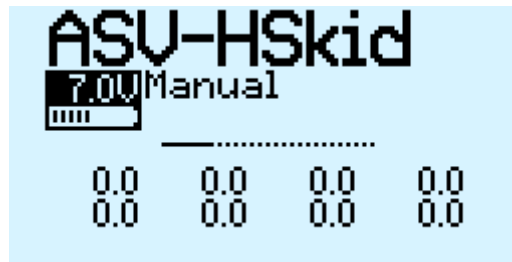
2. Power on the RCU. (Refer to 3.5)

Figure 71: Main Screen
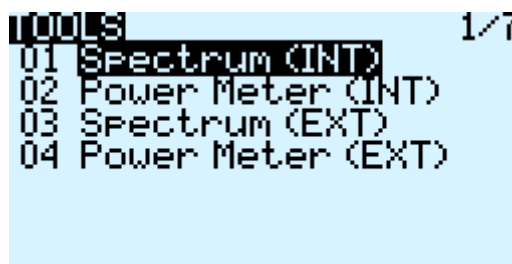
3. Hold down 'Menu' button.

Figure 72: RCU Settings

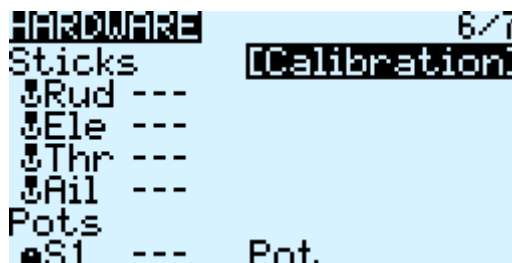4. Quick press 'Page' to switch to HARDWARE to Page 6/7.

Figure 73: Hardware Page

5. Highlight 'Calibration' and select.

6. Follow the onscreen instructions.

Figure 74: 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 75: Setup Tab

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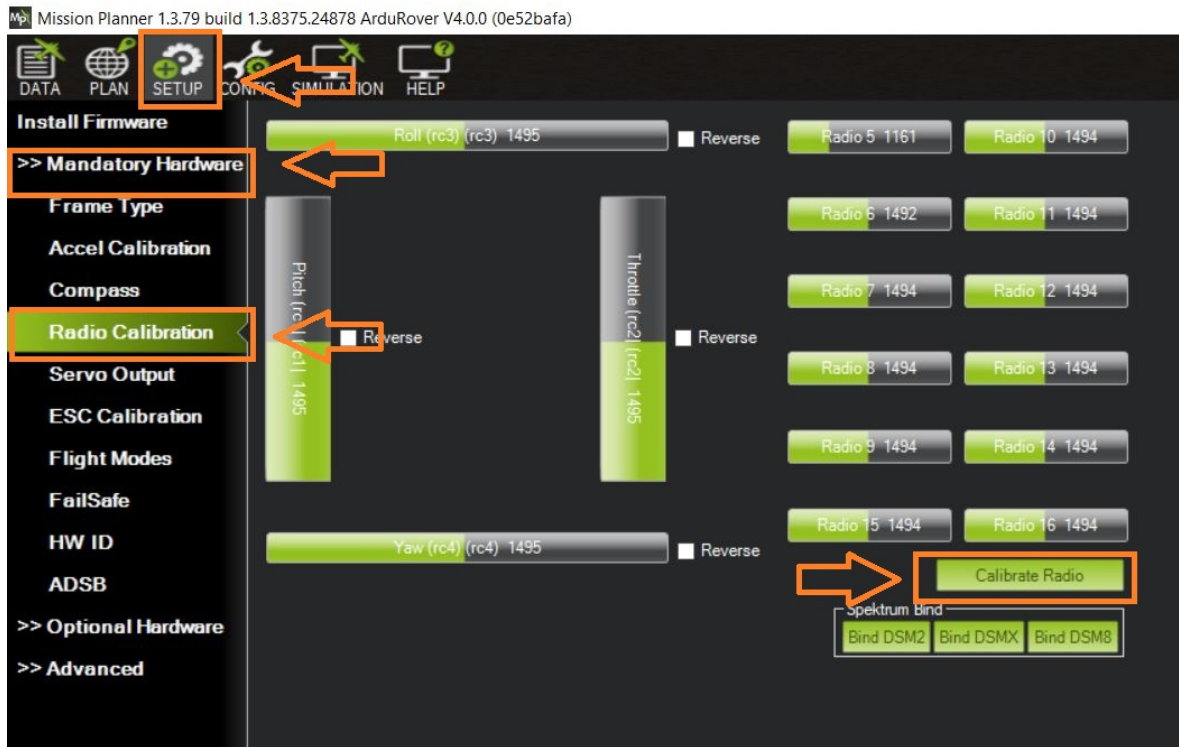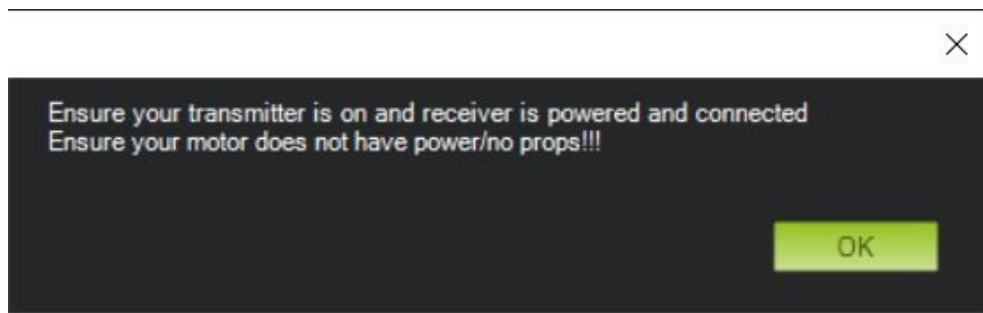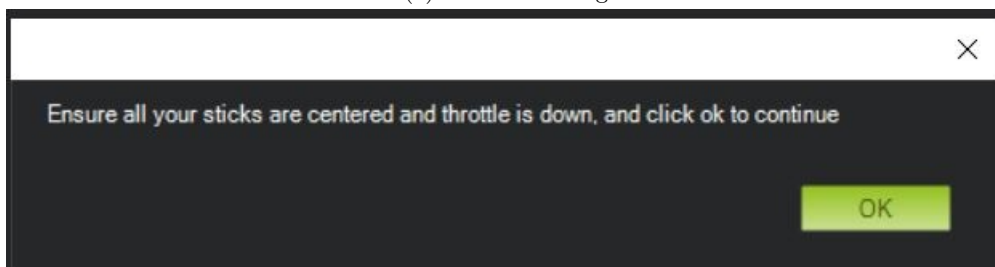
7. Select Radio Calibration.

