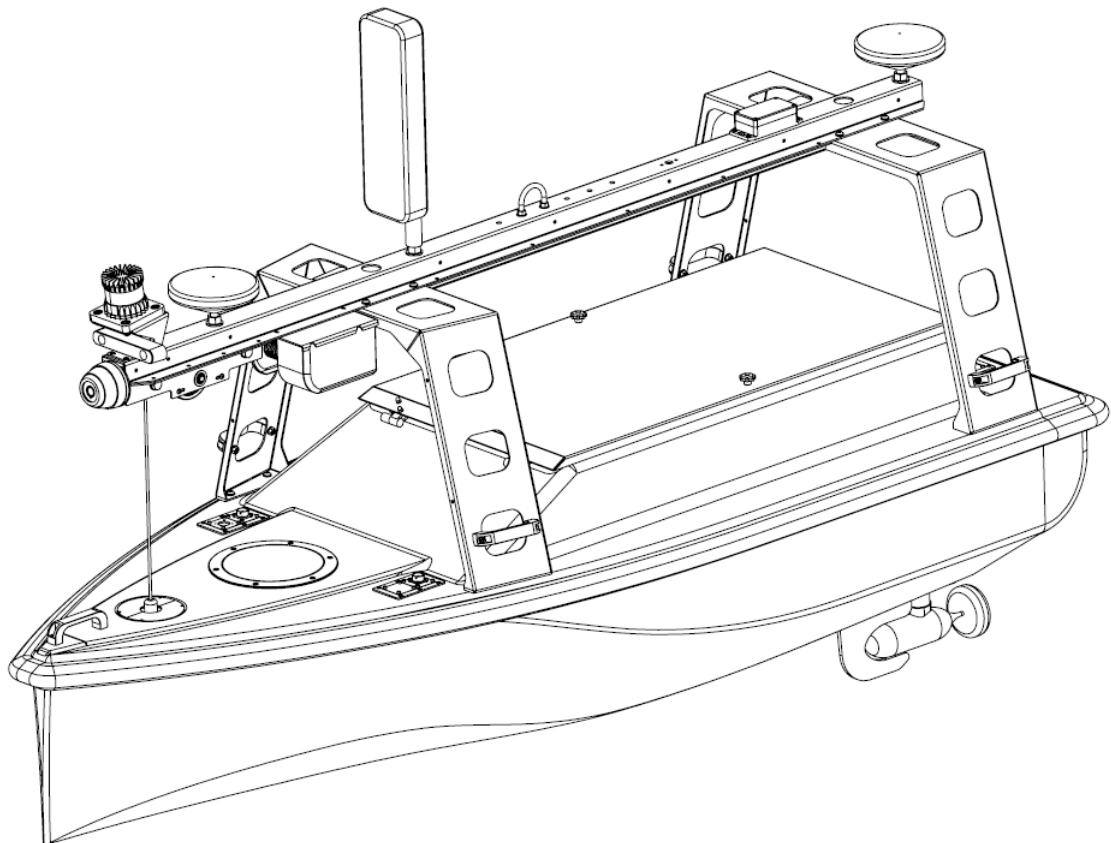


EchoBoat™ 240

User and Technical Manual

Seafloor Systems, Inc



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1 Introduction

1.1 System Overview

Welcome to the Seafloor Systems EchoBoat™ 240 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 EchoBoat™ 240 offers advanced hydrographic surveying capabilities, autonomous operation, flexible payload options, and real-time data viewing. The EchoBoat™ 240 features a robust hull and propulsion system, a sophisticated navigation and control unit and reliable communication systems. This manual is for hydrographic surveyors, marine scientists, and technical personnel involved in underwater mapping and surveying tasks using the EchoBoat™ 240.

1.2 Terms And Acronyms

ANP	AutoNav Plus
ASV	Autonomous Survey Vessel
Bow	Front or forward part of the vessel
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)*
Top Speed	4knots (2m/s)
Length	7.87ft (2.4m)
Width	2.95ft (0.9m)
Draft	1ft (0.3m)
Air Draft	4.3ft (1.32m)
Hull Material	High Density Polyethylene (HDPE)
Hardware	316 Stainless Steel
Weight (Base Boat)	350lbs (158.75kg)
Payload	200lbs (90.7kg)
Trailer Towing Weight	555lbs (251.7kg)(Base Boat and Trailer)
Power	24VDC
Battery Endurance	9 hours at Survey Speed
Thruster	2x Electric Outdrives
Steering	Directed Thrust Steering
Communication Range	Line of Sight, Up to 1km (Conditions Dependent)
Remote Control Voltage Range	6-8.5VDC
Remote Control Long Range Battery	2S LiPo
Remote Control Range	Line of Sight, Up to 1.2 miles (2km) (Conditions Dependent)
Shore Power Requirements	100-240VAC for PoE
Sea State	Beaufort Sea State 2 and Below (Figure 106)
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. Refer to Survey Endurance Chart 3.3.

1.4 System Limitations

To limit potential damage to the EchoBoat™ 240, 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 3.3)
- Range outside of 1.2mi (2km) line of sight. (Greater than 1.2mi (2km) with advanced Comms kit)
- 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 winds, heavy rain, etc.
- Collision Avoidance Assist (CAA) - **Optional Add On:** Limited effectiveness in adverse weather. Fog, rain heavy spray will affect range. CAA range is 25m in perfect conditions. CAA is a man in loop system.

1.4.1 Water Towing

Caution

If towing is required, keep tow speed below 5 knots (2.5m/s). Towing faster than 5 knots (2.5m/s) or too fast for sea conditions may cause equipment damage, or water to enter, or flooding/swamping/sinking of EchoBoat™ 240. If towing is required, keep tow speed below 5 knots (2.5m/s) in calm conditions and reduce speed if waves are present. Reduce the tow speed if waves break over the bow or the bow becomes submerged under the water surface.

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 EchoBoat™ 240 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 EchoBoat™ 240 for purposes other than water measurements, or pairing it with instruments exceeding a weight of 200lbs (90.1kg).

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 EchoBoat™ 240 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 EchoBoat™ 240.

Important Alert

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

- Avoid touching contacts.
- Do not undertake any repair work whatsoever on the Power 24-3500 EchoBoat™ 240 batteries.
- Never touch scuffed or severed wiring or obviously defective components.
- If you noticed a defect, immediately switch off the battery.
- Avoid contact with electrical components in water.
- Prevent mechanical forces from working on the batteries and cables.
- Never charge damaged batteries.
- Do not use the system near flammable gases, solvents, or vapours.
- Anyone with cardiac pacemaker must maintain a distance of at least 20in (50cm) from the Power 24-3500 and from the chargers.
- Keep the batteries away from heat sources.
- Do not store flammable objects near the batteries.
- Remove metal jewellery and wristwatches before you start work on batteries or in their vicinity.
- Always put down tools and metal objects without making contact with the batteries.
- When connecting the battery, ensure correct polarity and secure connections.
- Battery terminals must be clean and free of corrosion.

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.

EchoBoat™ 240 batteries:

- Always use a Torqeedo approved charger specifically designed for lithium ion batteries. Never use NiCD, NiMH, LiPo chargers to charge lithium ion batteries. (Refer to 3.6)

- Do not charge any type of battery on or near any flammable materials including in or near your vessel.
- Never leave batteries unattended while charging. Batteries on charge MUST remain under constant observation so that you may react quickly should any problems arise.
- Ensure proper ventilation when batteries are charging.

RCU Long Range Module Battery (Lithium Polymer (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. (Refer to 3.6)
- 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.

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 EchoBoat™ 240:

- **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 EchoBoat™ 240 is unattended. Always power off the batteries immediately after use.

Adhering to these safety guidelines is crucial for the safe and effective operation of the EchoBoat™ 240 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*
EchoBoat™ 240	1	EchoBoat™ 240 USV	
EchoBoat™ 240 Trailer	1	Custom made for EchoBoat™ 240	
Power 24-3500 Fast Charger	1	Charger for EchoBoat™ 240	
Shoreside Antenna	1	Paired to EchoBoat™ 240 Antenna	
Shoreside PoE	1	To power Shoreside Antenna	
10ft Ethernet Cable	1	To be used with Shoreside PoE and Shoreside Antenna	
Remote Control Unit (RCU)	1	Remote Control Unit for EchoBoat™ 240	
USB Charging Cable	1	Charging Cable for RCU	

Long Range Module	1	Used with RCU for extended range	
2S LiPo Battery	1	Used with Long Range Module	
LiPo Charger	1	Charger for the 2S LiPo Battery	
AML3 Adapter	1	To adapter the AML3 SVP to work with the SmartCast	
Voltage Tester	1	To measure the 2S LiPo voltage	
USB Drive	1	Loaded with software, drivers, and manuals	
ESC Programming and Cable	1	To be used for programming the ESCs (USB cable not included)	
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 Drawings

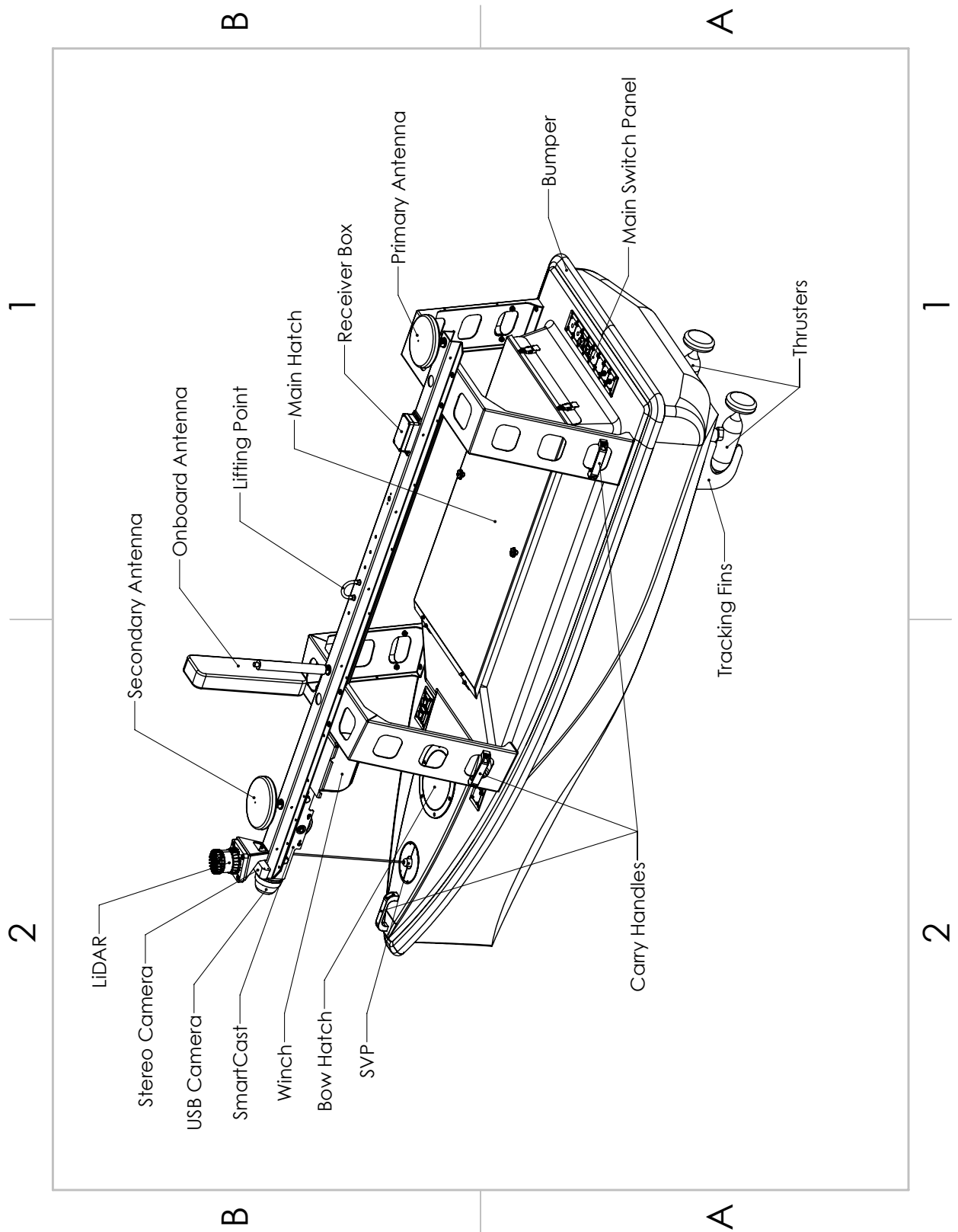


Figure 1: EchoBoat™ 240 System Overview

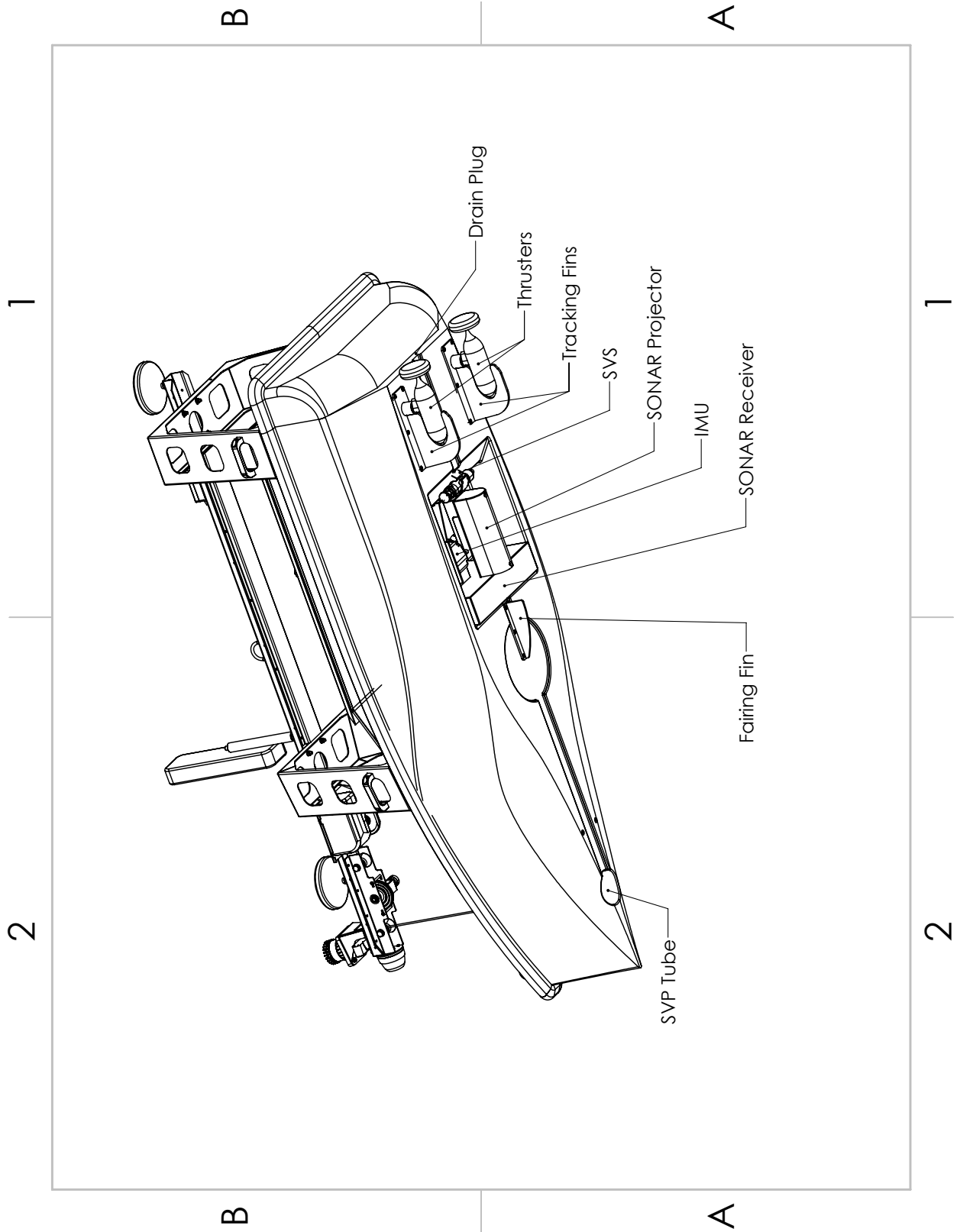


Figure 2: EchoBoat™ 240 Bottom View

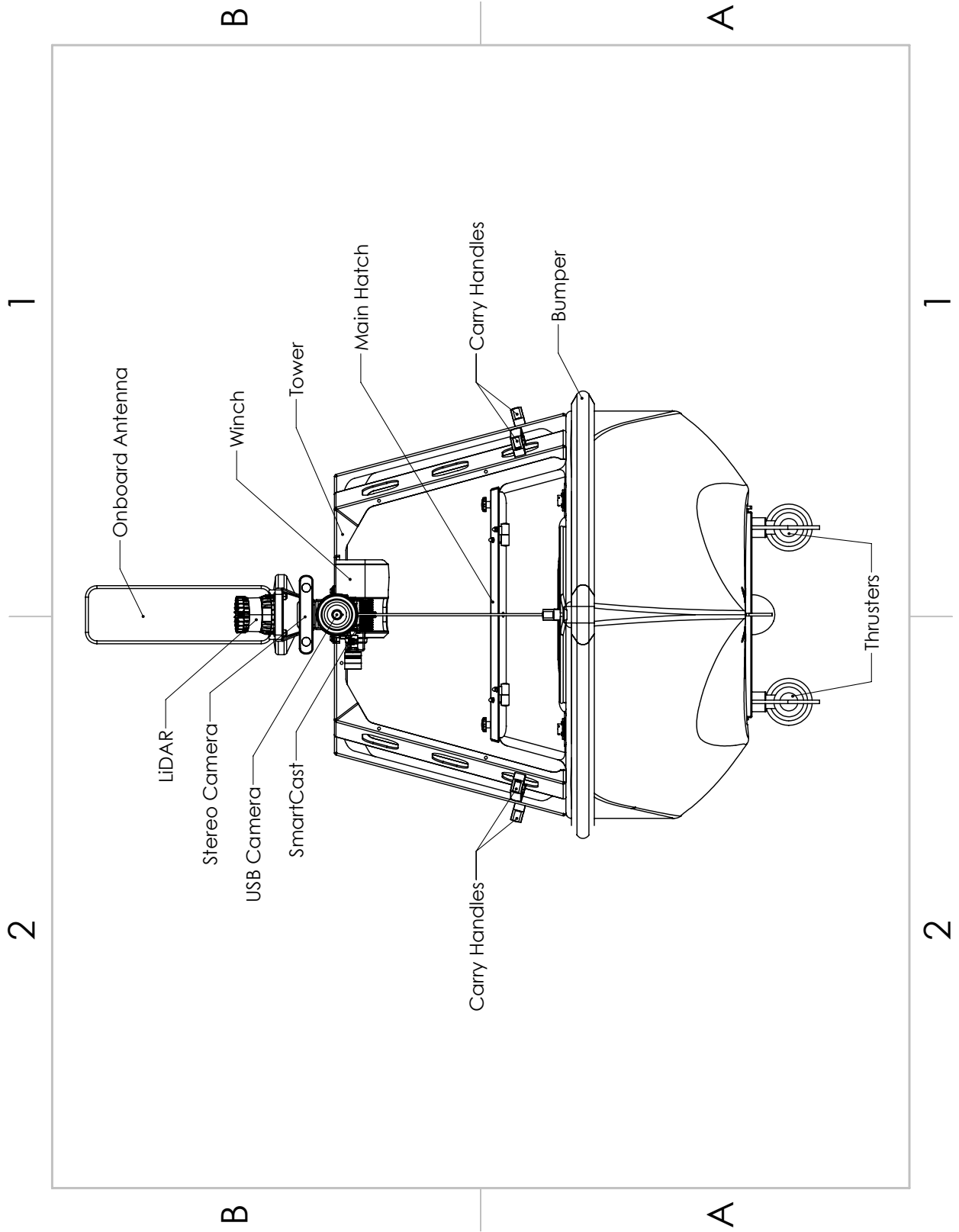


Figure 3: EchoBoat™ 240 Front View

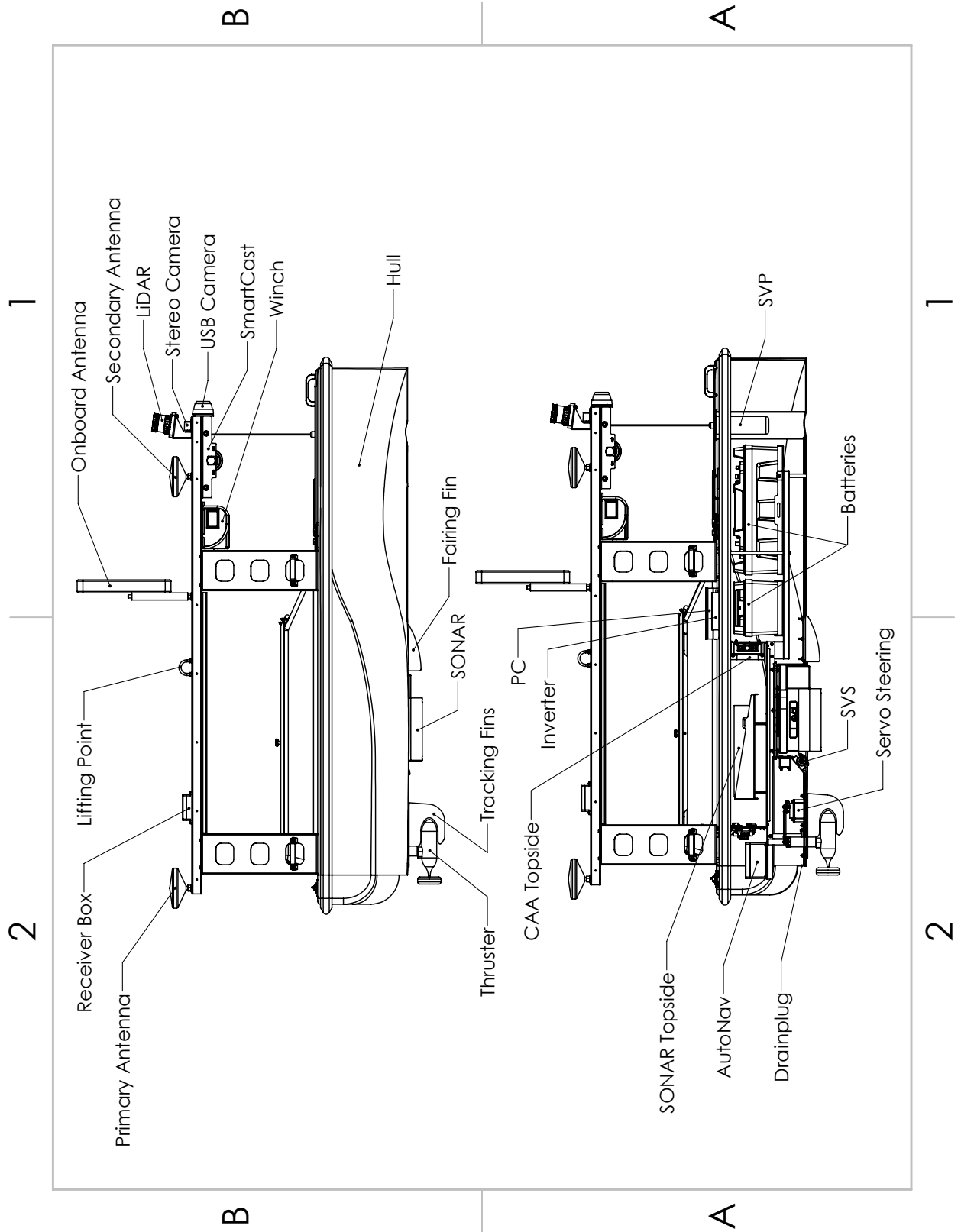


Figure 4: EchoBoat™ 240 Side View

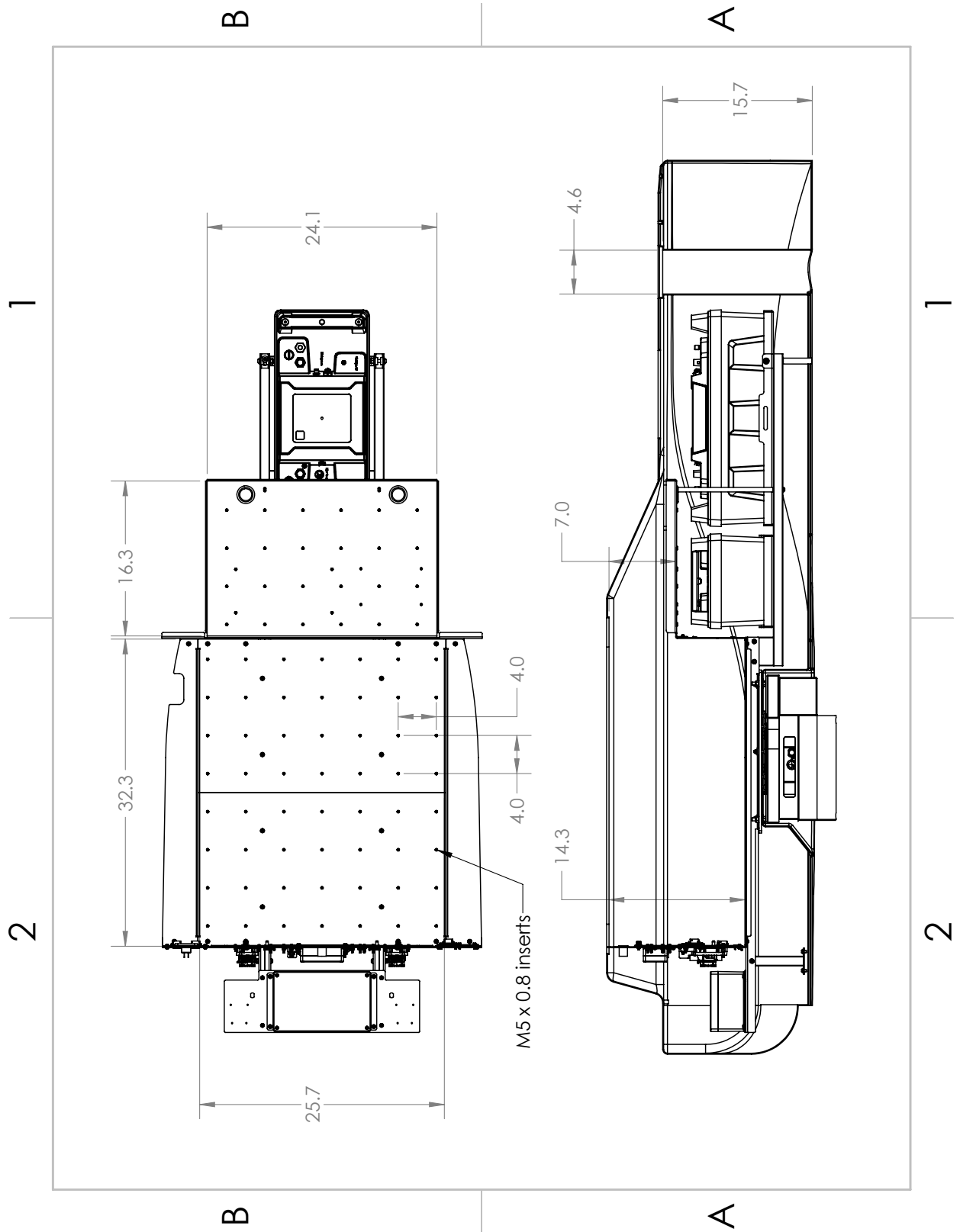


Figure 5: EchoBoat™ 240 Internal View

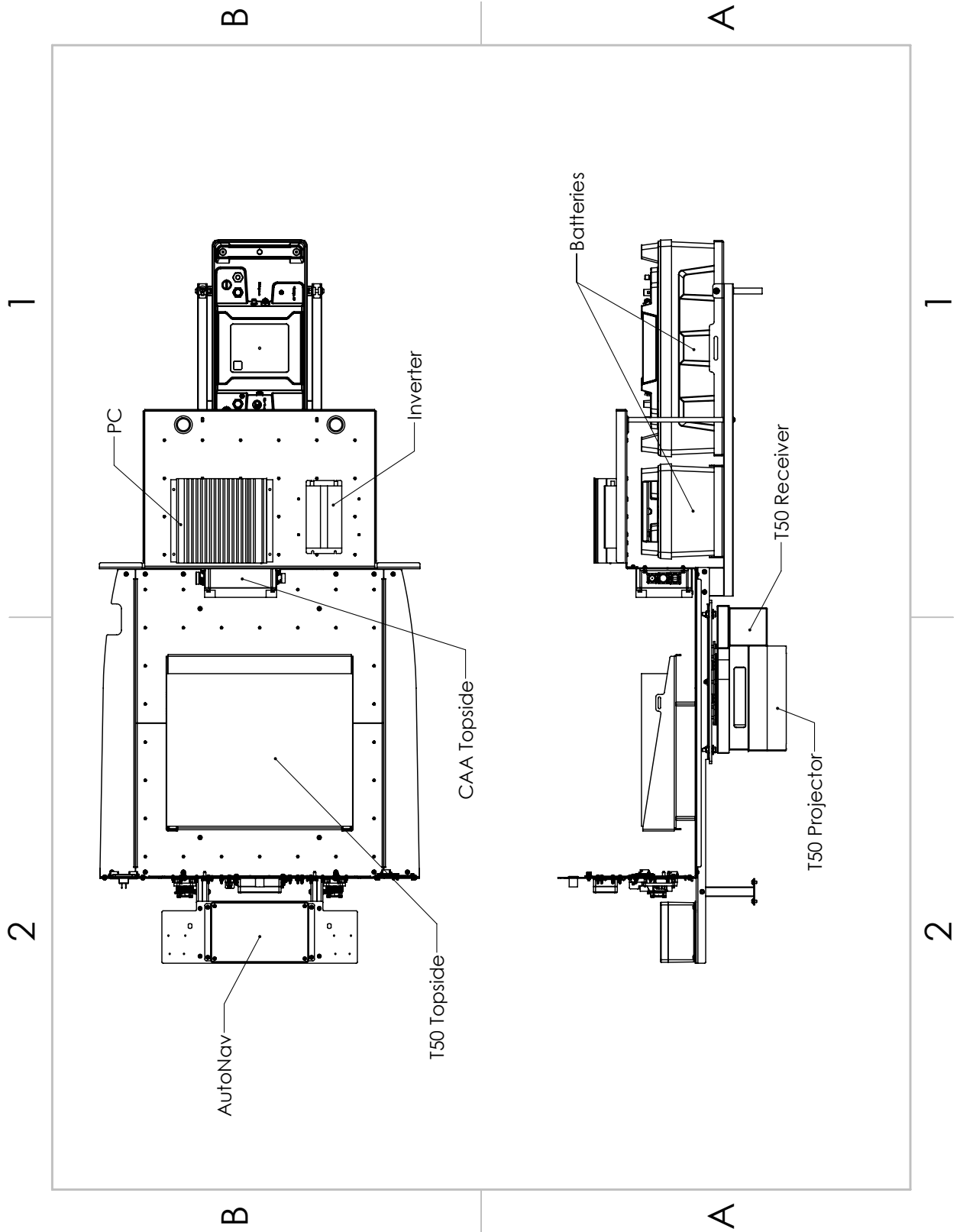


Figure 6: EchoBoat™ 240 Internal View With Equipment

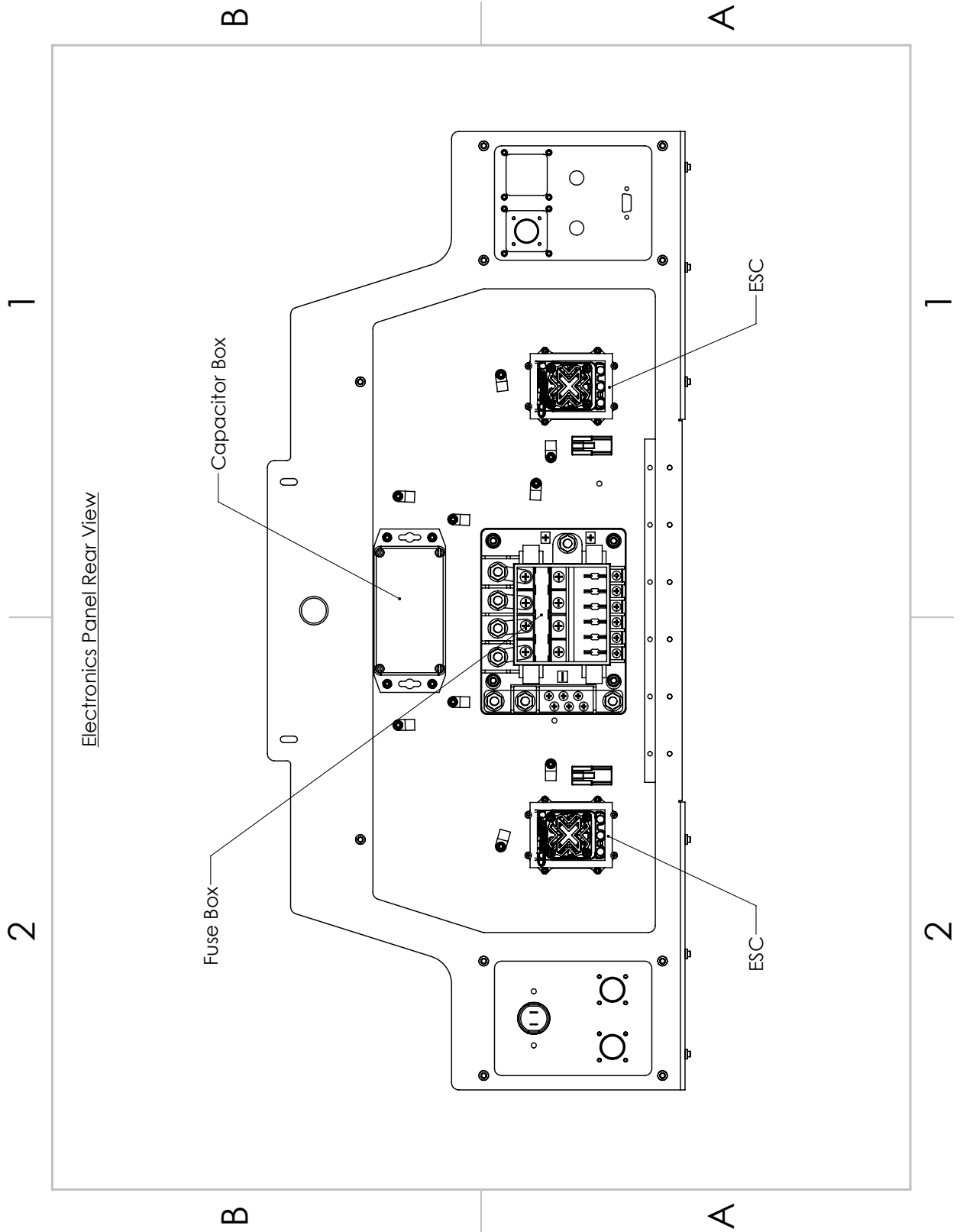


Figure 7: Electronics Panel Rear View

1. Unused
2. RTK Pass Through
3. Antenna 2 TNC Pass Through
4. Antenna 1 TNC Pass Through
5. AutoNav™ DB9 GPS Input
6. EchoBoat™ 240 Main Power Button
7. EchoBoat™ 240 Voltage Monitor
8. AUX 2 Power Bulkhead
9. AUX 1 Power Bulkhead

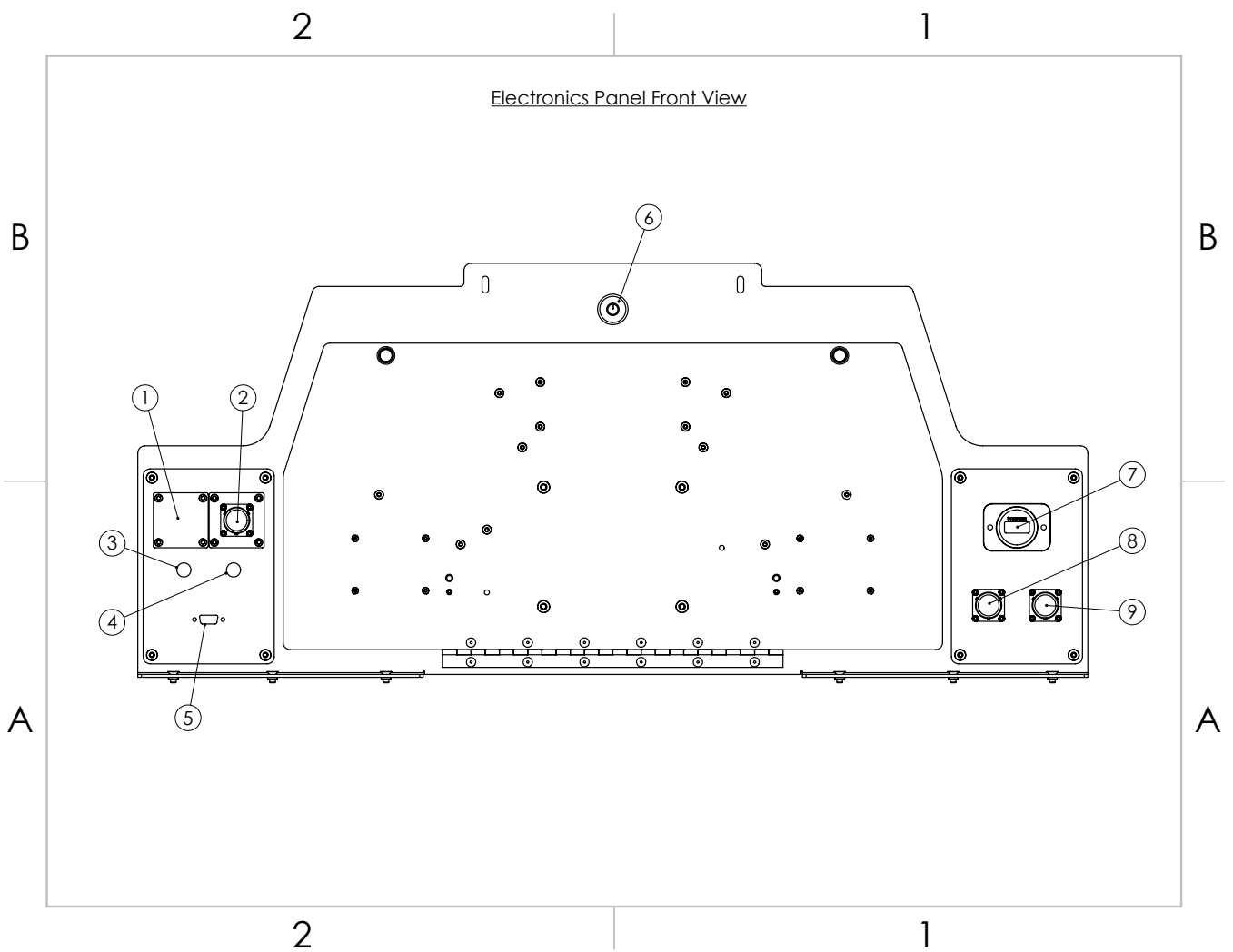


Figure 8: Electronics Panel Front View

1. AUX 1 Power Switch
2. AUX 2 Power Switch
3. Unused
4. Unused
5. RTK Pass Through
6. Receiver 3pin Bulkhead
7. Antenna 1 TNC Bulkhead
8. Antenna 2 TNC Bulkhead