Figure 76: Radio Calibration Steps

8. Select Calibrate Radio.

(a) Power Warning

(b) Radio Cal Instructions

Figure 77: 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 78: Radio Calibration Verification
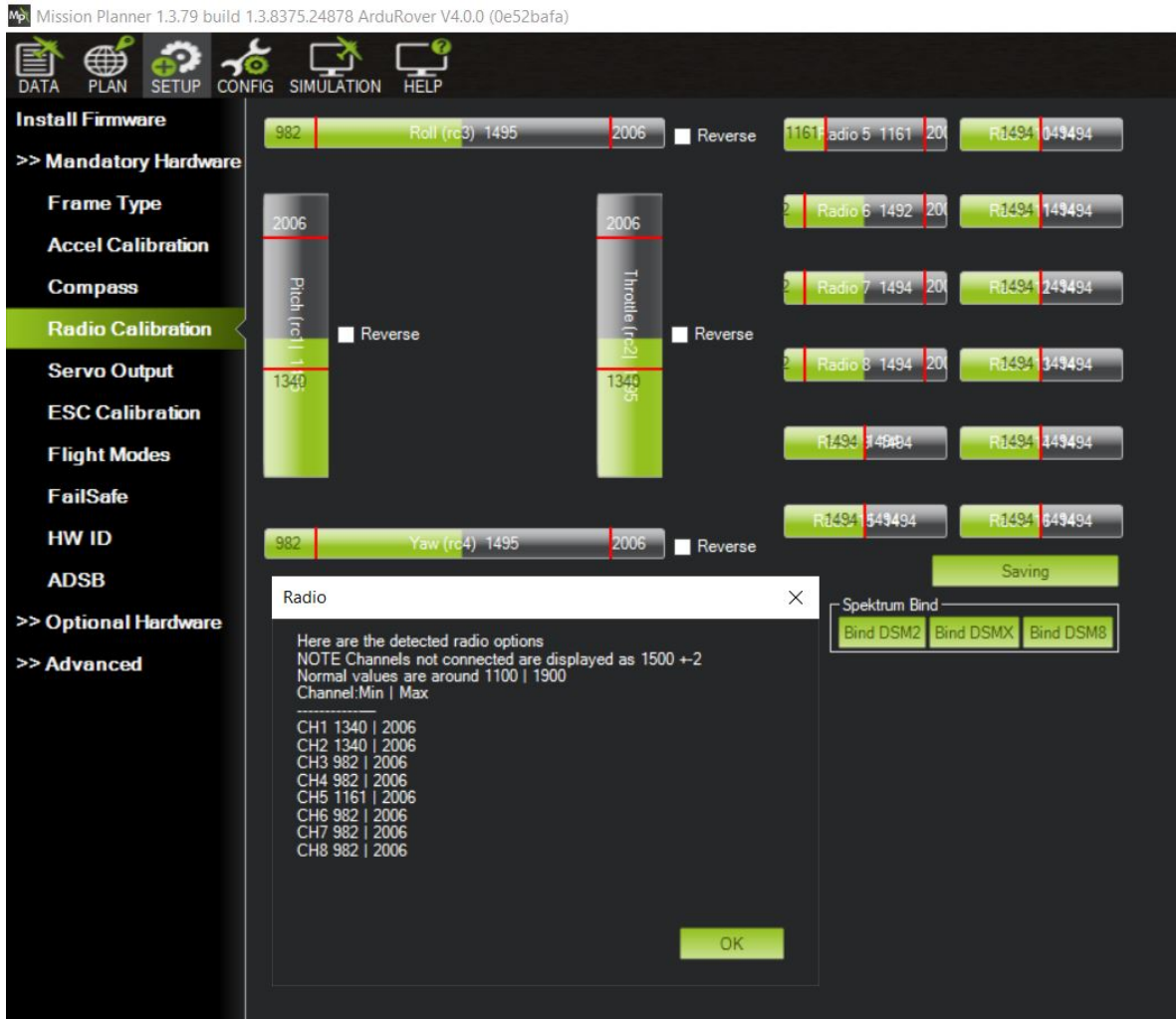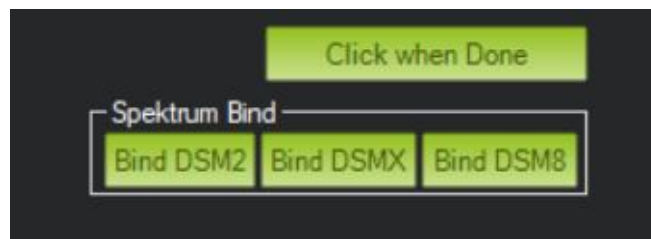
12. Select Click when Done.

Figure 79: Click When Done

13. A page will popup indicating the new min and max values. Press OK. (Refer to Figure 78)

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™.

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.

"Beep- Beep-"   **"Beep--"**
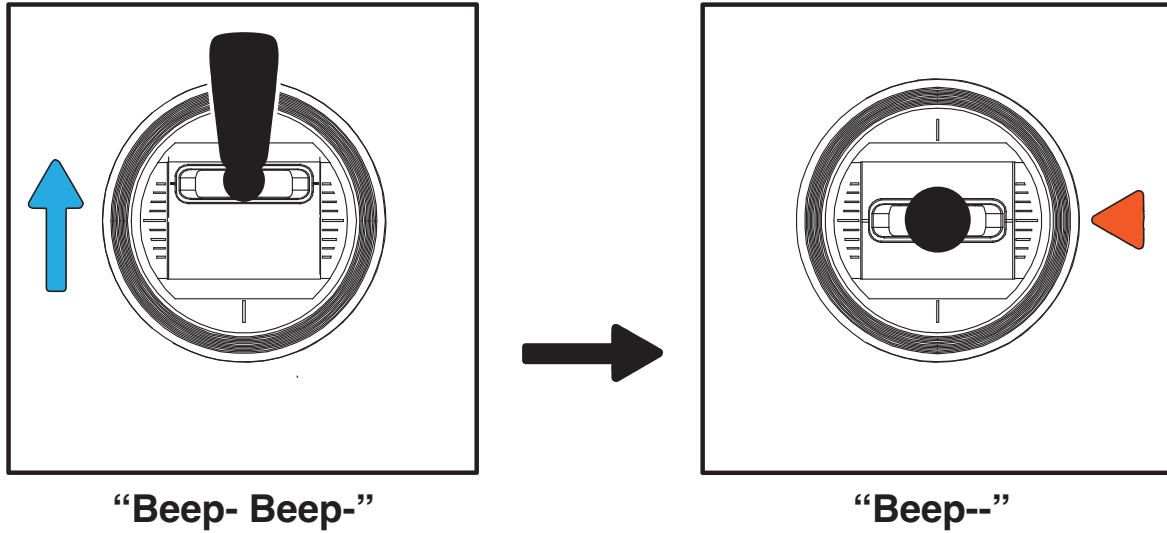
Figure 80: Joystick Position

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 81: ESC Programming Card Ports

2. Connect the ribbon cable to the ESC. Pay attention to the connector orientation.
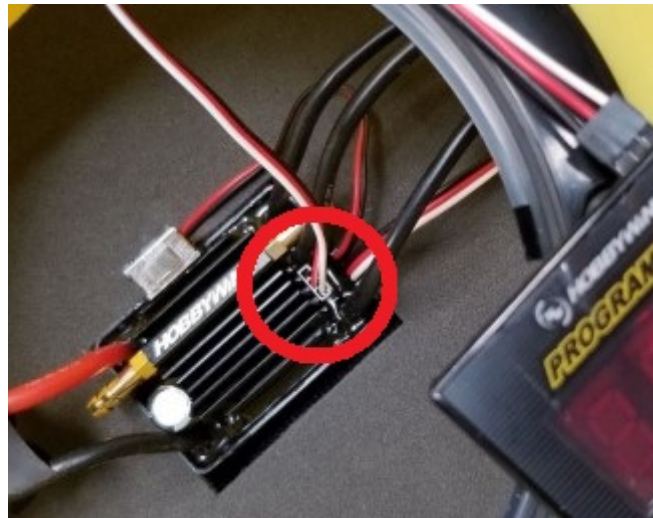
Figure 82: ESC Programming Card Connection