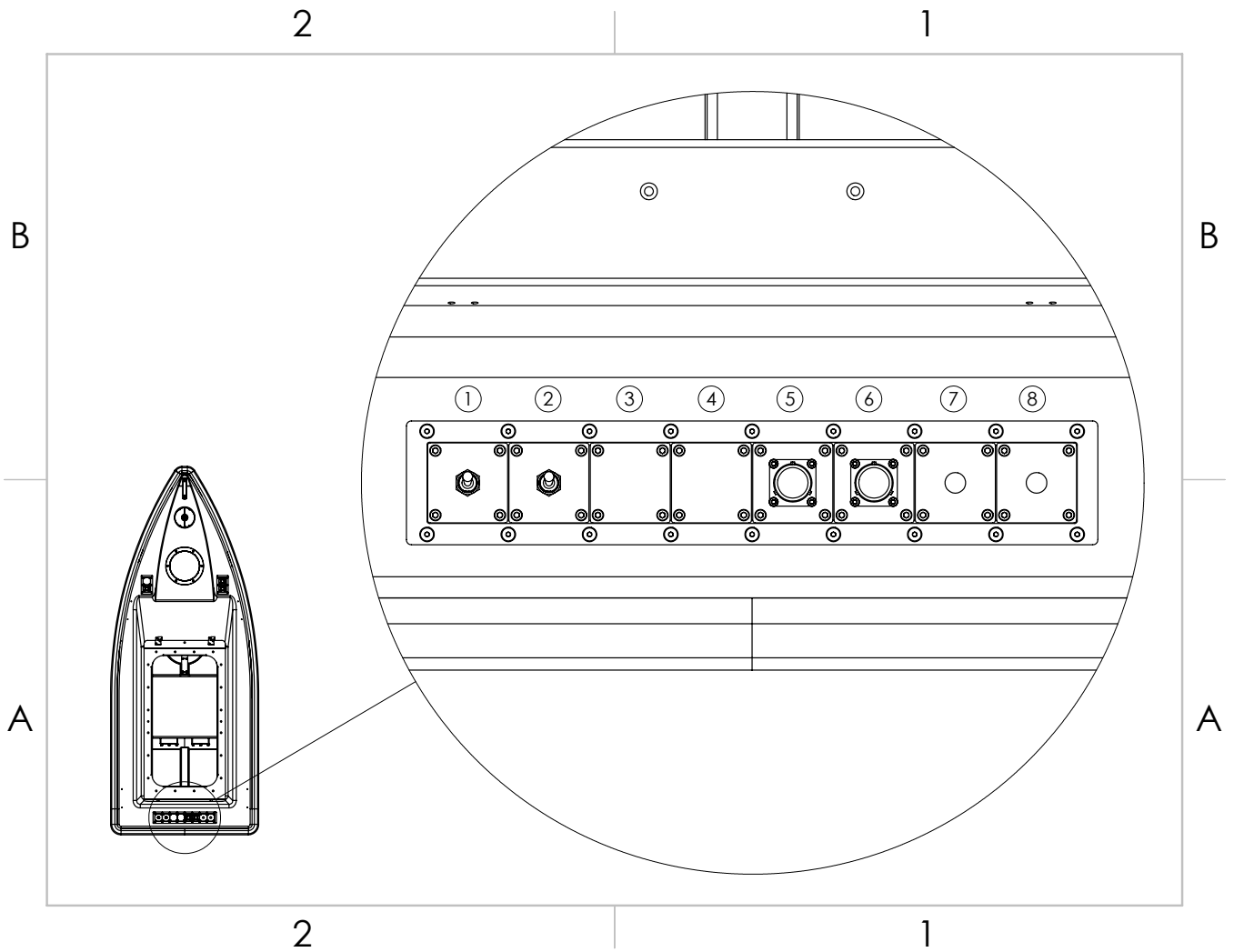


Figure 9: EchoBoat™ 240 Stern Bulkheads

1. Unused
2. SmartCast 12pin Bulkhead
3. USB Camera 4pin Bulkhead
4. Onboard Antenna Ethernet Bulkhead

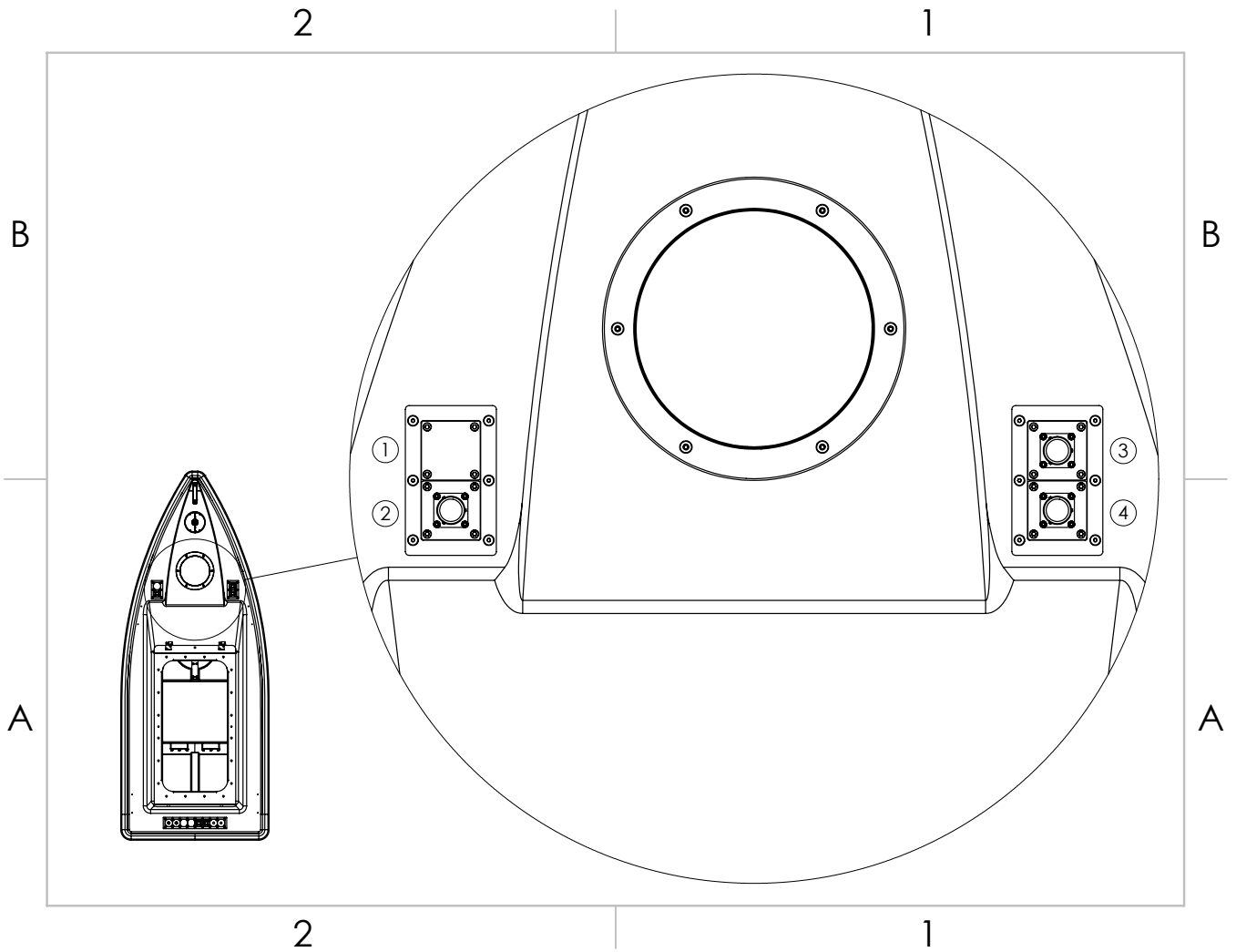


Figure 10: EchoBoat™ 240 Bow Bulkheads

3.3 EchoBoat™ 240 Endurance Chart

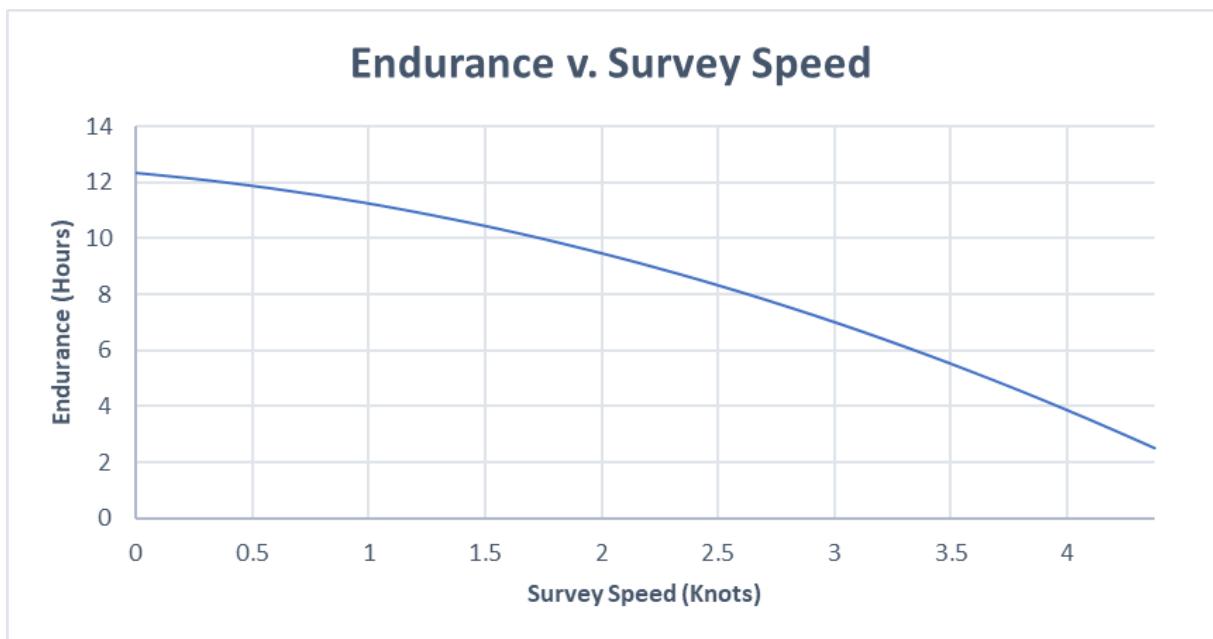


Figure 11: EchoBoat™ 240 Endurance Chart(Including 200W Sonar)

3.4 Remote Control Unit (RCU)

The EchoBoat™ 240 is controlled by a Taranis Q-X7 Access Transmitter.

Information

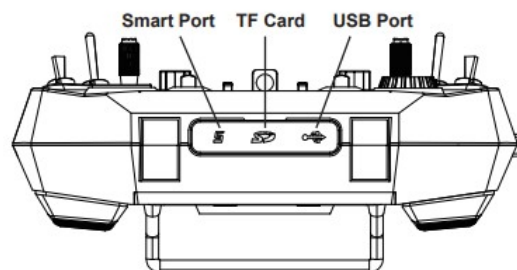


Figure 12: RCU Bottom View

To charge the battery:

- Open bottom dust cover to reveal USB mini port.
- Connect supplied USB mini cable.
- Connect USB A into a suitable charger source. It is expecting 5VDC at 2amps.

Important Alert

For safety you must arm the EchoBoat™ 240 to allow the thrusters to function. Always disarm or power off the vessel when working near the props.

To arm the EchoBoat™ 240:

Move SA switch up and hold SH down for 5 seconds. See Figure 13

To disarm the EchoBoat™ 240:

Move SA switch down and hold SH down for 5 seconds. See Figure 13

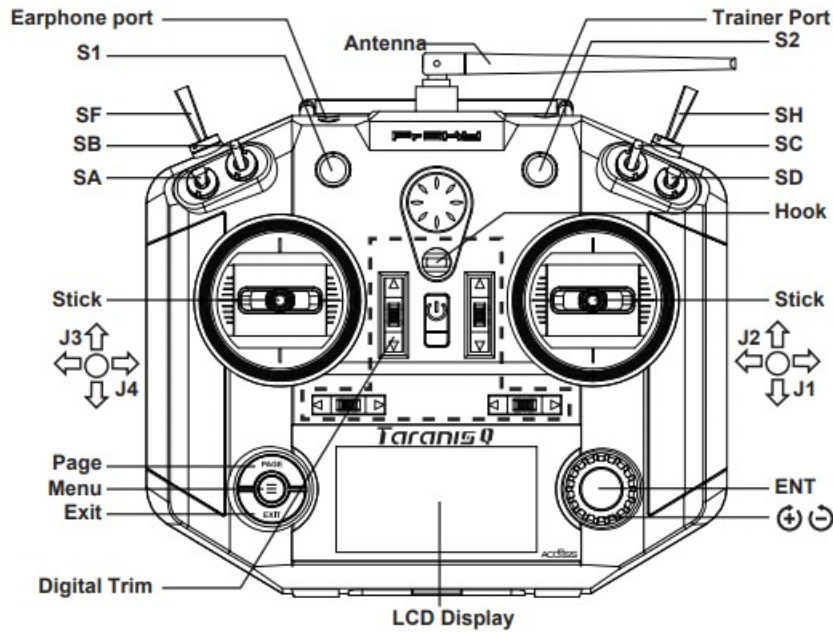


Figure 13: RCU Front View

Remote Control Unit Functions

Power (Not labeled - Right below Hook)	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	Manual SmartCast (Default Position - Straight Up) Clockwise to spool out Counter-Clockwise to spool in
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 + SH down
Digit Trims	Unused
Earphone Port	Unused
Trainer Port	Unused
Module Bay	Long Range Module Connects here (Refer to Figure 14)
Battery Cover	RCU Internal Battery Location (Refer to Figure 14)

Table 4: RCU Functions

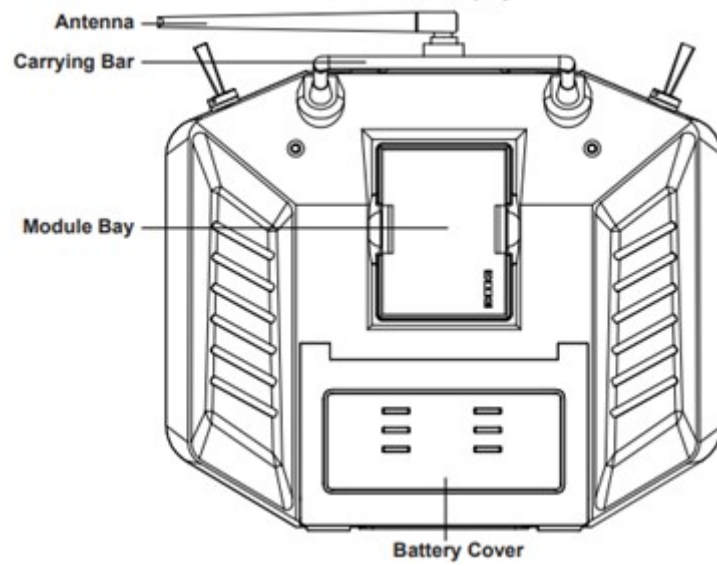


Figure 14: RCU Back View

3.5 Voltage Tester

Information

Max voltage of a 2S battery is 8.4VDC.

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 15: 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.

3.6 Battery Charging

3.6.1 EchoBoat™ 240 Charging

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

It is not recommended to operate the EchoBoat™ 240 while the batteries charge.

Caution

EchoBoat™ 240 battery voltage minimum is 21VDC. The battery shuts down at 12VDC as a protective measure. Discharging batteries below 21VDC can damage the battery requiring a return to the manufacturer for service.

Caution

Charging EchoBoat™ 240 batteries:

To Connect:

1. Start with the EchoBoat™ 240 powered on and disarmed. (Refer to 3.7)
2. Power off the onboard PC, inverter, and any sonar systems. (Refer to 3.12)
3. Connect Fast Charger output cable into the EchoBoat™ 240 charging cable.

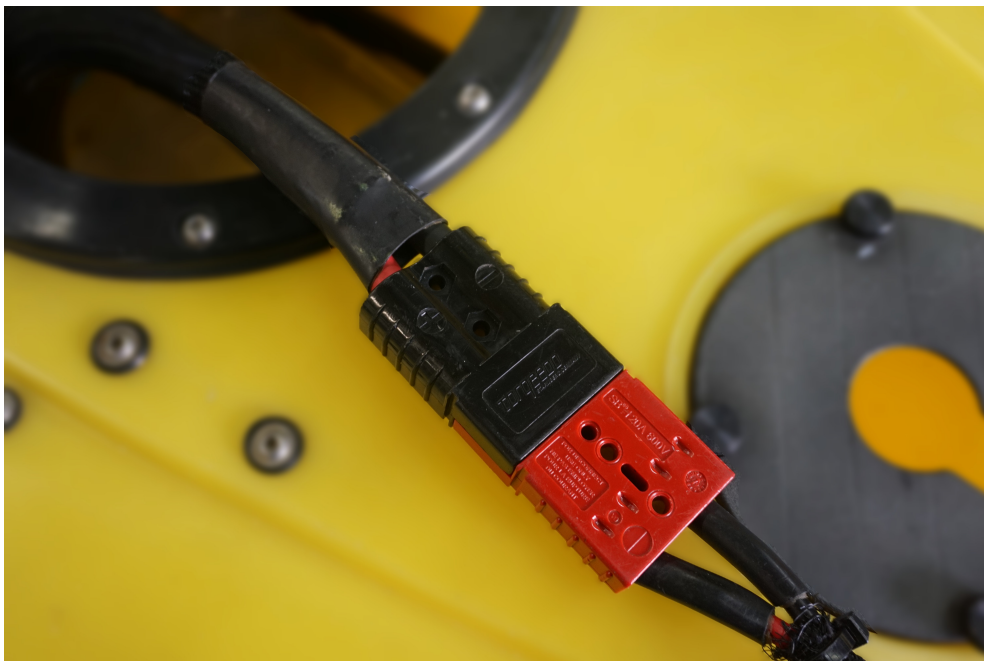


Figure 16: EchoBoat™ 240 Charging Connectors

4. Connect Fast Charger to AC power. 100-240VAC/50-60Hz.
5. Charging complete when charger switches to standby mode.

To Disconnect:

1. Disconnect Fast Charger from AC power.
2. Disconnect Fast Charger output cable from the EchoBoat™ 240 charging cable.
3. Power off EchoBoat™ 240. Hold down Main Power Button(Figure 19) for 5 seconds. (Refer to 3.12)

Technical Data

Property	Value
AC Input	100-240VAC
Rated Voltage	25.64VDC
Final charging voltage	29.05VDC
Final discharging voltage	21VDC
Maximum voltage at the terminals	29.05VDC
Maximum discharge current	180A
Ambient temperature, storage	-22°F to 131°F (-30°C to +55°C)
Ambient temperature, charging	32°F to 113°F (0°C to +45°C)
Usable Energy	3500 Wh
IP Protection class	IP67
Max. output power	1700 Watt at 240VAC 750 Watt at 100VAC
Charging Time	About five hours 0-100% at 240VAC About ten hours 0-100% at 100VAC

Table 6: Fast Charger Technical Data

3.6.2 Long Range Module Battery Charging

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 2S battery is 8.4VDC.

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.

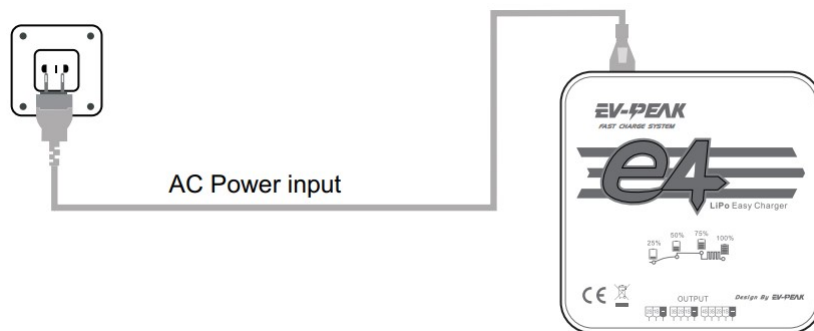


Figure 17: Cube Balance Charger Power

3. Charger will run a self-check. Wait for LED 1, 3 and LED 2, 4 to blink alternately before proceeding.
4. Connect the 2S 7.2V LiPo battery balance cable to the 2S (left) port.

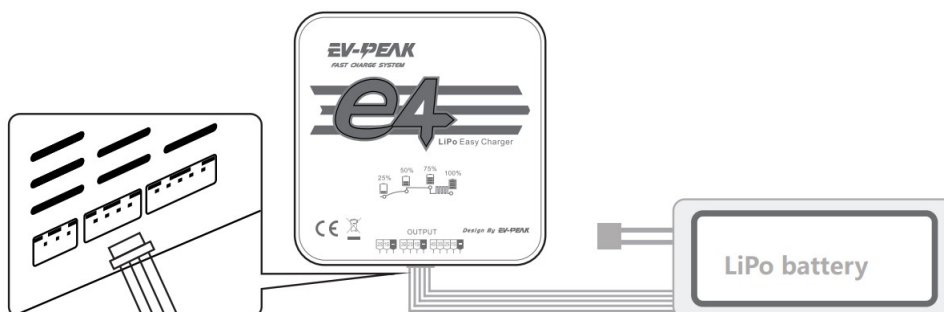


Figure 18: Cube Balance Charger Connection

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 8: E4 Cube Balance Charger Technical Data

3.7 EchoBoat™ 240 Power On Procedure

Information

Important Note:

- Shut down batteries at 21VDC. Voltage can be viewed on the Voltage Sensor, see Figure 45 and 8 for internal Voltage Display)
1. Power on the RCU. (Refer to 3.4)
 2. Verify all switches are in their default locations and the right joystick is center. (Refer to 3.4)
 3. Power on EchoBoat™ 240 by quick pressing the power button. Figure 19



Figure 19: EchoBoat™ 240 Main Power Button

4. Red LED ring will illuminate when powering on.



Figure 20: Main Power Button - Red LED Illuminated

5. Arm the EchoBoat™ 240 with the RCU. (Refer to 3.4)
6. Verify throttle and steering function correctly.
7. Secure all hatches and knobs before launching vessel.



Figure 21: Lid Latch

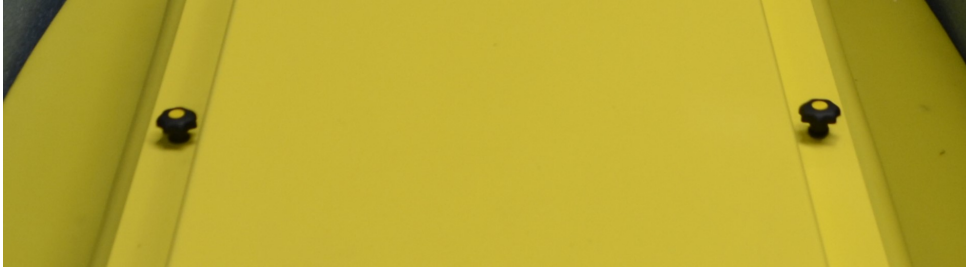


Figure 22: Lid Knobs

3.8 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 EchoBoat™ 240.
 - 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 23: Shoreside Hardware Setup

Software setup (Windows 11):

1. Right click the WiFi icon on the taskbar.

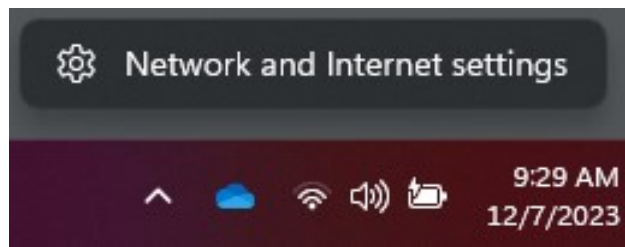


Figure 24: Network And Internet Settings

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



Figure 25: Advanced Network Settings

4. Open More Network Adapter Options.

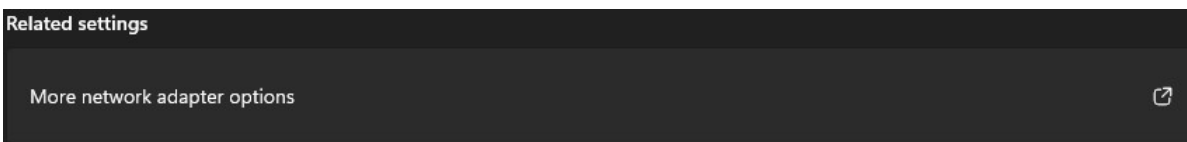


Figure 26: Network Adapters

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

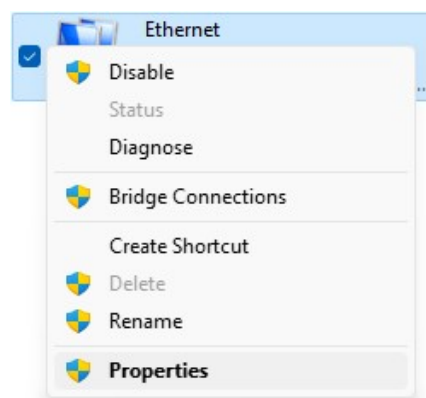


Figure 27: Ethernet Properties

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

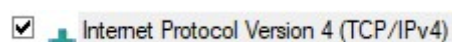


Figure 28: Internet Protocol

7. Change the follow settings:

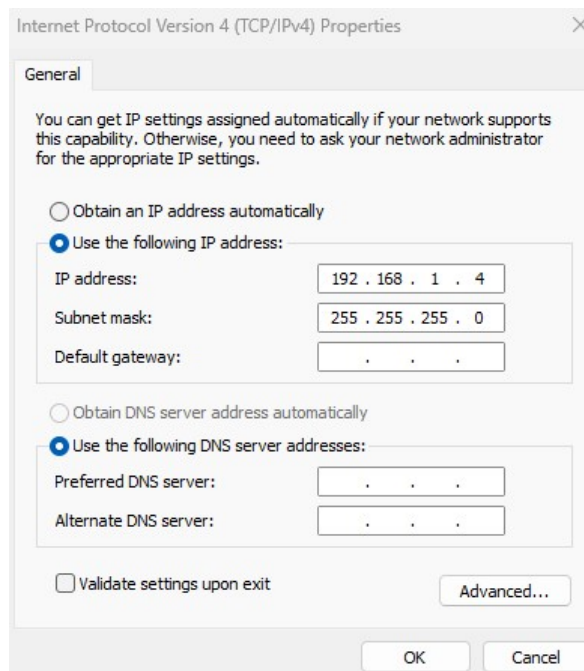


Figure 29: Ethernet Settings

- 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.

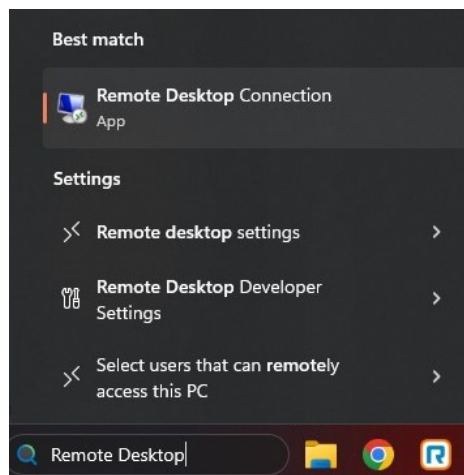


Figure 30: Taskbar Search

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

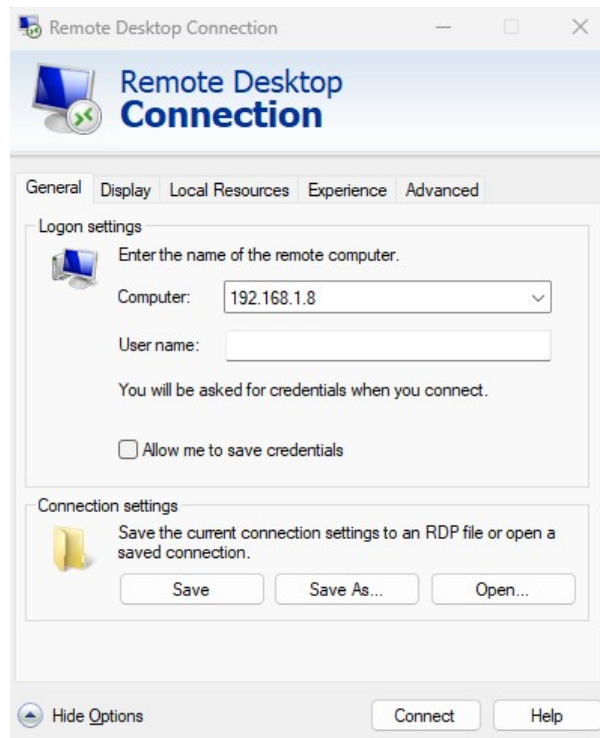


Figure 31: Remote Desktop Connection

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

3.9 Manual Operation

EchoBoat™ 240 is a directed thrust 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 while pushing it forward. For a right turn, move the right joystick to the right while pushing it forward.
- 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 EchoBoat™ 240 is headed toward you.

3.10 Autonomous Operation

3.10.1 Mission Planner

Information

Seafloor System's AutoNav™ requires three NMEA input GPS strings. GPS/GNSS system not provided by Seafloor, will need to be configured to output the required NMEA strings.

- GGA, RMC, HDT at 5Hz with a GP Talker ID(Prefix) at 57600 baud rate. RS232 Protocol with DB9 connector. USB to DB9 adapter do 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
 - \$GPHDT,139.23,T*25

Caution

Important: The AutoNav™ navigates using GPS waypoints, users should toggle to Manual mode to avoid objects and always maintain line of sight

AutoNav™ 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 3.4)
- 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 EchoBoat™ 240.

Mission Planner:

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

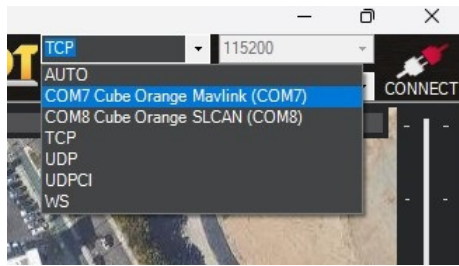


Figure 32: COM Port

- 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'.

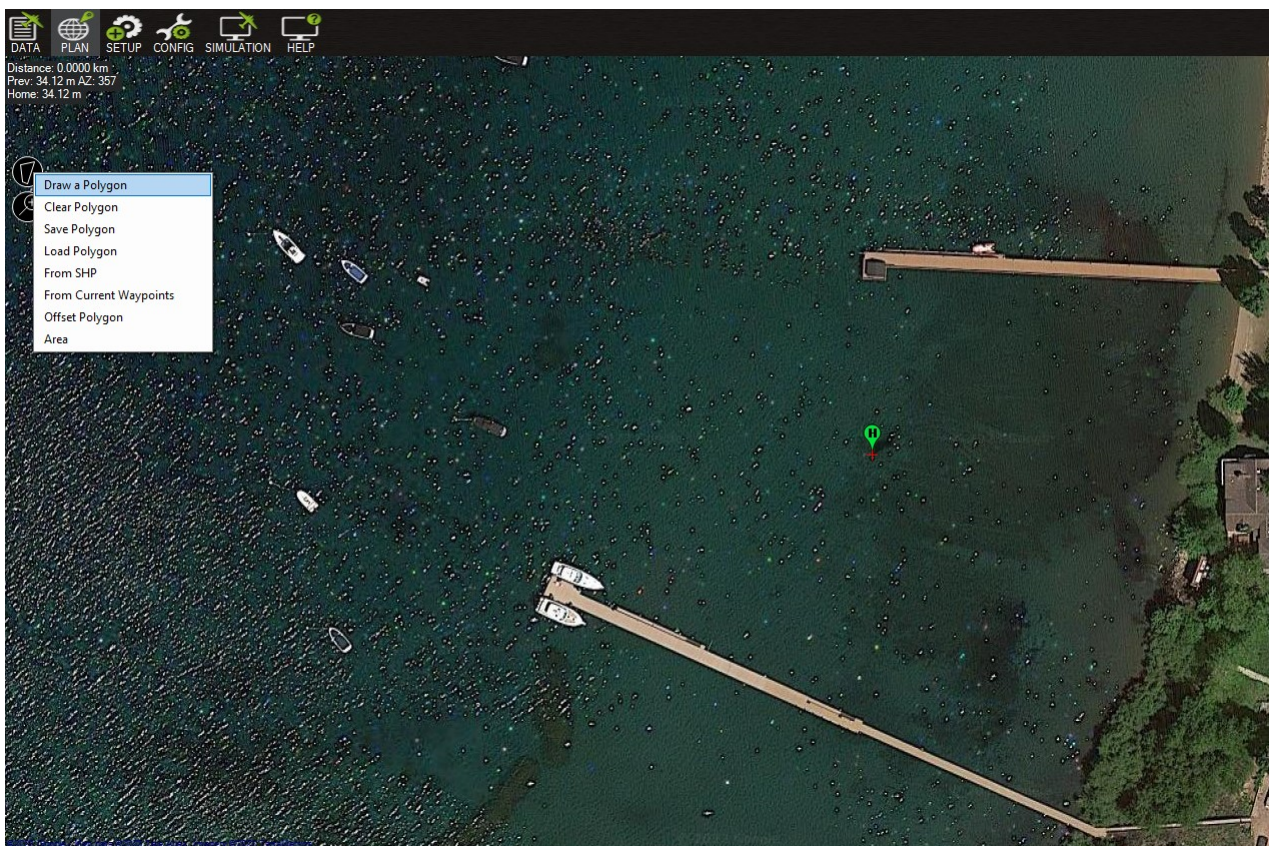


Figure 33: Polygon Select

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 EchoBoat™ 240 to desired location and drop polygon points at each extent.
7. Right click survey area. Highlight 'Auto WP' and select 'SimpleGrid'.

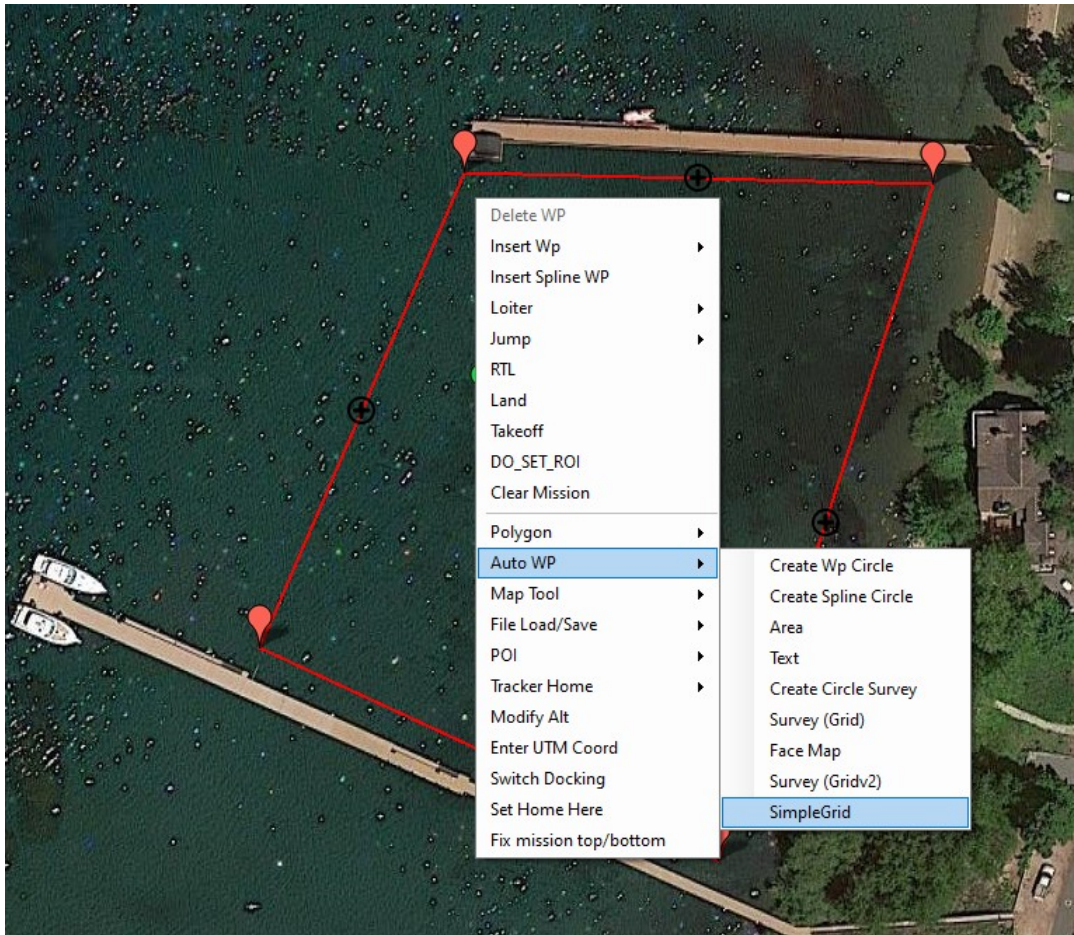


Figure 34: SimpleGrid Select

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 9: SimpleGrid Settings

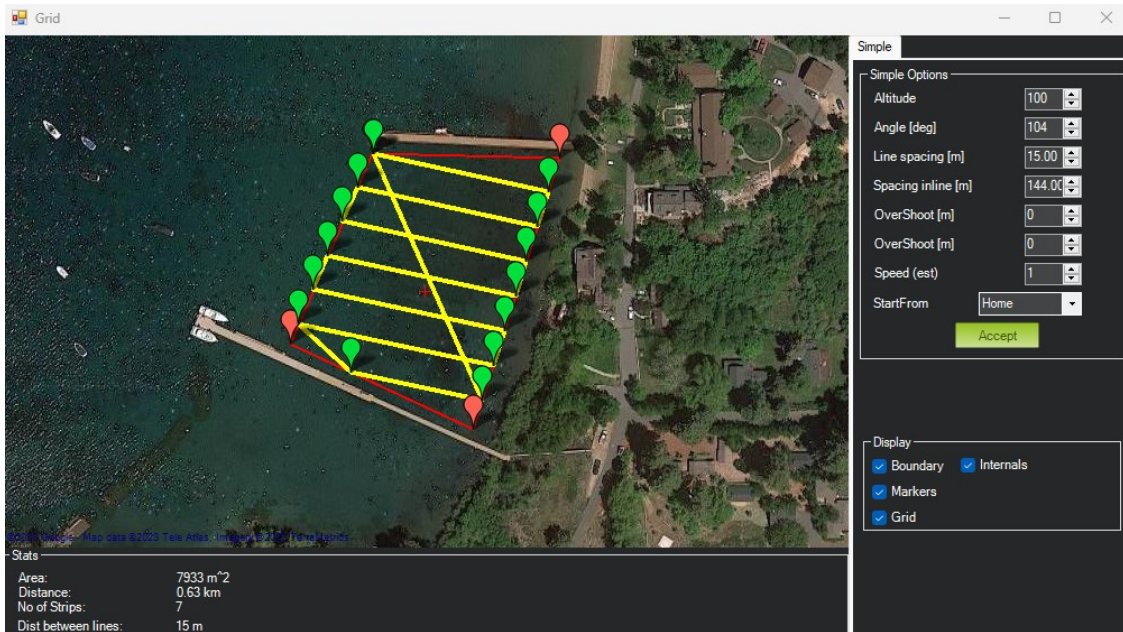


Figure 35: SimpleGrid Settings

8. Delete the first command, speed change.

	Command	Delay				Lat	Long	Alt	Frame	Delete			Grad %	Angle	Dist	AZ
1	DO_CHANGE_SPEED	1	1	0	0	0	0	0	Relative	X			0	0	0	0
2	WAYPOINT	0	0	0	0	39.0882645	-119.9410	100	Relative	X			259.8	168.9	107.2	356

Figure 36: Delete DO_CHANGE_SPEED

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

9. Click 'Write' on the right panel.



Figure 37: Write Mission

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

3.10.2 Hypack

Information

Seafloor System's AutoNav™ requires three NMEA input GPS strings. GPS/GNSS system not provided by Seafloor, will need to be configured to output the required NMEA strings.

- GGA, RMC, HDT at 5Hz with a GP Talker ID(Prefix) at 57600 baud rate. RS232 Protocol with DB9 connector. USB to DB9 adapter do 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
 - \$GPHDT,139.23,T*25

Caution

Important: The AutoNav™ navigates using GPS waypoints, users should toggle to Manual mode to avoid objects and always maintain line of sight.

AutoNav™ 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 3.4)
- 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.