3. Power on the HyDrone™ AutoNav Plus™. 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.

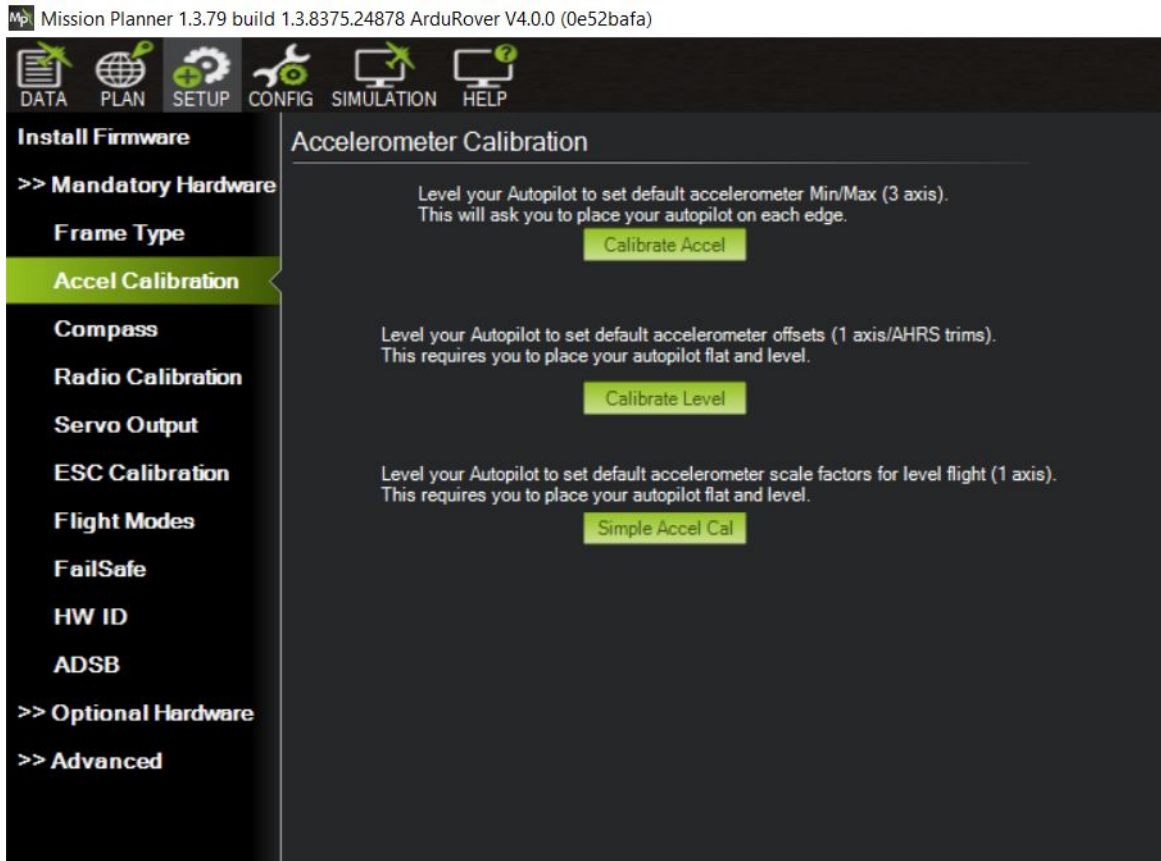Figure 83: Accel Calibration

7. Select Mandatory Hardware.

8. Select Accel Calibration.
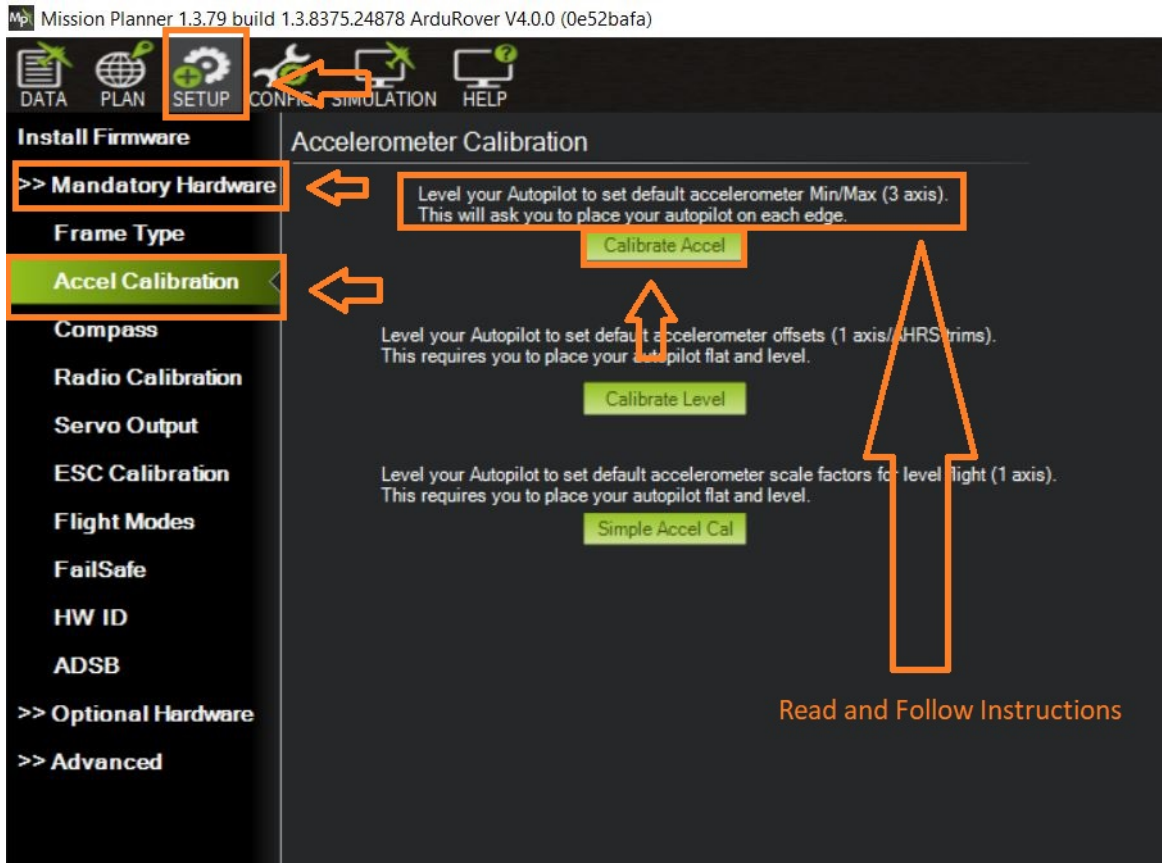
Figure 84: Accel Calibration Steps

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).**
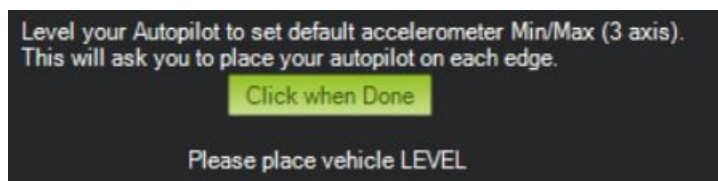
Figure 85: Accel Calibration In Process

(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.
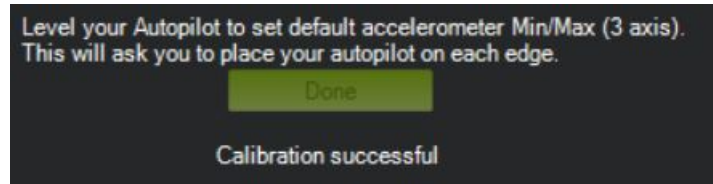
Figure 86: Accel Calibration Complete