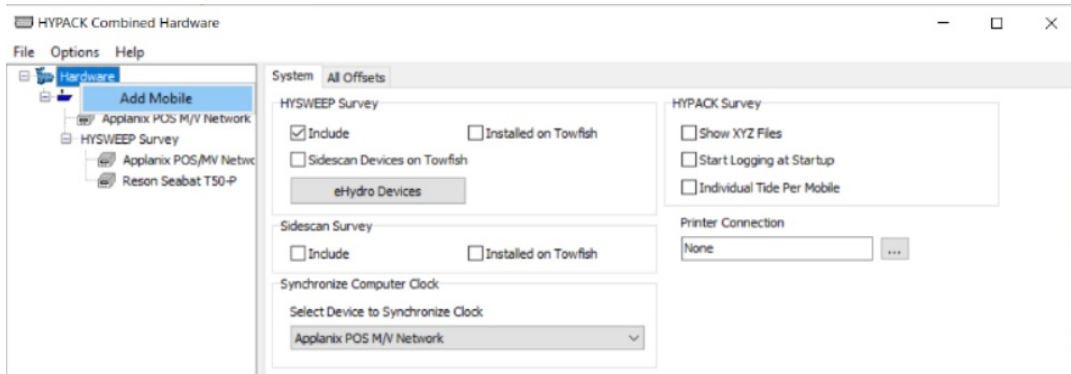


Figure 38: Add Mobile

4. Under the new Mobile, add Mavlink driver.

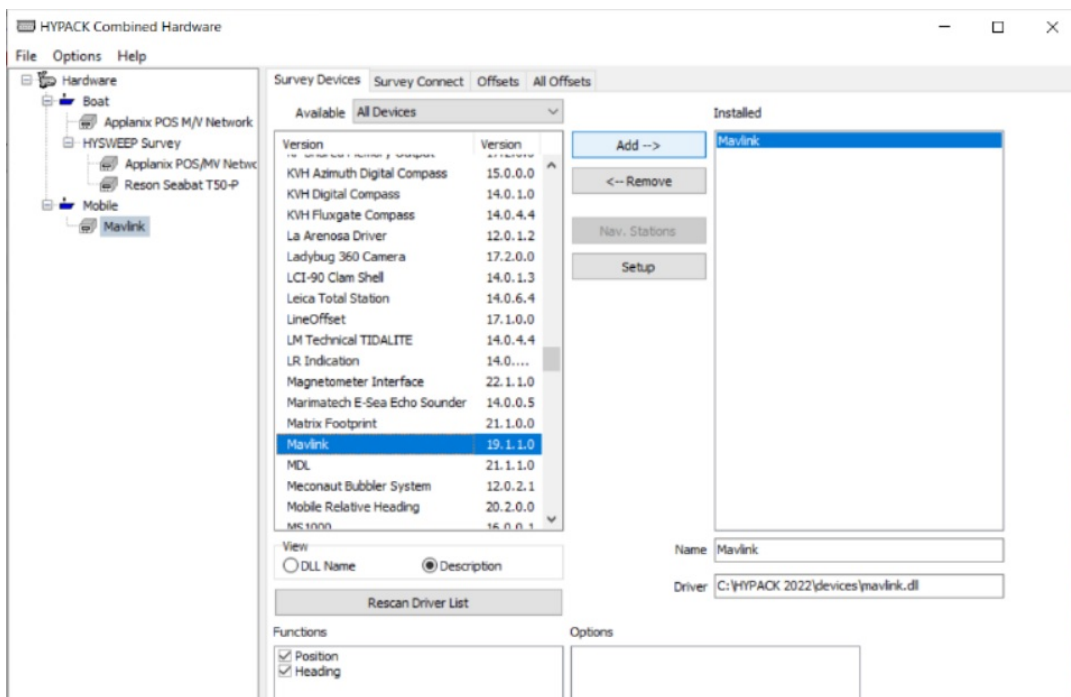


Figure 39: Add Mavlink Driver

5. Device Connection is Serial.

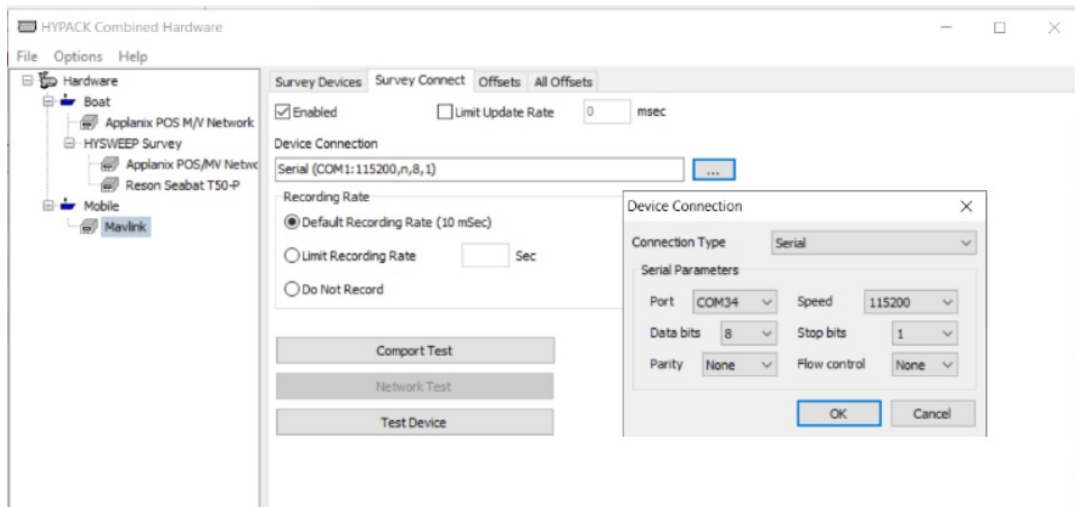


Figure 40: Set COM Port

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.

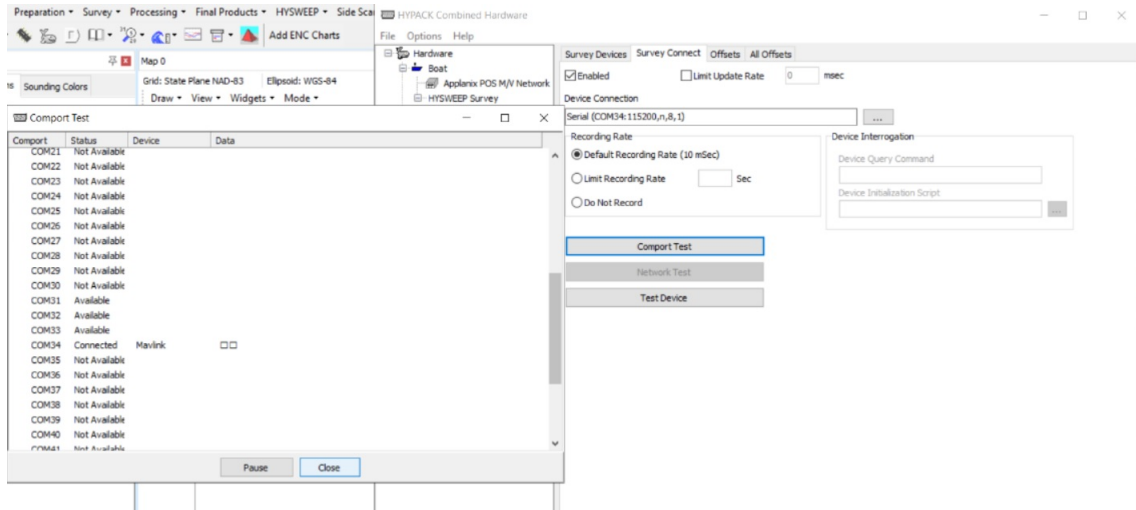


Figure 41: COM Test

Line Planning:

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

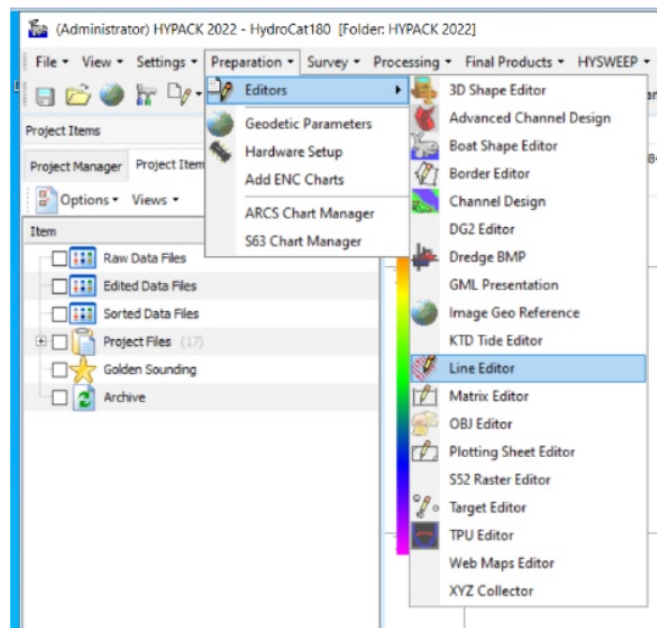


Figure 42: Line Editor

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

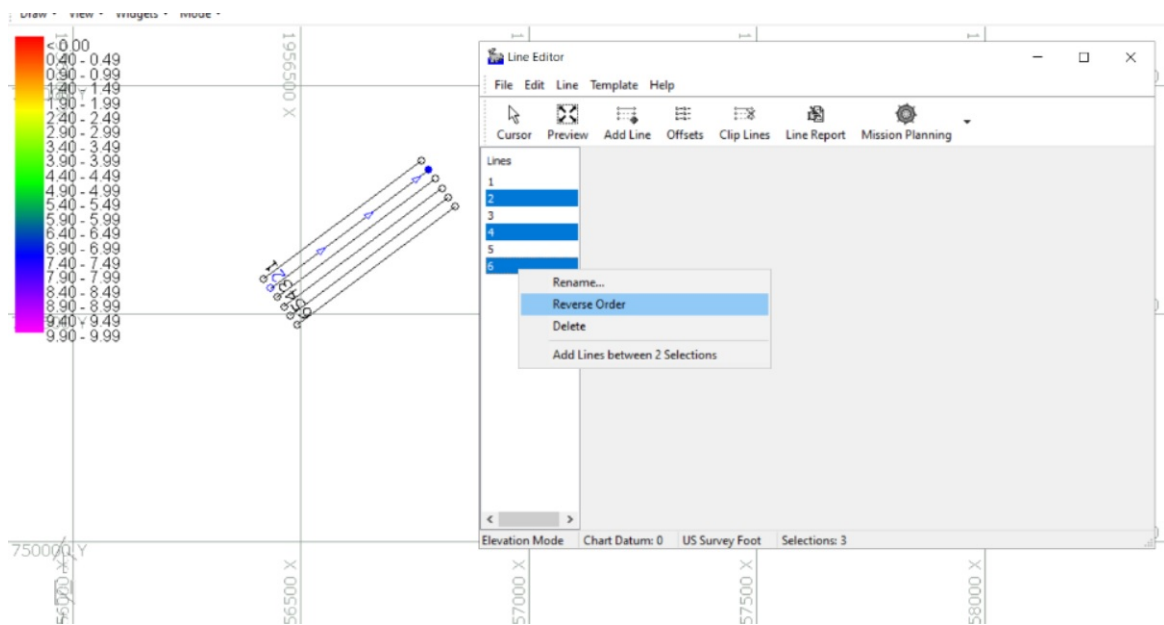


Figure 43: Reverse Every Other Line

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

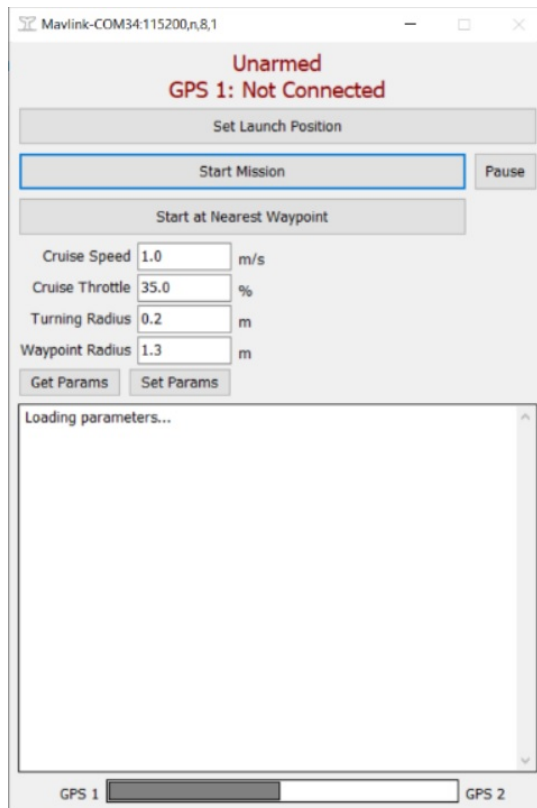


Figure 44: Mavlink Driver Control

- 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 EchoBoat™ 240 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.

3.11 SmartCast Operation

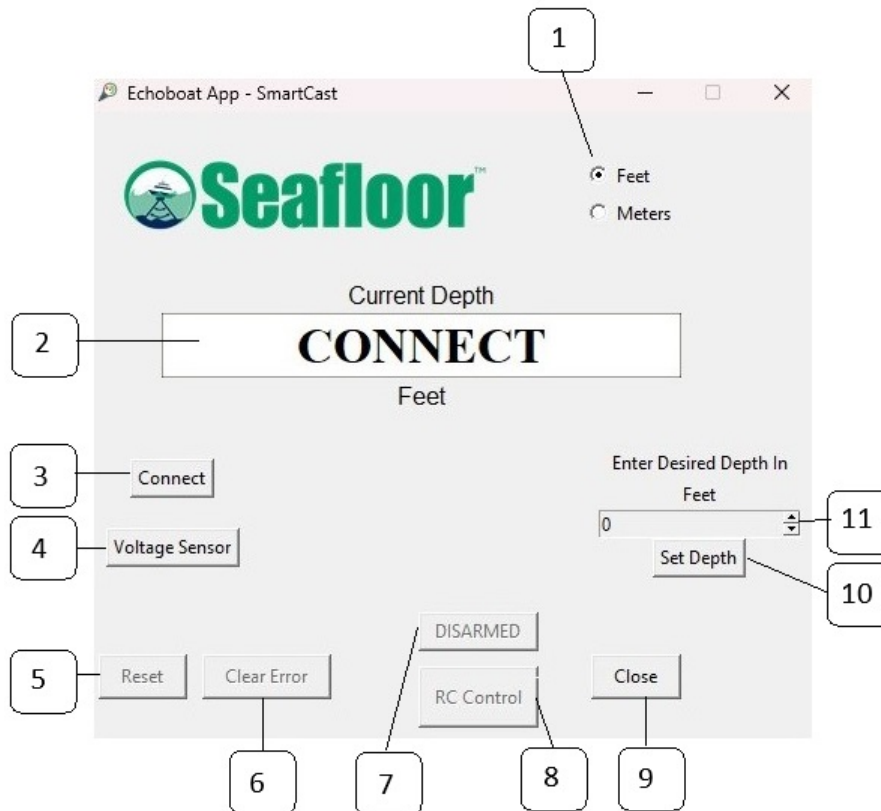


Figure 45: SmartCast GUI Layout

Button Labels:

1. Units: Select the units the system will use; feet or meters.
2. Screen: Displays the current position/depth of the sensor(SVP).
3. Connect: Connect SmartCast software to the SmartCast hardware.
4. Voltage Sensor: Displays the EchoBoat™ 240 voltage.
5. Reset: Used when the system is armed to bring the sensor home and reset the current position to zero.
6. Clear Error: Used to clear the continuous error caused by the sensor getting stuck on an object underwater.
7. DISARMED: Used to arm/disarm the SmartCast for casting.
8. RC Control/Cast: Displays 'RC Control' when the system is not armed and is used to send a cast when the system is armed.
9. Close: Close App
10. Set Depth: Used to confirm the value set in Desired Depth (11).
11. Desired Depth: Use the arrows to change the depth of the cast.

Information

The SmartCast has 100ft (30m) of rope. Is it recommended to drop the sensor a maximum of 90% of the depth. As to not get the sensor stuck on the ground.

Caution

Must have an SVP attached prior to manual or automated operation.

Manual SVP Cast Operation:

1. Power on the RCU.
2. Power on the EchoBoat™ 240.
3. Open the Seafloor App, located on the desktop.
4. Connect to the Seafloor App.
5. Using the S2 knob (Refer to 3.4), drop the sensor to the desired depth.
6. The current depth can be viewed on the Seafloor SmartCast App.
7. Use the S2 knob to retrieve the sensor back up.
8. Once home, center the S2 knob.

Automated SVP Cast Operation:

1. Open App.
2. Connect to the Seafloor SmartCast App.
3. Select Feet or Meter.
4. Enter Desired Depth.
5. Select Set Depth to confirm.
6. Select Disarmed to change state to ARMED. The SmartCast will calibrate zero position of sensor by retracting the SVP into the home position.
7. Select Cast to cast the sensor.
 - Once the cast has begun the system will reset the 'Current Depth' to zero. It will then descend to the 'Desired Depth', pause for two seconds, and then come back up and reset 'Current Depth' a third time. After completion it will disarm itself.

Caution

Important There is a 5 second safety cutoff when the sensor hits the home position. You will not have manual or auto control until the 5 second timer runs out. If you continue to pull the sensor home, the safety cutoff will continue to reset. Constant cycle of the safety cutoff *CAN* damage the SmartCast motor. Always move the S2 knob to center when done.

Information

Important Tips:

1. RCU control is only possible with PC powered on.
2. Do not run the SmartCast while the boat is moving quickly, in heavy current or large waves.
3. Do not get line wrapped in propellers.
4. If the same depth is desired for multiple casts, it is not required to click 'set depth' each time. The previous depth will be used.
5. It is recommended to unspool and respool the line before every mission to ensure the line does not become tangled. Tangled lines can result in the direction of motion to be reversed or large amounts of line being released at once. Both of which can stop the SmartCast from functioning properly.

3.12 EchoBoat™ 240 Power Off Procedure

1. Power off sonar power output via sonar GUI.
2. Upon retrieval of the EchoBoat™ 240, disarm using the RCU SA and SH switch. (Refer to page 3.4)
3. Shut down the onboard computer via Windows taskbar.
4. Power off EchoBoat™ 240 by holding down the Main Power Button(19) for 5 seconds until the red LED ring illuminates.
5. Power off RCU by holding Power button until the 4 dots count down. Release at one dot. (Refer to page 3.4)

3.13 Fail Safe

Important Alert

If there's a failure, the EchoBoat™ 240 is equipped with built-in 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.

3.14 Collision Avoidance Assist (CAA) Operation - Optional Add On

CAA operation instructions for EchoBoat™ 240. **Optional Add On**

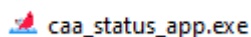
Information

CAA requires active LiDAR and GPS to operate.

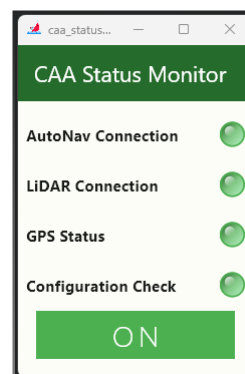
Important Alert

CAA is not operational while the EchoBoat™ 240 is in manual operation mode.

1. CAA is activated when the CAA power switch is enabled on the EchoBoat™ 240.
2. **Monitoring Status:** A CAA status monitor application can be found in EchoBoat/Documents/CAA/Status.



(a) CAA Status Monitor App



(b) CAA Status All Good

Figure 46: Monitoring CAA Status

- (a) Launch `caa_status_app.exe` to view current status of CAA.
- (b) If CAA is active all status lights will be green.

3. **Real-time View:** Once active, CAA obstacles can be viewed within Mission Planner.

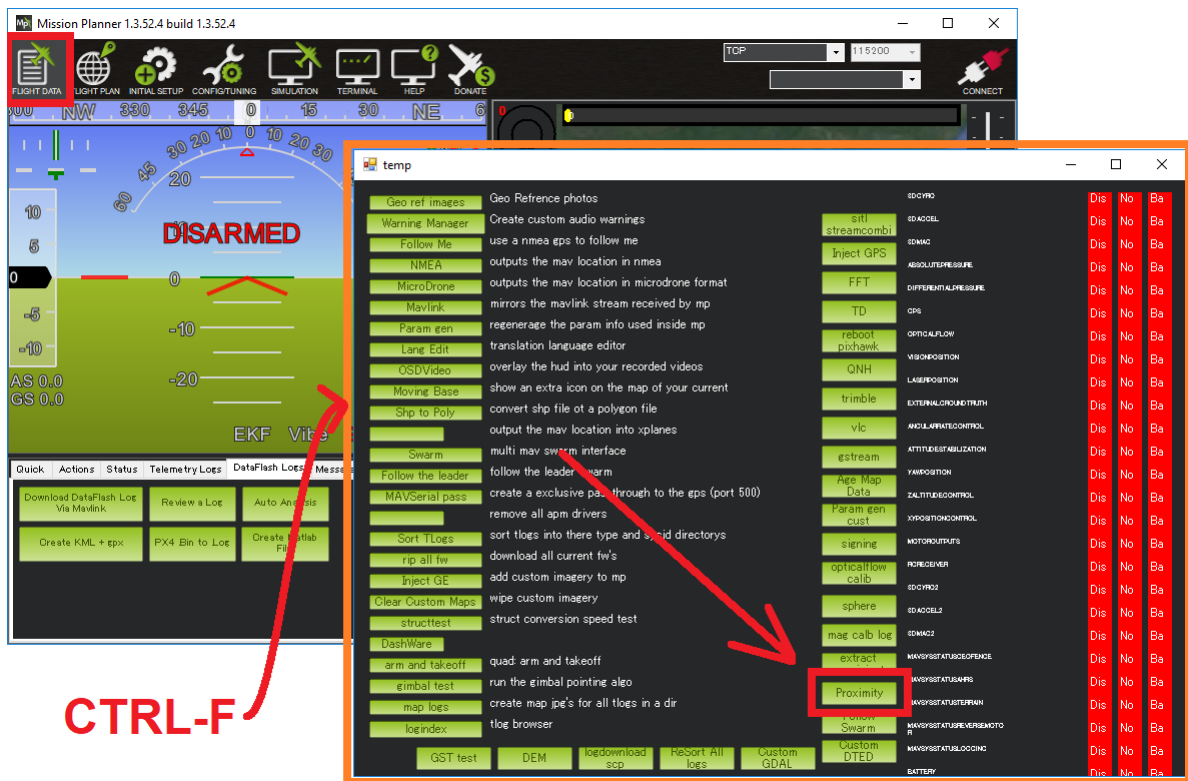
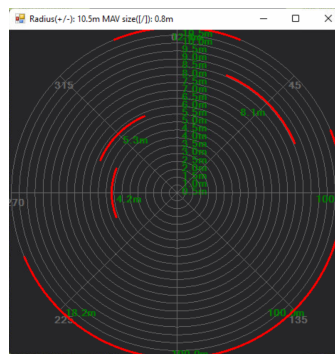


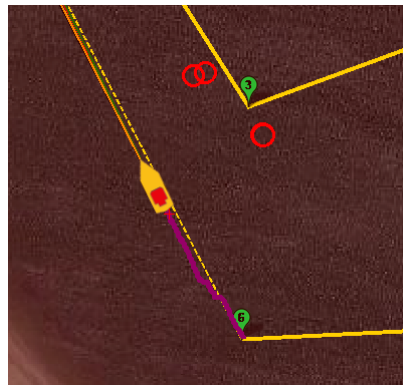
Figure 47: Launching Proximity View

- (a) Select Mission Planner's Data screen.
- (b) Press Ctrl-F.
- (c) Select the Proximity button.

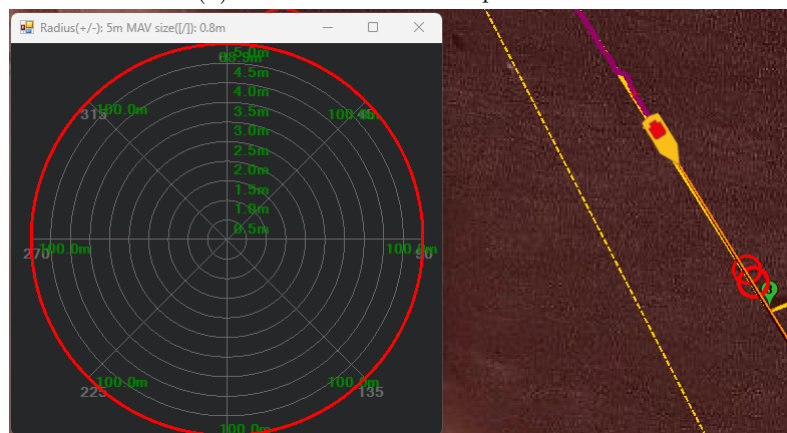
4. **Interpreting Data:** The proximity data is divided into 8 sectors around the EchoBoat™ 240.



(a) CAA Obstacles As Proximity Zones



(b) CAA Obstacles As Map Indicators



(c) CAA Obstacles With Proximity

Figure 48: Different Options To Monitoring Obstacles In Mission Planner

5. **Operation:** Once the EchoBoat™ 240 is placed in autonomous mode (Refer to 1.4). CAA will use the obstacles detected to navigate around them.

4 Frequently Asked Questions (FAQ)

- The thruster does not spin in reverse.
 - The ESC is not programmed to “Forward and Reverse” running mode. Refer to 6.5 for ESC Programming.
- EchoBoat™ 240 is powered, but the thruster motor does not respond. Alert tone of beep-, beep- (1 second interval) is heard.
 - There is no signal from the AutoNav™. Verify that the RCU is powered, the RCU and Receiver are paired, and AutoNav™ is armed.
- Water is leaking from the hatch.
 - Verify the condition of the hatch seal. Lubricate or replace as necessary.
- The prop is spinning without engaging the Throttle.
 - Verify that the Throttle Trim is centered. Calibrate if necessary, refer to 6.4.
- EchoBoat™ 240 is still powered when the main switch is in the off position.
 - Contact Seafloor Systems.
- EchoBoat™ 240 has a limited turning radius or only turns in one direction.
 - Verify that the props are clean of debris. Calibrate, refer to 6.4.
- EchoBoat™ 240 is not going into Auto mode.
 - No GPS or Compass Variance. Verify your GPS is outputting GGA, RMC, HDT at 5Hz with a talker ID(Prefix) of GP at a 57600 Baud rate. Use the supplied Null Modem if you are confident your GPS is outputting correctly.
- Thruster no longer has power after getting debris caught in it.
 - Replace the 40A MIDI fuse. Refer to 5.3

5 Troubleshooting

5.1 Propeller Orientation And Rotation

If the propellers on a EchoBoat™ 240 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 49: Prop Rotation

- Port Thruster
 - Motor must rotate clockwise
 - * If rotating the wrong direction, power down EchoBoat™ 240 and swap two of the three motor wires from the ESC to Thruster. (Refer to figure 86)
 - Prop is CW



Figure 50: CW Prop

- Starboard Thruster
 - Motor must rotate counter-clockwise
 - * If rotating the wrong direction, power down EchoBoat™ 240 and swap two of the three motor wires from the ESC to Thruster. (Refer to figure 86)
 - Prop is CCW



Figure 51: CCW 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 6.6)
- **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 dual antenna GNSS/INS system**
 - Incorrect NMEA GPS strings or primary antenna location is incorrect.

5.3 Fuse Panel

5.3.1 Generation 2

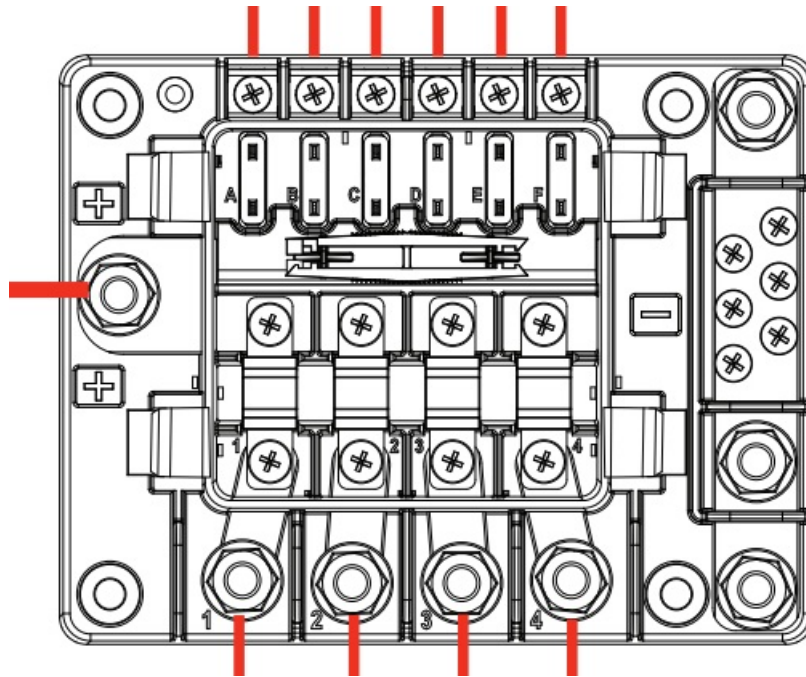


Figure 52: Generation 2 - Distribution Fuse Panel

Lettered fuses are AT0/ATC.

- A. 1A - AutoNav
- B. 20A - SmartCast
- C. 40A - Inverter
- D. 5A - PC
- E. Unused
- F. Unused

Numbered fuses are MIDI.

- 1. 40A - Starboard ESC
- 2. 40A - Port ESC
- 3. 30A - Aux 1
- 4. 30A - Aux 2

5.3.2 Generation 1

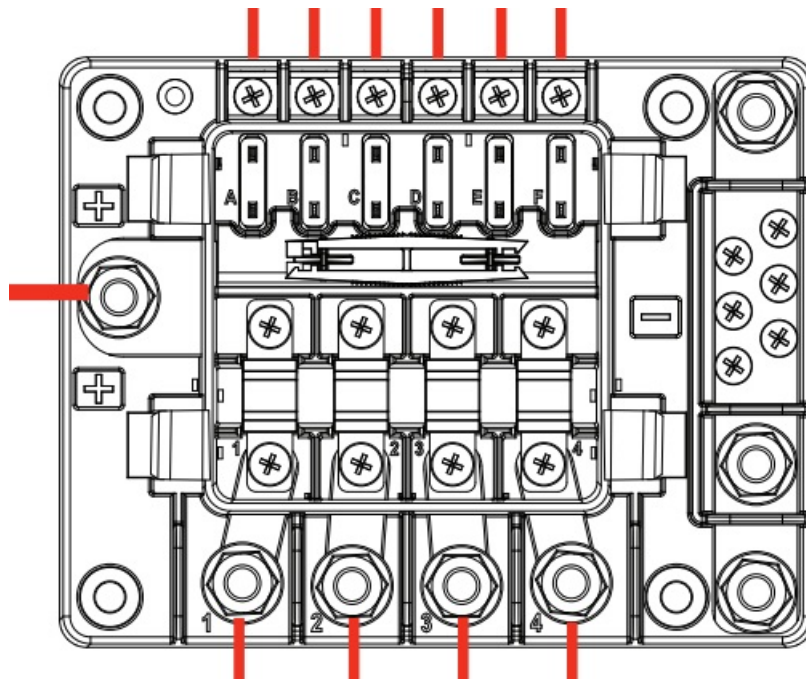


Figure 53: Generation 1 - Distribution Fuse Panel

Lettered fuses are AT0/ATC.

- A. 1A - AutoNav
- B. 20A - SmartCast
- C. 40A - Inverter
- D. 5A - PC
- E. 40A - PowerCube
- F. 5A - Water Pump

Numbered fuses are MIDI.

- 1. 40A - Starboard ESC
- 2. 40A - Port ESC
- 3. 30A - Aux 1
- 4. 30A - Aux 2

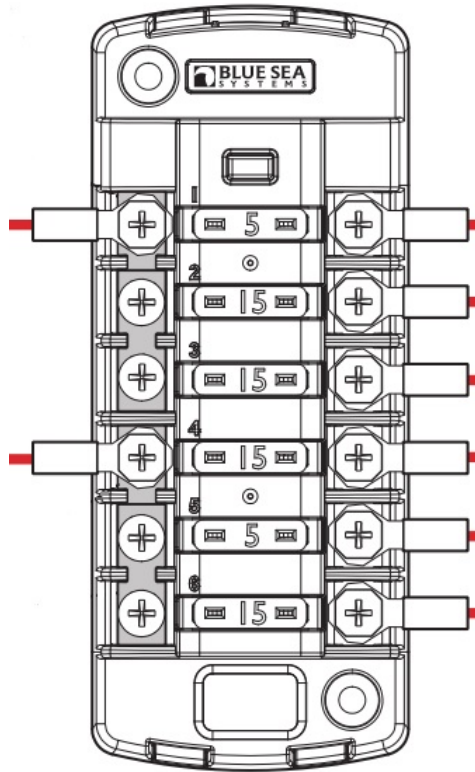


Figure 54: Servo Fuse Panel

Fuses are AT0/ATC.

1. 5A - Starboard Servo
2. 5A - Port Servo
3. unused
4. unused
5. unused
6. unused

5.4 EchoBoat™ 240 Batteries

Important Information

In case of a battery error, LED ring(20) on the main power button will blink. Switch off the batteries by holding the main power button for 5 seconds.

In case a short-circuit or an overload has occurred:

1. Remove the charger. Verify error has cleared by powering on the EchoBoat™ 240, if not move onto next steps.
2. Power down.
3. Remove ALL fuses and power on the EchoBoat™ 240. If cleared, one by one install a fuse per power up until error is shown.
4. If error is still present, contact Seafloor Systems.

In case an over-/undertemperature has occurred:

1. Wait until the battery has returned to its operating temperature -4°F to 140°F (-20°C to +60°C).
2. Power on the EchoBoat™ 240.
3. If error is still shown, contact Seafloor Systems.

5.5 SmartCast

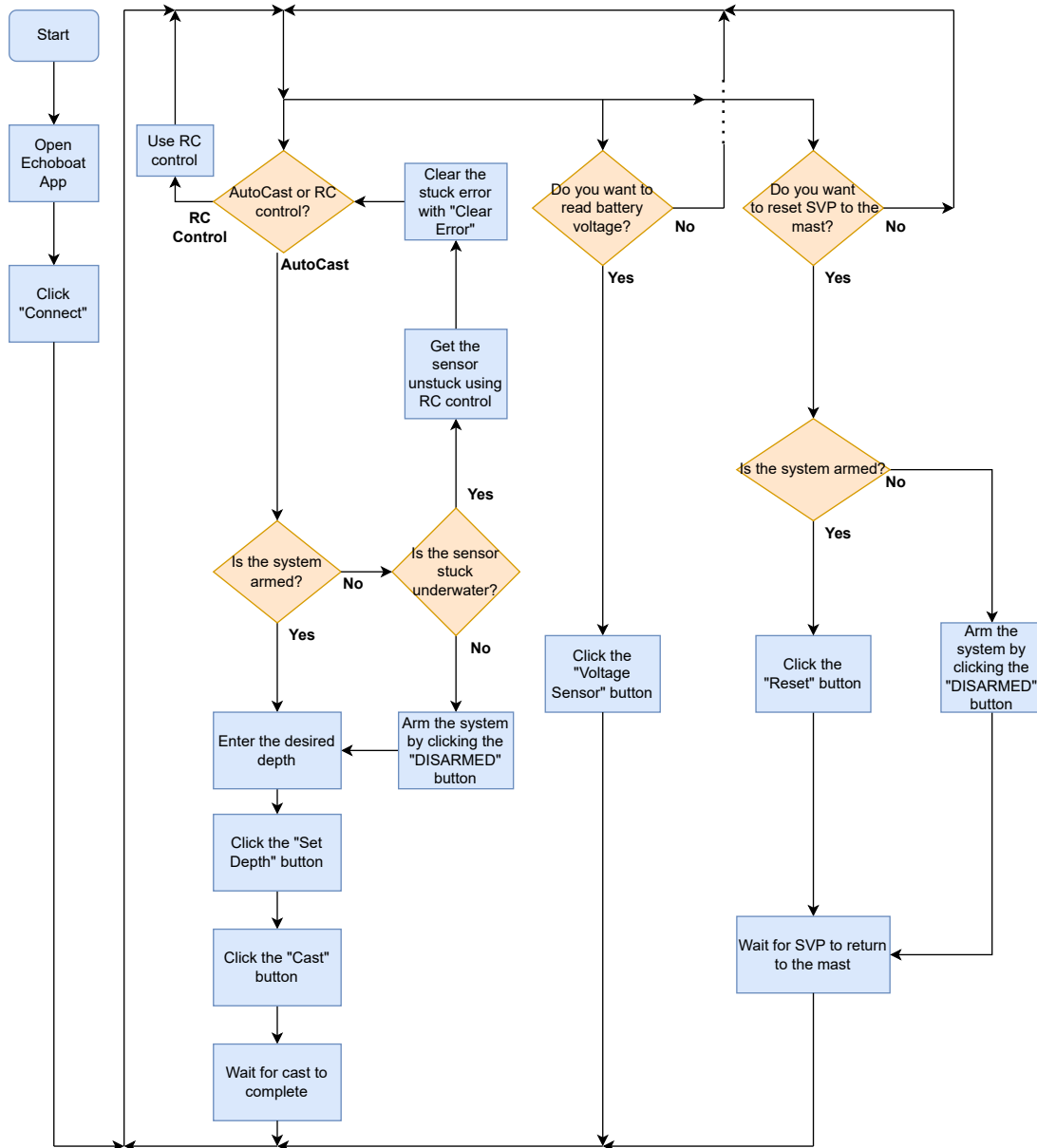


Figure 55: SmartCast Flow Diagram

5.6 Collision Avoidance Assist (CAA)

To verify the CAA is scanning objects correctly:

1. **Launching Foxglove Studio:** This can be done by searching for it in your Windows Taskbar application launcher.

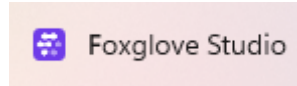


Figure 56: FoxGlove Studio

2. In Foxglove Studio, in the **Open data source** section, select **Open connection** Connect to a live robot or server.

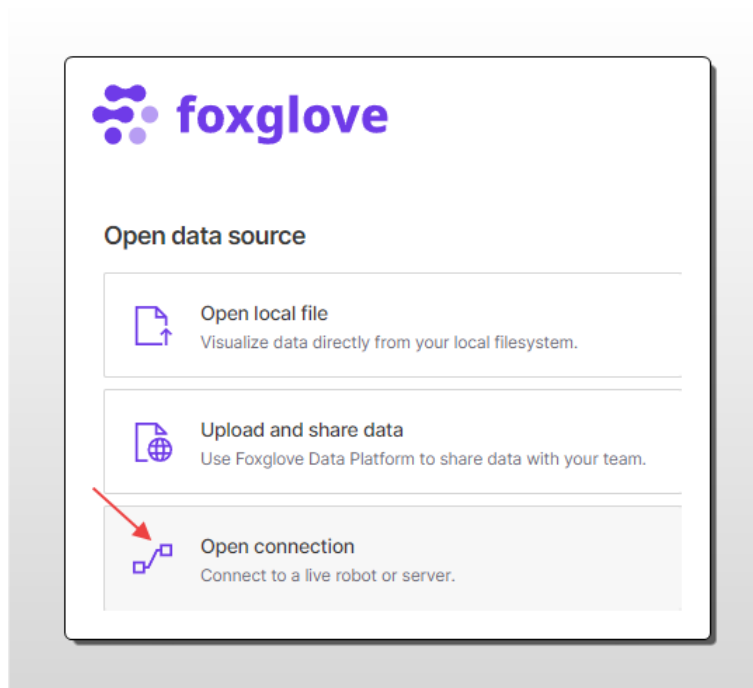


Figure 57: FoxGlove Open Connection

3. Select **Rosbridge**
4. Enter the **WebSocket URL** for the EchoBoat™ 240, which is `ws://192.168.1.200:9090`.
5. Click **Open** to establish your connection to CAA

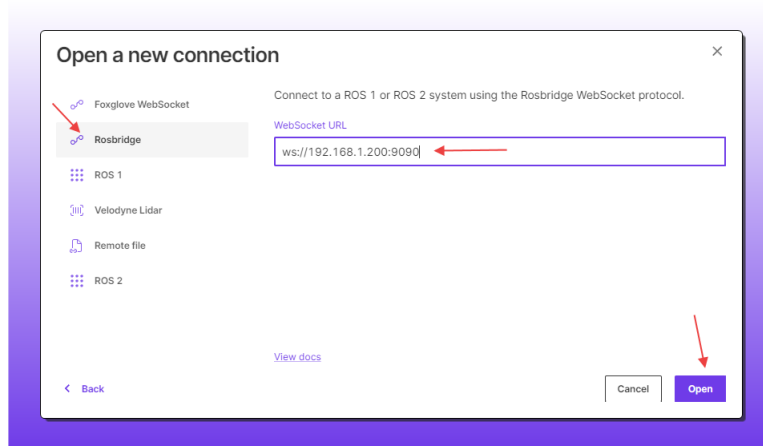


Figure 58: Connecting To CAA

6. The default panel configuration or the last used panel configuration will be shown with active LiDAR data.
7. **Resetting FoxGlove Studio Panel Configuration:** To set standard panel configuration or if panel settings were changed please import the configuration file to fix:
 - (a) Click the selection menu at the top left of the Foxglove Studio Application.
 - (b) Select **View**.
 - (c) Select **Import layout from file...**
 - (d) The standard panel configuration template will be stored in EchoBoat/Documents/CAA.
 - i. LidarOnlyCAA5-Foxglove-Studio-Panels.json for LiDAR only CAA.
 - ii. FullCAA5-Foxglove-Studio-Panels.json for Full CAA with LiDAR and Computer Vision.