12. Set the AutoNav Plus™ on a level surface again.

13. Select Calibration Level. (See Figure 83)

6.8 AutoNav Plus™ Compass 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.

7. Select Mandatory Hardware.

8. Select Compass.

9. Select Start.
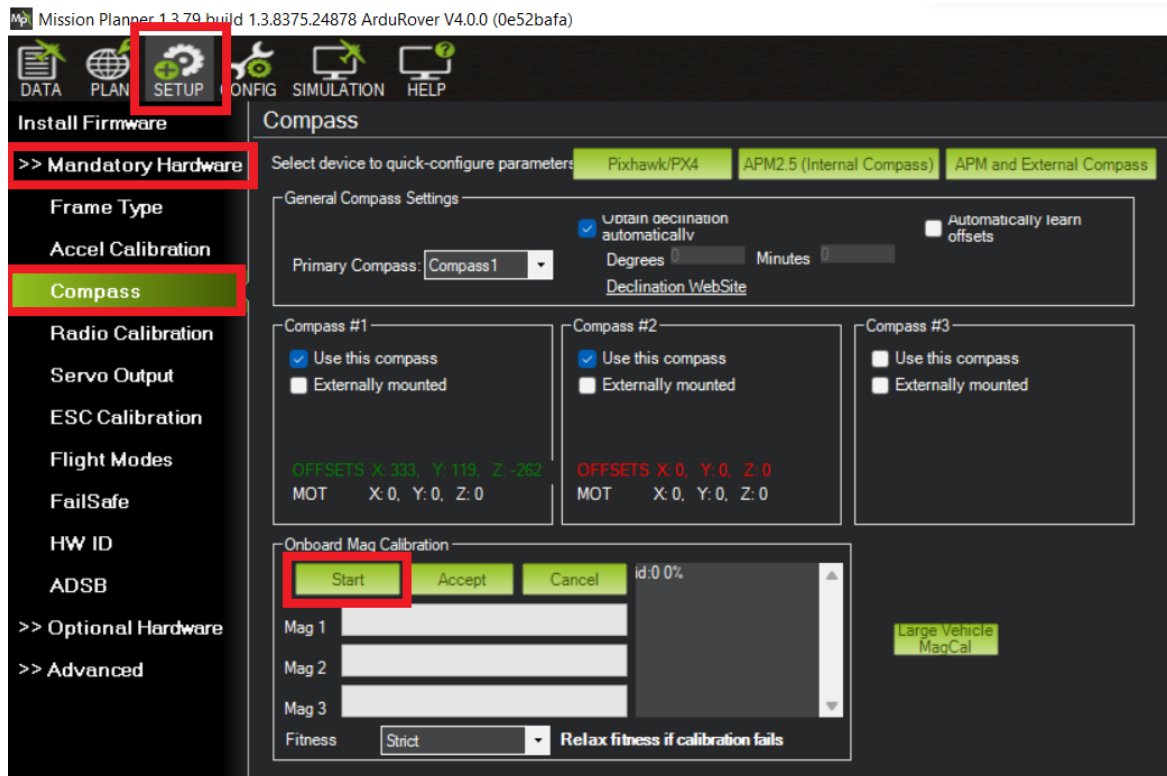
Figure 87: Compass Calibration Steps

10. Rotate the AutoNav Plus™ 360 degrees on the X, Y, and Z axis.
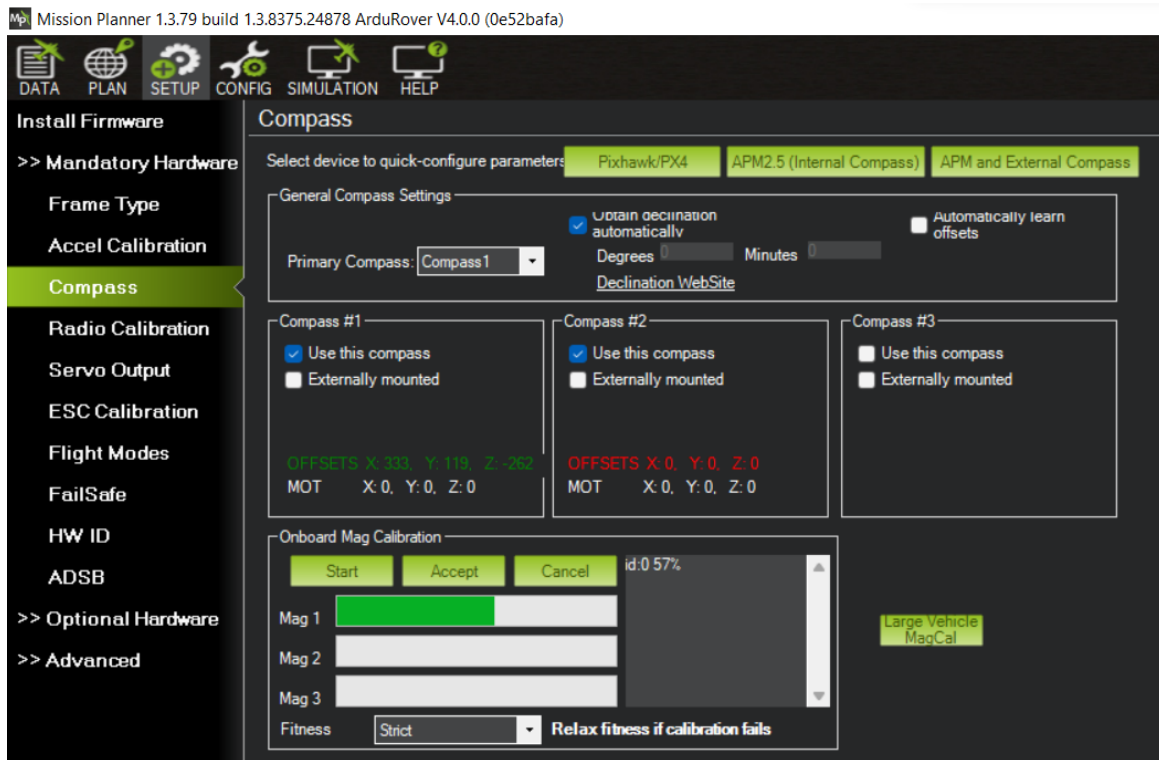
Figure 88: Compass Calibration Progress

11. Mag 1 green progress bar will start increasing.

12. A "Please reboot the autopilot" popup will indicate compass calibration is complete.
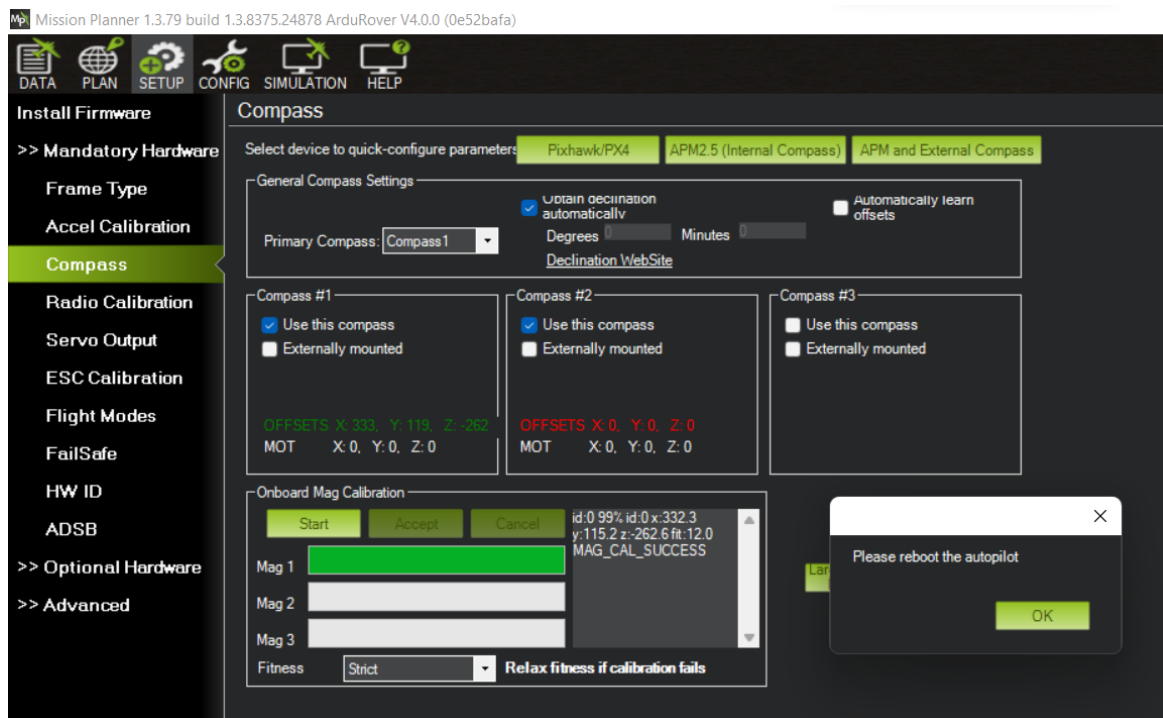
Figure 89: Compass Calibration Complete

13. Select 'OK'.

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

15. Select 'reboot pixhawk'.

Figure 90: CTRL-F Screen

16. The autopilot hardware will reboot. Mission Planner will disconnect and automatically reconnect. (If it does not, you can manually connect)
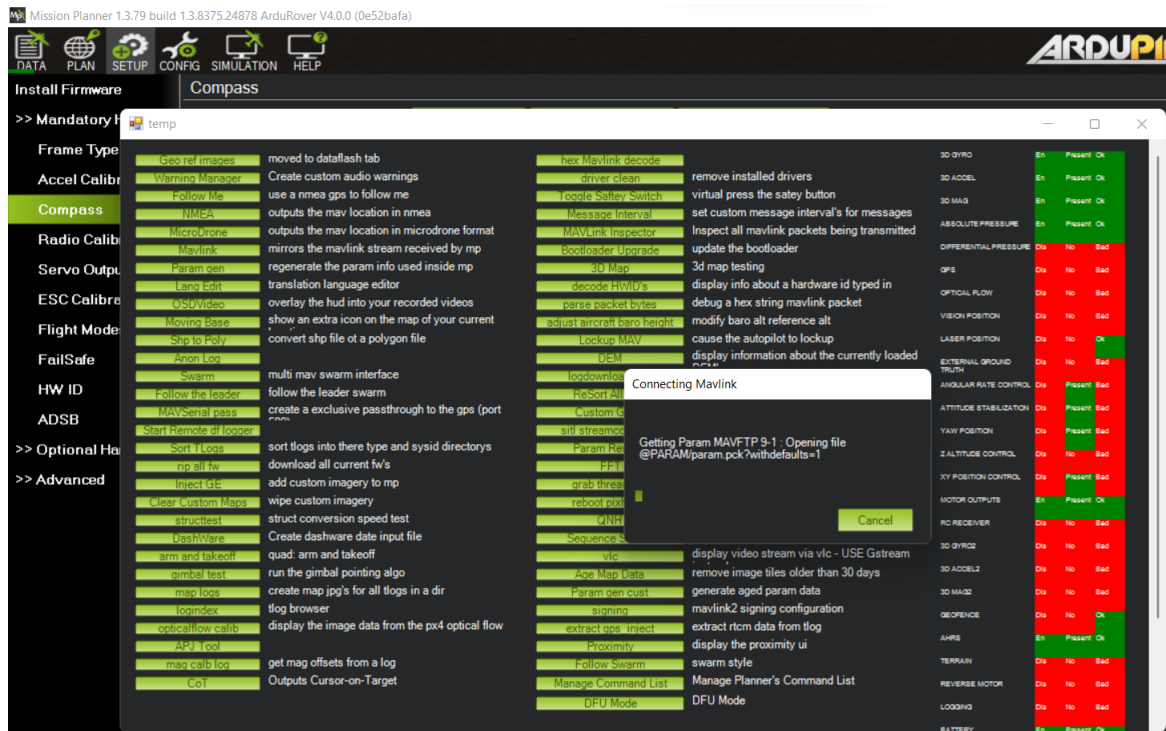
Figure 91: Reboot Complete

17. Calibration complete.

7 Service And Maintenance

7.1 Maintaining Your Investment

Maintaining your HyDrone™ AutoNav Plus™ 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

1. Remove the 2x M5 nyloc with a 8mm wrench.

Figure 92: Thruster Removal

2. Disconnect the 3 motor wires from the ESC. (Figure 112)

3. Remove the cable gland nut and seal off the thruster wires.

4. Slide 1 of the 3 motor wires through the cable gland at a time until it's fully removed.

5. Install thruster adapter plate to new thruster, if required.

Figure 93: Thruster Adapter Plate

6. Install new thruster motor wires through cable gland.

7. Install the cable gland seal and nut.

   - Ensure the seal sits in it's notched location for proper sealing.

8. Install new thruster onto the pontoon mating plate.

9. Install the 2x M5 nyloc.

7.3.2 Propeller Replacement

<div align="center">Caution</div>

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

1. Remove the 2x M5 nyloc with a 8mm wrench.

Figure 94: Thruster Removal

2. Remove the 4x M3x6 bolts with a 2mm Allen driver.

Figure 95: Thruster Adapter Plate Removal

3. Remove the 5x screws with a #3 Philips driver.

Figure 96: Thruster Housing Removal

4. Remove the 2x screws with a #3 Philips driver.

Figure 97: Prop Removal

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

Figure 98: Prop Removed

6. Install the replacement W30 prop.

7. Follow the instructions in reverse order for reassembly.

7.3.3 Motor Cleaning

<div style="background:orange">Caution</div>

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

1. Remove the 2x M5 nyloc with a 8mm wrench.

Figure 99: Thruster Removal

2. Remove the 4x M3x6 bolts with a 2mm Allen driver.

Figure 100: Thruster Adapter Plate Removal

3. Remove the 5x screws with a #3 Philips driver.

Figure 101: Thruster Housing Removal

4. Remove the 2x screws with a #3 Philips driver.

Figure 102: Prop Removal

5. Remove the prop. The prop may be suctioned to the motor housing. Use care when removing.
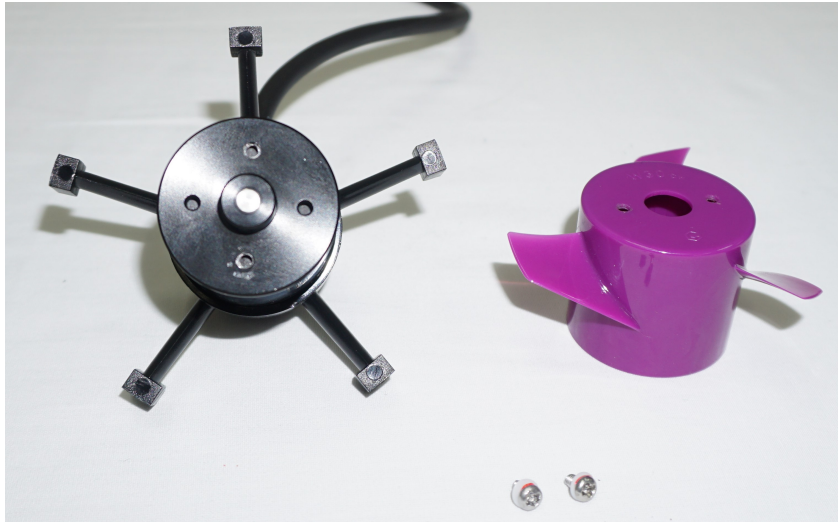
Figure 103: Prop Removed

6. Remove the 2x M3 bolts with a 2.5mm Allen Driver

Figure 104: Motor Housing Removal

7. Loosen the 2x set screws on the collar towards the bow using a 1.5mm driver(not supplied).
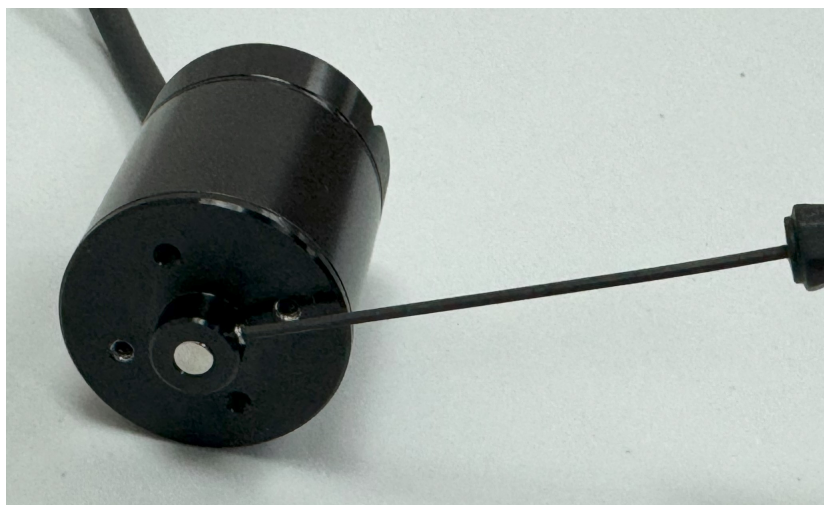
Figure 105: Rotor Removal

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

Figure 106: Stator And Rotor

9. Inspect the magnets and protective coverings. Clean with mild soap and water.

10. Follow the instructions in reverse order for reassembly.

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 107: RCU 2x Screw Locations