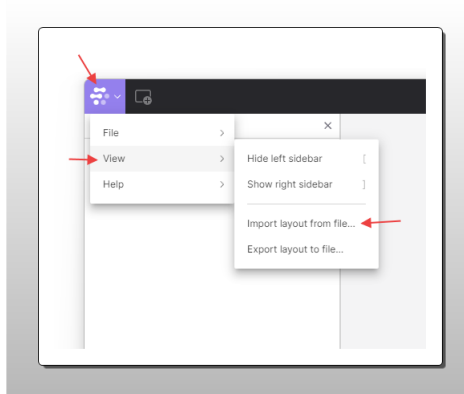


Figure 59: Importing A Default Panel Layout For Foxglove Studio

8. **Interpreting Foxglove Studio:** Once the EchoBoat™ 240 receives data from the CAA, the live data can be seen in five main panels; NearIR LiDAR, LiDAR Signal Image, 3D View, lidar_obstacles, and Map.

Information

Full CAA with Computer Vision has an additional four panels; Left Camera, Right Camera, camera_obstacles, and detected object types.

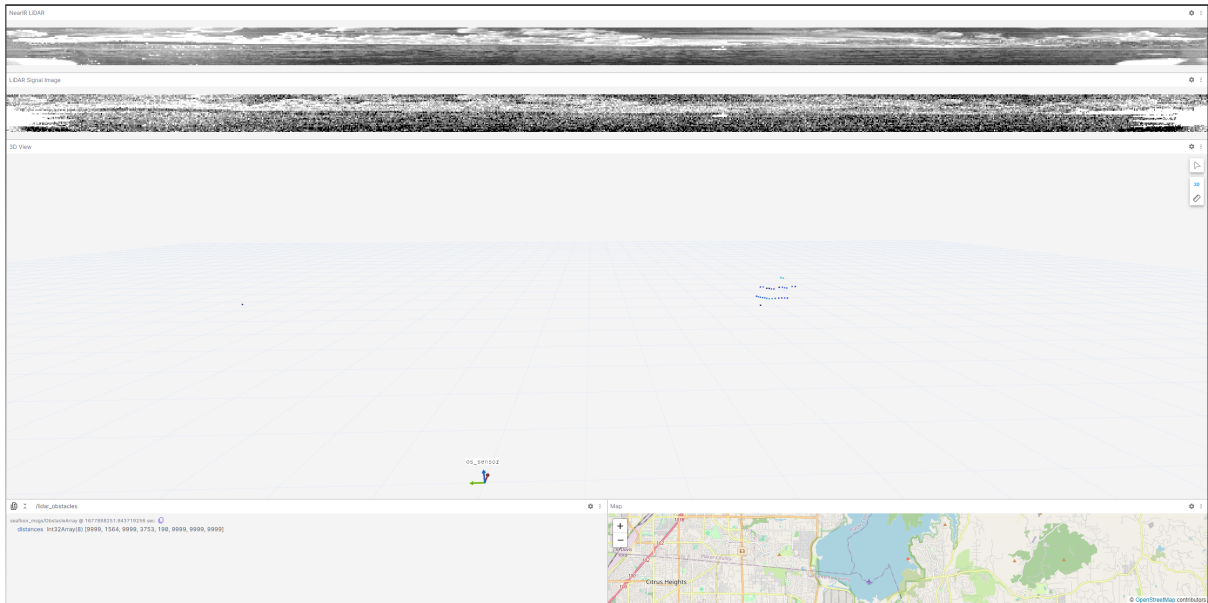


Figure 60: LiDAR Only FoxGlove Panels

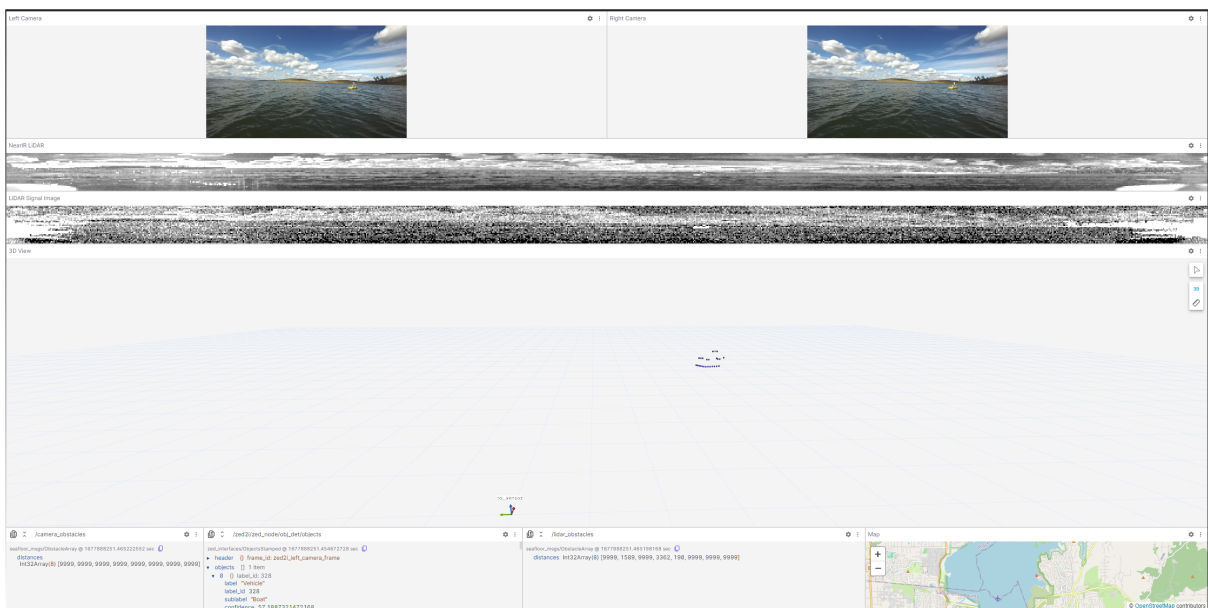


Figure 61: Full CAA FoxGlove Panels

- (a) **3D View Panel:** The red arrows show the forward direction that CAA is viewing. This panel can be used to view the 3D environment in different ways.
 - i. **Change Perspective:** Click and drag the mouse within the 3D panel to alter the view-point or angle from which the 3D scene is observed.
 - ii. **Pan:** Hold down the right mouse button and drag the mouse to move the view horizontally or vertically across the scene.
 - iii. **Zoom:** Scroll the mouse wheel to change the distance between the viewer and the 3D scene, making objects appear larger or smaller.
 - iv. **Rotate:** Hold down the left mouse button and drag the mouse to change the orientation of the 3D scene.
- (a) **Obstacles Detected:** Once CAA detects an obstacle with the LiDAR.
 - i. **Distance, Angle, Degree:** The obstacles distance, angle off the LiDAR, and degree off the EchoBoat™ 240 are calculated and displayed in the 3D View.

- ii. **Proximity Zones:** The proximity zones are populated with the nearest obstacles from around the EchoBoat™ 240.
- iii. **Interpreting lidar_obstacles:**
 - A. The values in lidar_obstacles are in centimeter distances.
 - B. A value of 9999 indicates that there is no obstacle seen by CAA for that zone.
 - C. The lidar_obstacles array is from the first value which is the 45 degree angle directly in front of the EchoBoat™ 240 rotating every 45 degrees clockwise.

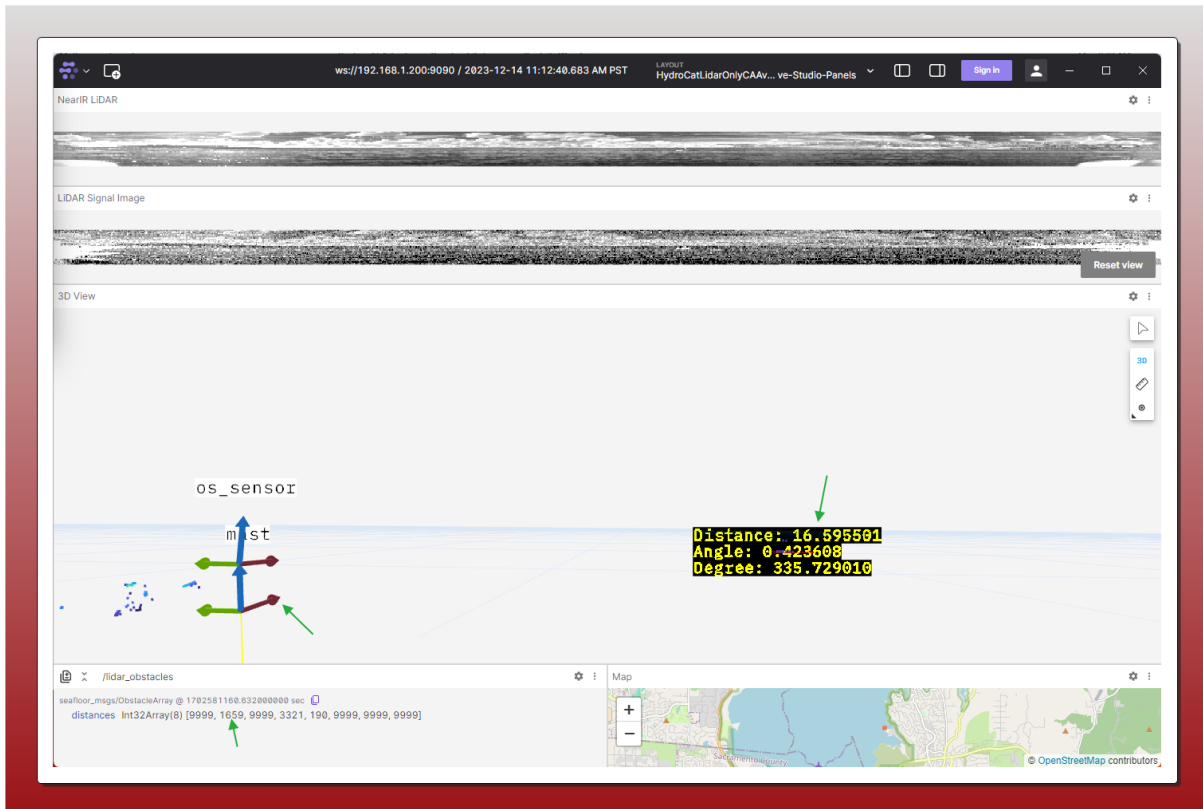


Figure 62: Obstacle Detected

- (b) **Disabling Distance View:** To disable viewing the distance calculations from CAA detected obstacles.
 - i. Click the gear icon in the top right side of the 3D View Panel.
 - ii. Click **Toggle visibility** next to /lidar_clustering/distances
 - iii. An icon for a closed eye will appear and the selection will be greyed out.
 - iv. Click the **X** at the top right of the Panel selection menu to close the 3D panel menu.

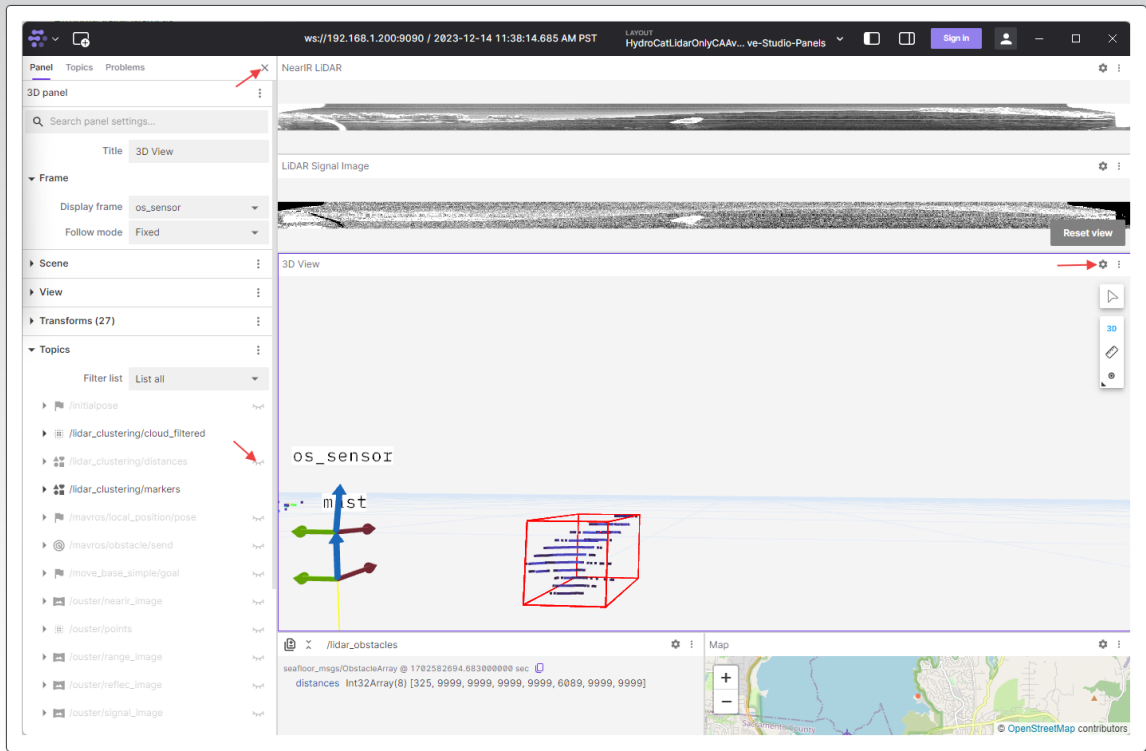


Figure 63: Disabling Distance Viewing

- v. Obstacles will now only be seen with their bounding boxes and not display distances.

Important Alert

CAA is not operational if the EchoBoat™ 240 is not receiving correct LiDAR data.

If LiDAR data is not showing up or the viewing angle is incorrect. Check the cabling and mounting of the LiDAR. Please contact Seafloor Systems to remote assist if a cabling or mounting issue was not found.

6 Configuring Procedures

6.1 RCU Receiver Binding Procedure

Archer R8 Pro Binding:

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

If you are changing RCU and know the REG ID, you can skip the registration process by changing the new RCU REG ID.

1. Refer to 3.4 for button or switch locations on RCU.
2. Power on the RCU, power off the Archer R8 Pro.
3. Quick press 'Menu' on the RCU.

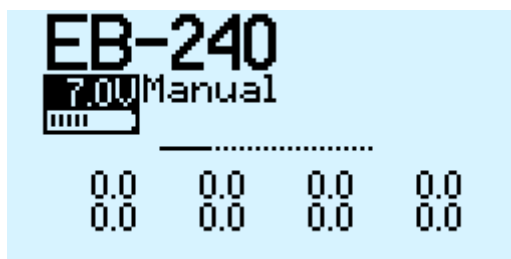


Figure 64: RCU Model Select Screen

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

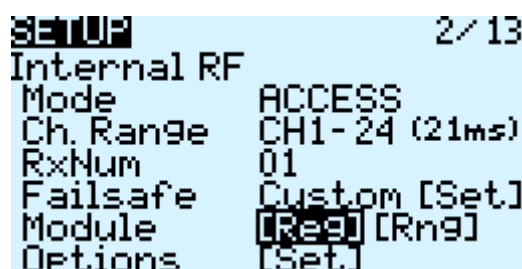


Figure 65: RCU Internal RF

5. Using the ENT knob, scroll down to INTERNAL RF. See figure 65.
 - (a) Archer R8 Pro 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.

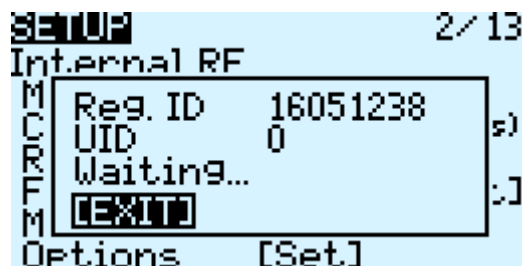


Figure 66: RCU - Waiting To Register

- ii. On the Archer R8 Pro, hold down the receiver button while powering up the Archer R8 Pro. See figure 67.



Figure 67: Archer R8 Pro

- 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.
 7. Power on the Archer R8 Pro.



Figure 68: RCU Binding Screen - SimuRX1/2 Is Only Used For Simulation

8. Press OK once bind is successful.

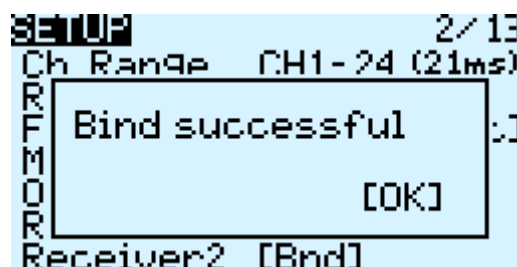


Figure 69: RCU Bind Successful

R9 Stab OTA Binding:

1. Refer to 3.4 for button or switch location on RCU.
2. Long Range Module must be installed for this section.
3. Power on the RCU, power off the R9 Stab OTA.

4. Quick press 'Menu' on the RCU.

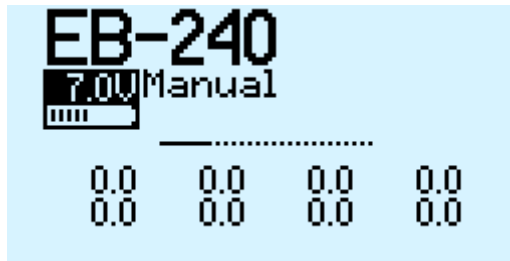


Figure 70: RCU Model Select Screen

5. Quick press 'Page' to switch to SETUP Page 2/12.

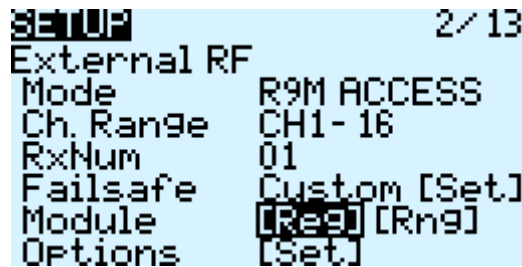


Figure 71: RCU External RF

6. Using the ENT knob, scroll down to EXTERNAL RF. See figure 71.
7. Registration is only required if a RCU or Rx was replaced.

(a) R9 Stab OTA Registration:

- i. Under External 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.

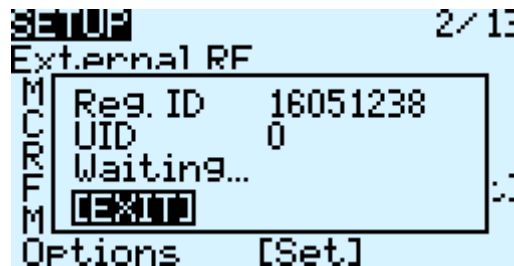


Figure 72: RCU - Waiting To Register

- ii. On the R9 Stab OTA, hold down the receiver button while powering up the R9 Stab OTA. See figure 73.