3. Remove the module bay cover.

4. Remove the battery cover. (Figure 23)

5. Disconnect the battery.

Figure 108: RCU Additional Screw Locations

6. Remote the additional two Phillip screws.

7. Carefully split case of the RCU.

Figure 109: RCU RTC Location

8. Locate the RTC battery(circled red in Figure 109) and remove it.

9. Replace it with a new CR1220 battery.

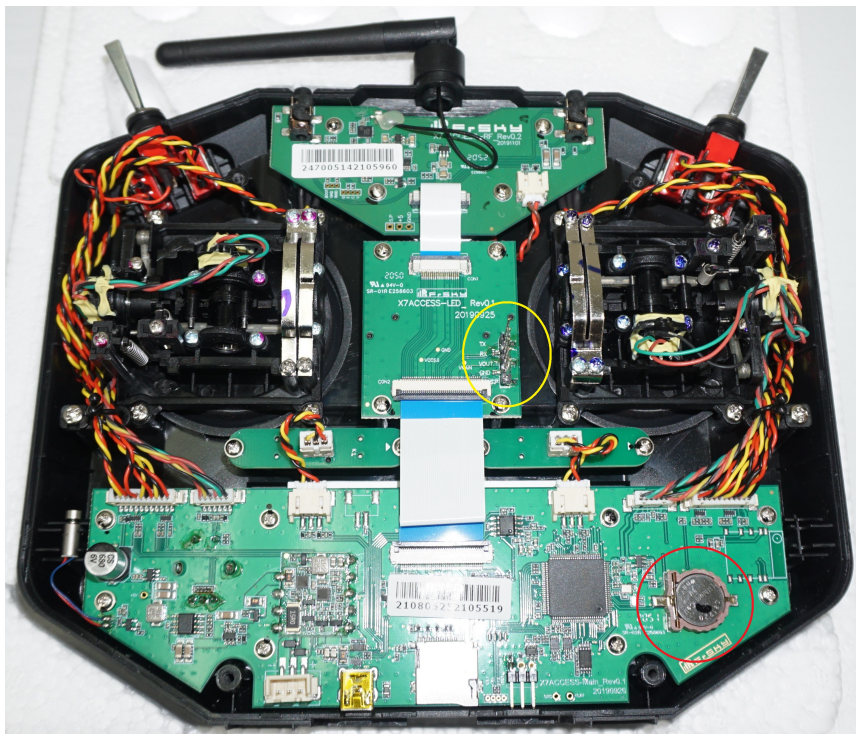10. Carefully put the two case halves together. Verify the module bay pins (circled yellow in Figure 109) slide through the slot (Figure 23).

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). 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). 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.

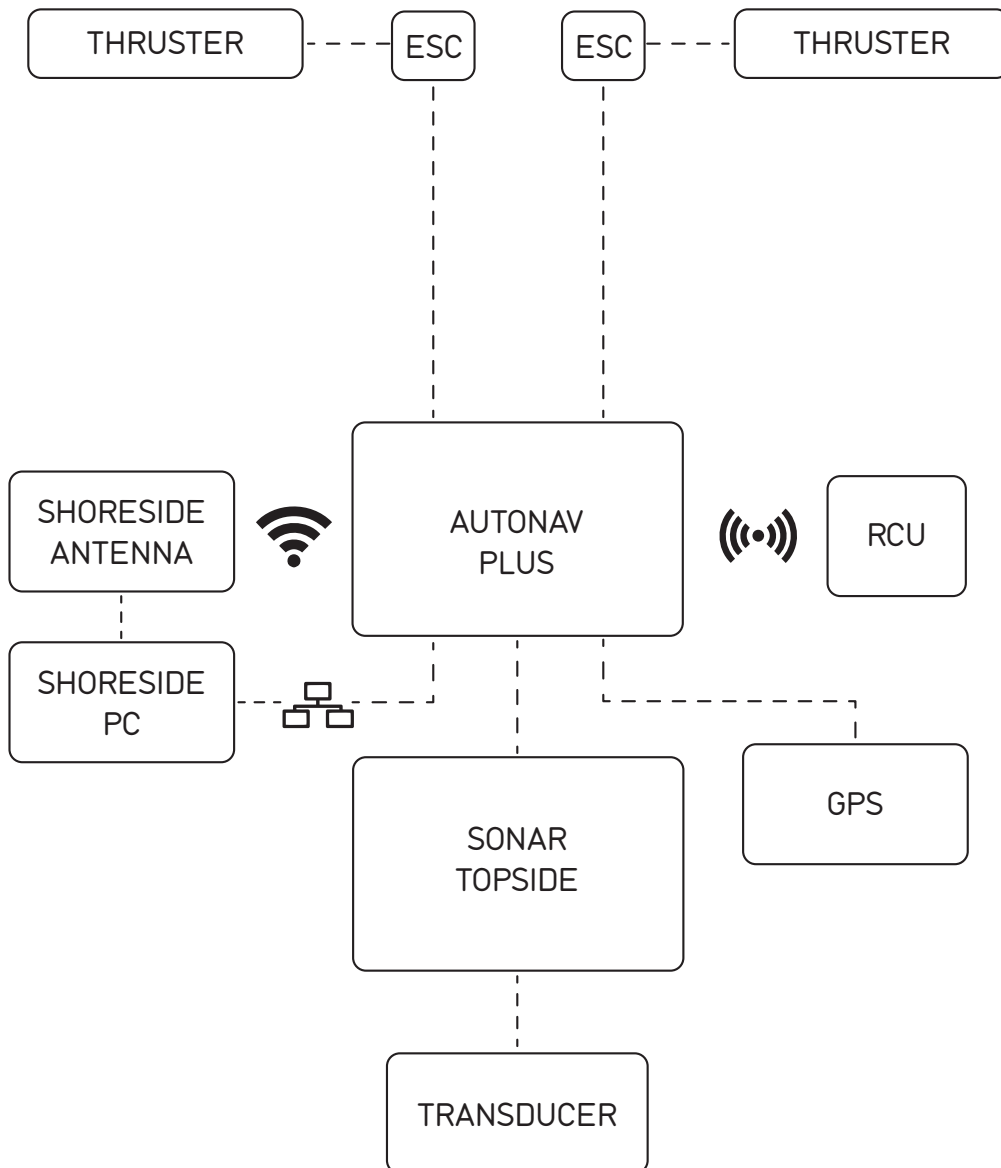Figure 110: Beaufort Sea State

8.2 Block Diagrams

THRUSTER — ESC   ESC — THRUSTER

SHORESIDE ANTENNA   AUTONAV PLUS   RCU

SHORESIDE PC   SONAR TOPSIDE   GPS

TRANSDUCER

Figure 111: Block Diagram

8.3   Electrical Diagrams

Motor Wire Color	Phase Letter	ESC Wire Color
		Blue
Green	A	Yellow
White	B	Orange
Blue	C	

Port Motor Pinout

Motor Wire Color	Phase Letter	ESC Wire Color
		Blue
Blue	A	Yellow
White	B	Orange
Green	C	

Starboard Motor Pinout
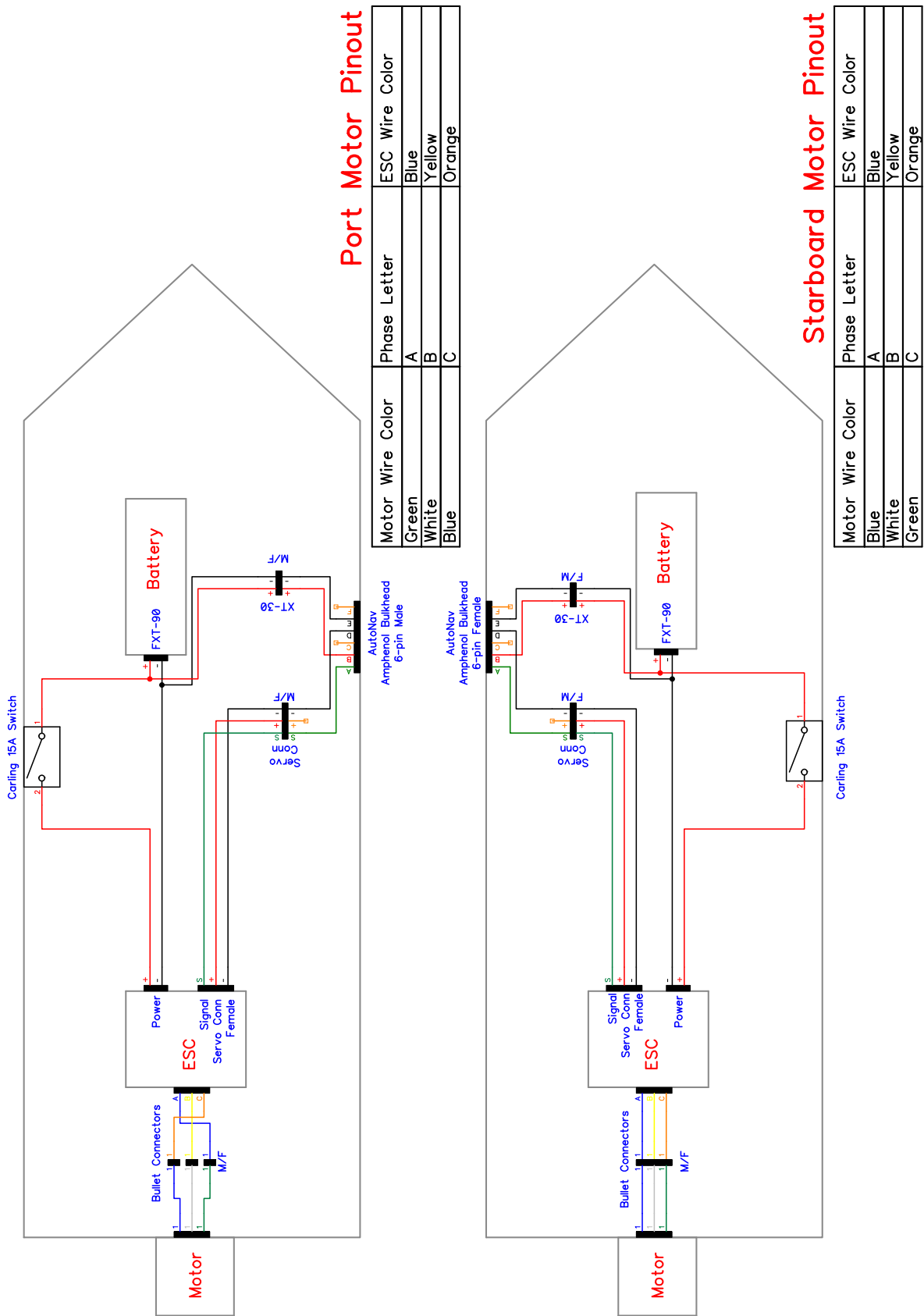
Figure 112: HyDrone™ Electrical Diagram

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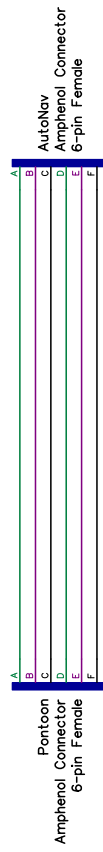(See Figure 5 for Bulkhead Locations)

Figure 114: Port Pontoon Power Data Cable Diagram
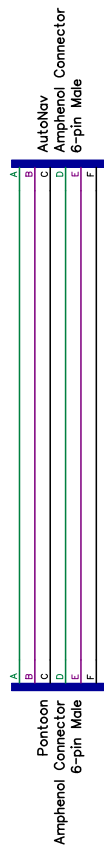
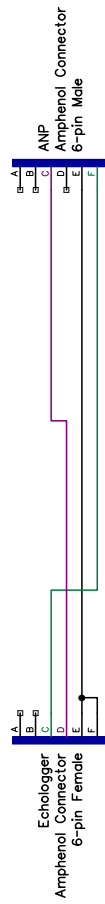Figure 115: Starboard Pontoon Power Data Cable Diagram

Figure 116: AutoNav Plus™ To Hydrolite Plus Echo Sounder Data Cable Diagram
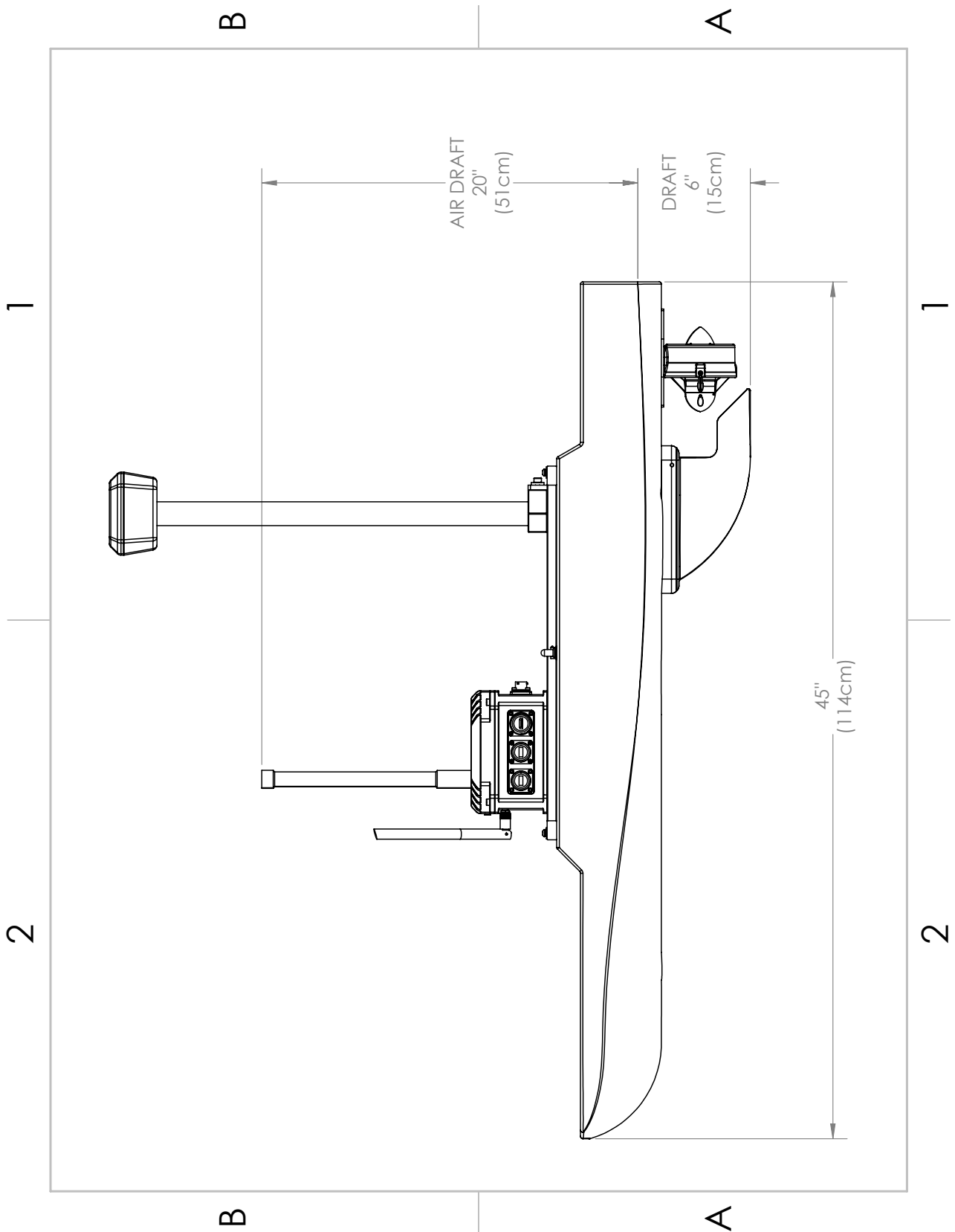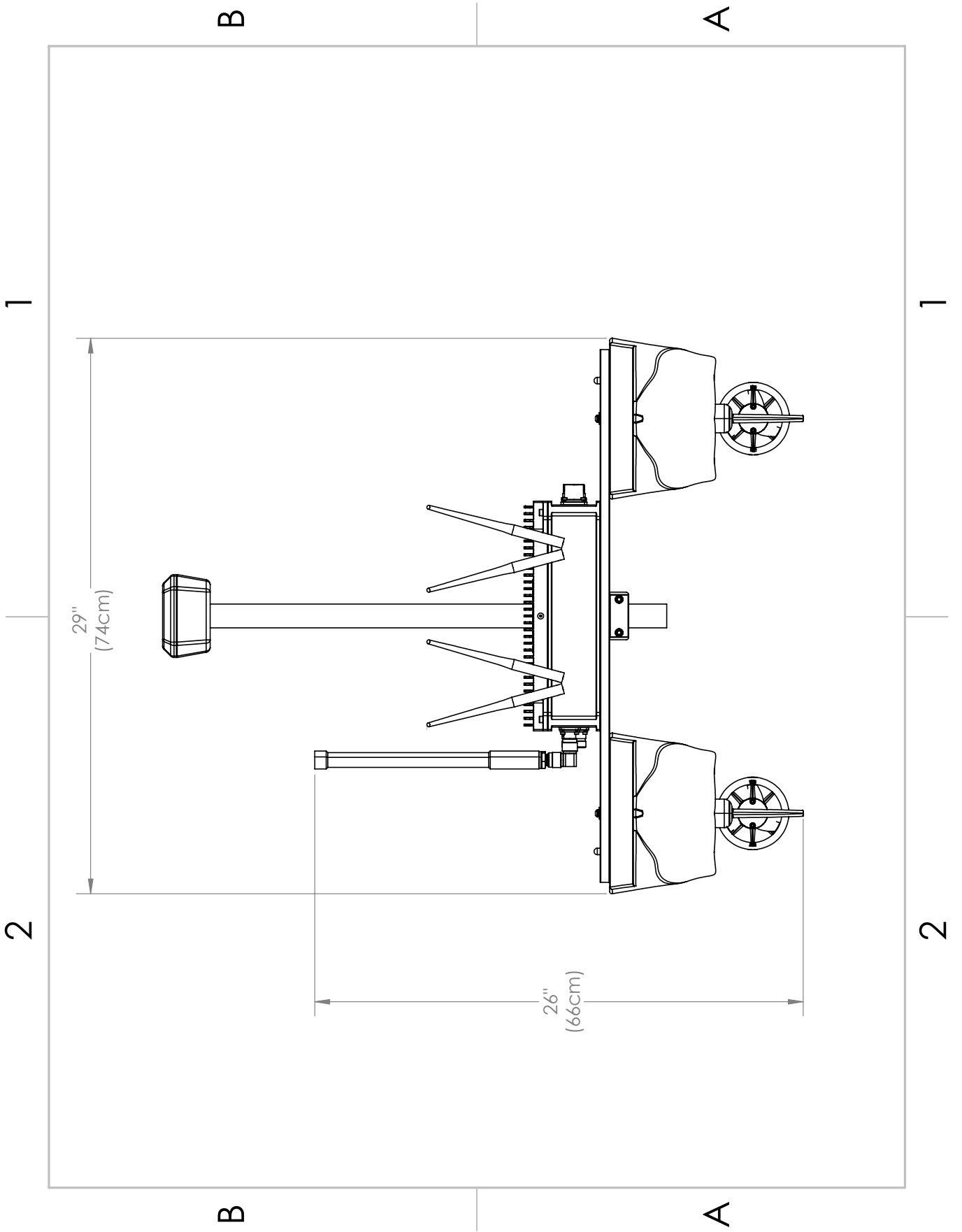
8.4   Mechanical Diagrams

AIR DRAFT
20"
(51cm)

DRAFT
6"
(15cm)

45"
(114cm)

Figure 117: Side View Diagram

Figure 118: Front View Diagram
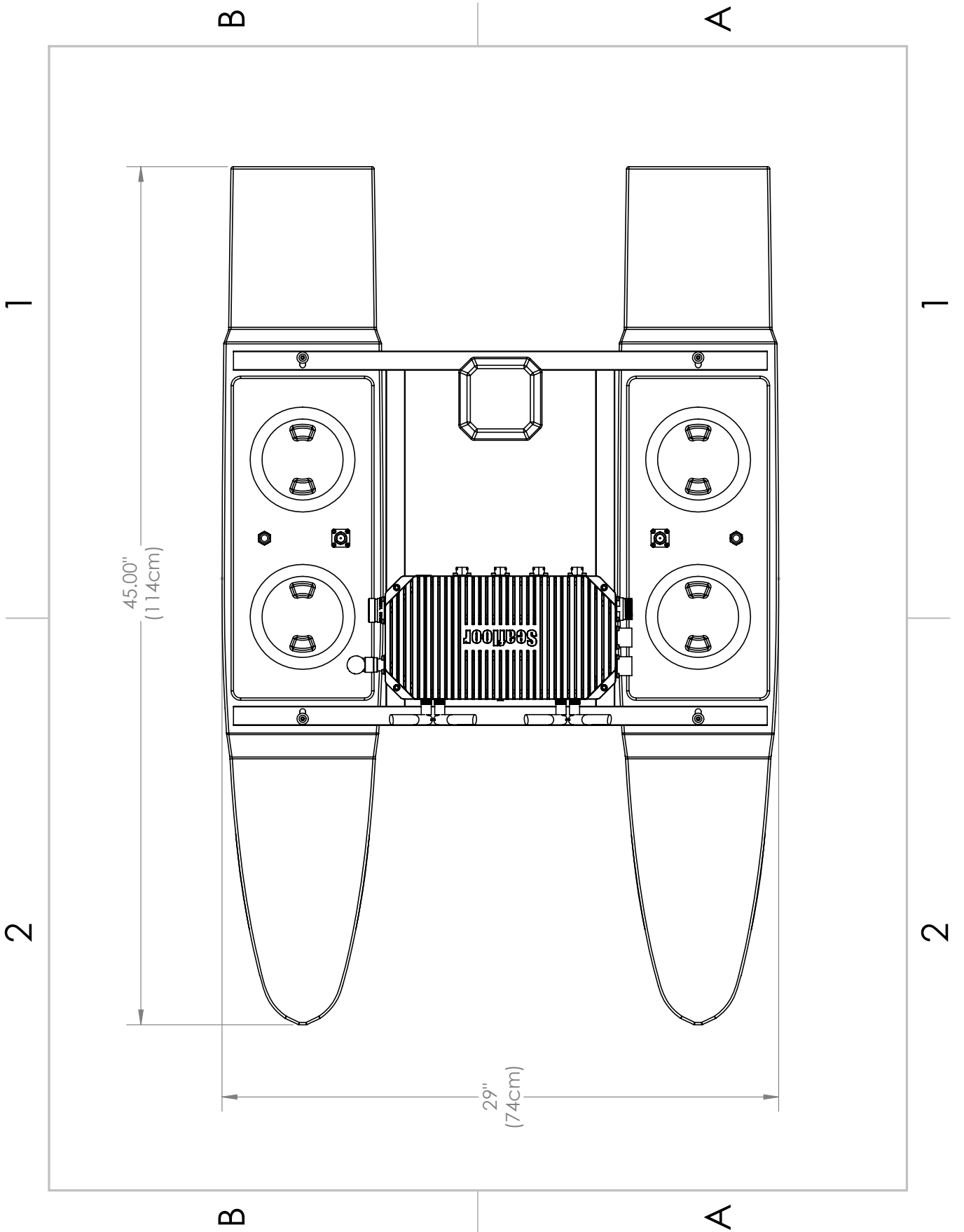
Figure 119: Top View Diagram

Revision History

Revision	Date	Author(s)	Description
1.0	3.27.2024	BA	Created