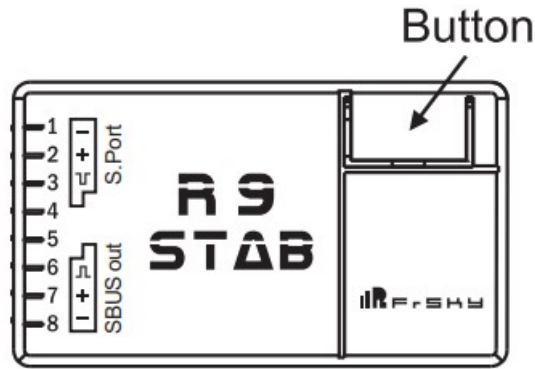


Figure 73: R9 Stab OTA

- 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.
8. Scroll to Receiver 1 and select Bnd.
 9. Power on the R9 Stab OTA.



Figure 74: RCU Binding Screen - SimuRX1/2 Is Only Used For Simulation

10. Press OK once bind is successful.

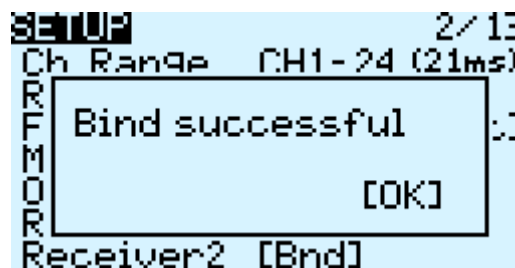


Figure 75: RCU Bind Successful

6.2 RCU Calibration Procedure

Calibrations should only be initiated if the EchoBoat™ 240 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 3.4 to familiarize yourself with the RCU controls.

1. EchoBoat™ 240 must be powered off.
2. Power on the RCU. (Refer to 3.4)

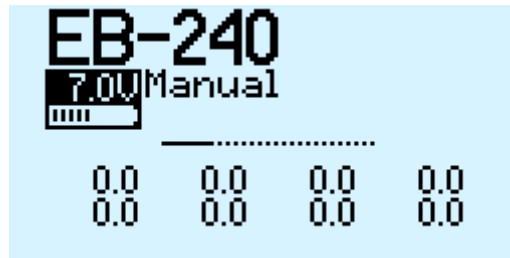


Figure 76: Main Screen

3. Hold down 'Menu' button.

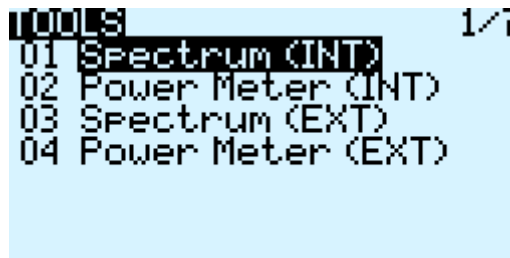


Figure 77: RCU Settings

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

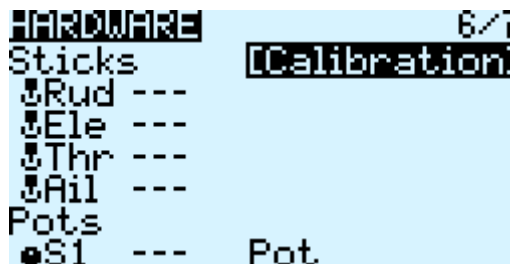


Figure 78: Hardware Page

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



Figure 79: 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.

6.3 AutoNav™ Radio Calibration Procedure

1. Power on the RCU.
2. Power on the AutoNav™. (AutoNav™ can be powered via vessel or USB port.)
3. Connect to the AutoNav™. (USB Telemetry Module is 57600 baud rate. USB Cable is 115200 baud rate.)
4. Vessel MUST be disarmed.
5. Select Setup tab.



Figure 80: Setup Tab

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

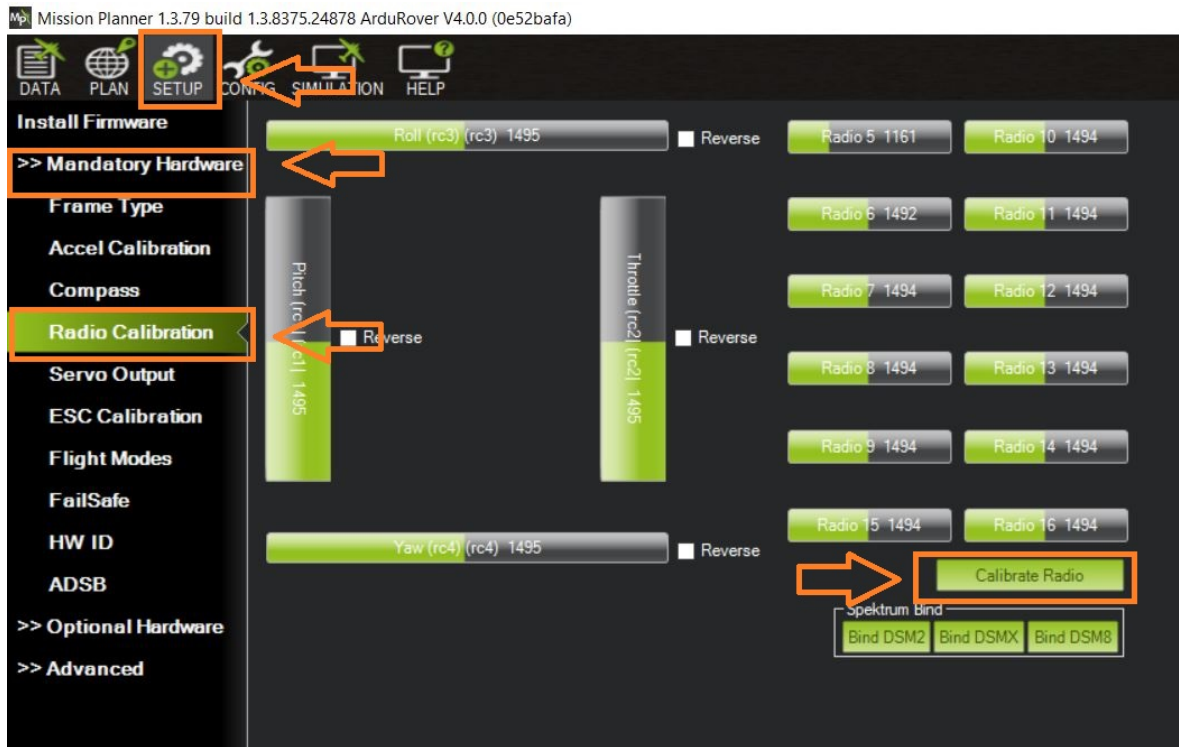
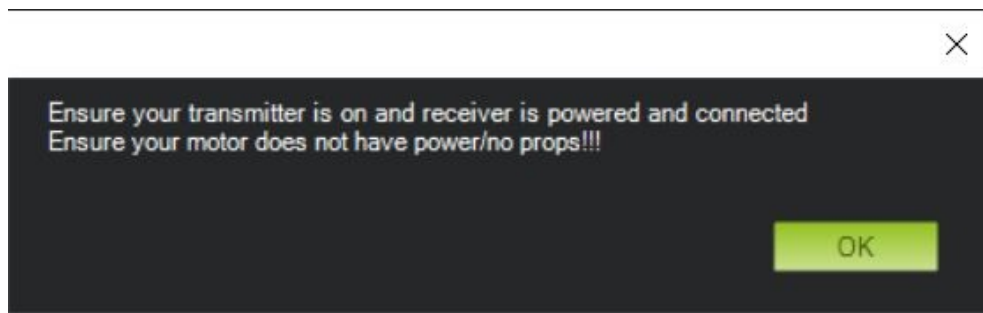
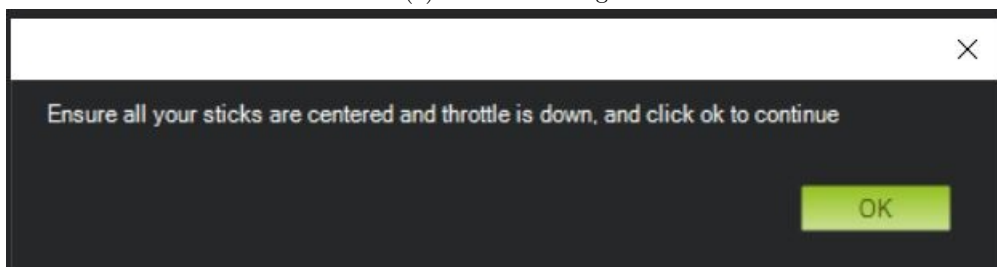


Figure 81: Radio Calibration Steps

8. Select Calibrate Radio.



(a) Power Warning



(b) Radio Cal Instructions

Figure 82: 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.

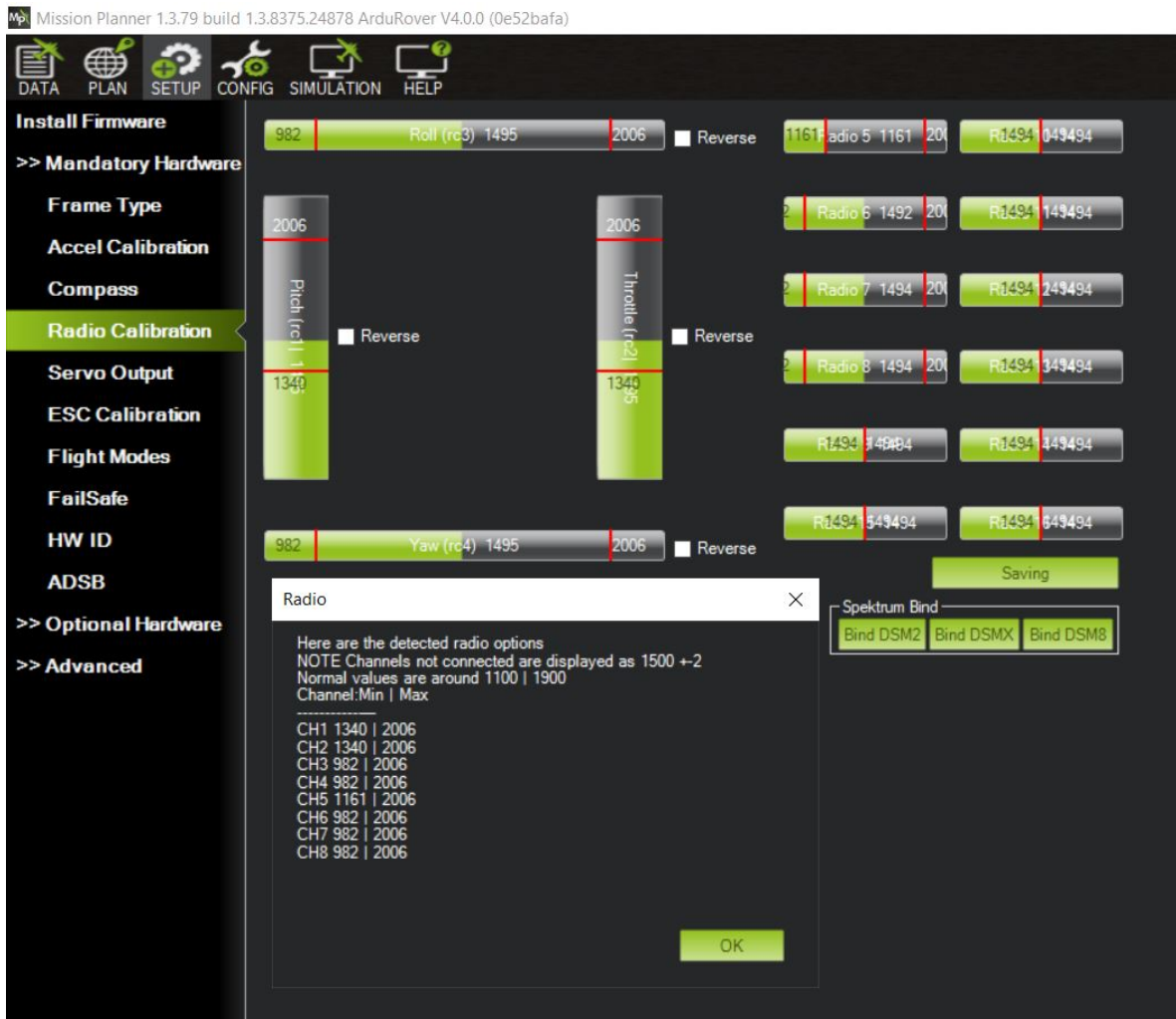


Figure 83: Radio Calibration Verification

12. Select Click when Done.

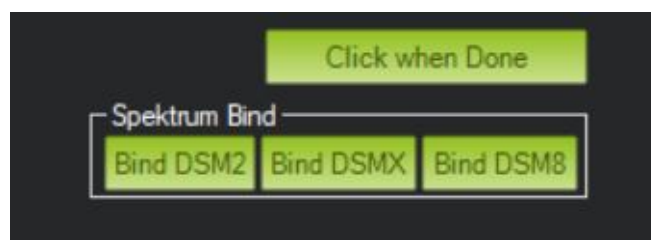


Figure 84: Click When Done

13. A page will popup indicating the new min and max values. Press OK. (Refer to Figure 83)

6.4 ESC Calibration Procedure

6.4.1 Generation 2

1. Calibrate one ESC at a time.
2. Power on the RCU. (Refer to 3.4)
3. Power on the EchoBoat™ 240. (Refe to 3.7)

4. Arm the EchoBoat™ 240. (Refer to 3.4)
5. Open the stern electrical panel to access the ESCs.

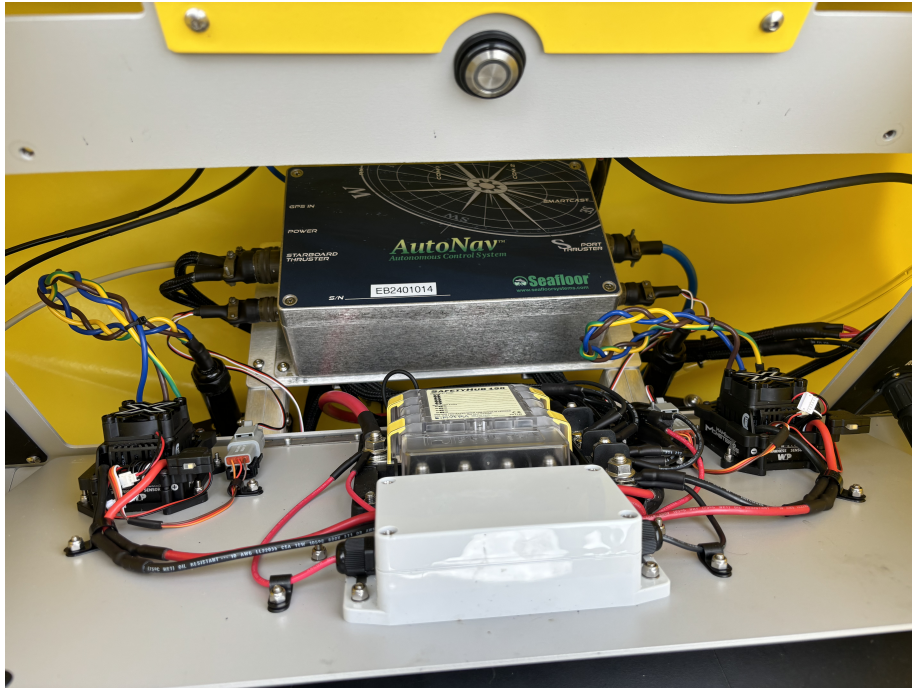


Figure 85: Generation 2 Electrical Panel

6. Must be able to see LED.

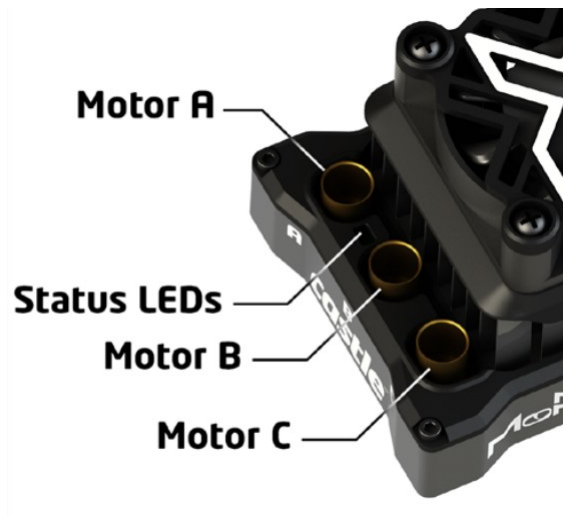


Figure 86: ESC LED Location

7. Power off each ESC via it's power switch.

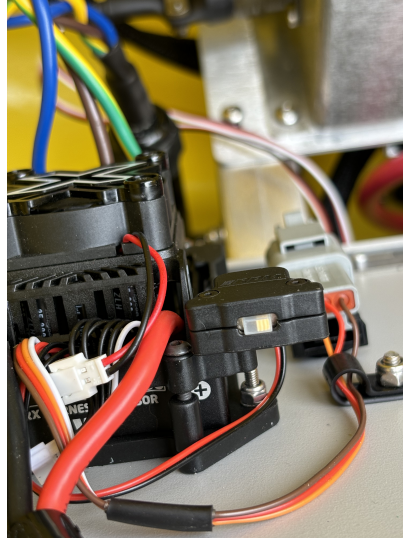


Figure 87: ESC Power Switch

8. Push the Throttle Control for full throttle.
9. Power on **one** ESC via it's power switch. Refer to 87
 - Green LED will flash.
10. When red LED flashes move the Throttle Control to full reverse.
11. When yellow LED flashes, release the Throttle Control to neutral position.
12. Calibration complete.
13. Repeat for the opposite side.

6.4.2 Generation 1

1. Calibrate one ESC at a time.
2. Power on the RCU. (Refer to 3.4)
3. Push the Throttle Control to full throttle on the pontoon you are calibrating.
4. Power on the EchoBoat™ 240.
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 88: Joystick Position

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

6.5 ESC Programming Procedure

6.5.1 Generation 2

Caution

EchoBoat™ 240 must be powered off when programming the ESC. Failure to follow instructions can result in damage to the ESC programmer and ESC.

1. Power off the EchoBoat™ 240.
2. Using your **field laptop**, open Castle Link. (Application is on the supplied USB Drive or Seafloor Systems website)



Figure 89: Castle Link Icon



Figure 90: Castle Link Disconnected

3. Connect the supplied Castle Link Programming cable into the ESC.
4. Connect the supplied Castle Link Programming Cable into your **field laptop**.
5. Castle Link application will auto connect.



Figure 91: Castle Link Connected

6. Select load. Find the programming file on the supplied USB.



Figure 92: Castle Link Load Settings

7. Select okay.



Figure 93: Castle Link Writing Settings

8. Programming complete.

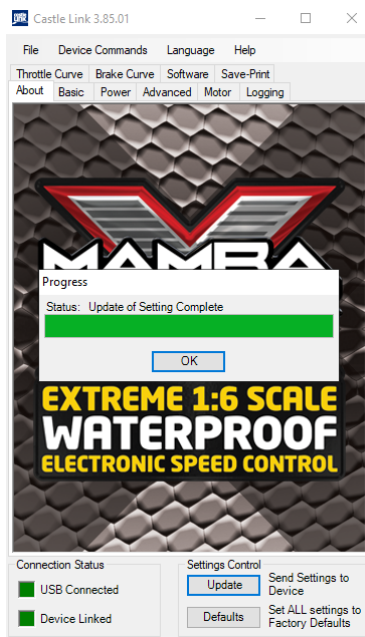


Figure 94: Castle Link Programming Complete

9. Repeat for the opposite side.

6.5.2 Generation 1

ESC Programming

1. Connect the attached ESC ribbon cable into the programming slot on the programming card.



Figure 95: ESC Programming Card Ports

2. Power on the EchoBoat™ 240. The Programming Card will power on.
3. Using the chart below, match the Items with the 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

6.6 AutoNav™ Accel Calibration

1. Remove AutoNav™ from EchoBoat™ 240. Disconnect all cables.
2. Connect the 3ft (1M) USB A to A cable into communication port of the AutoNav™.
3. Connect the opposite end into the onboard PC.
4. Open Mission Planner.
5. Connect to the AutoNav™ with 115200 baud rate.
6. Select Setup tab.

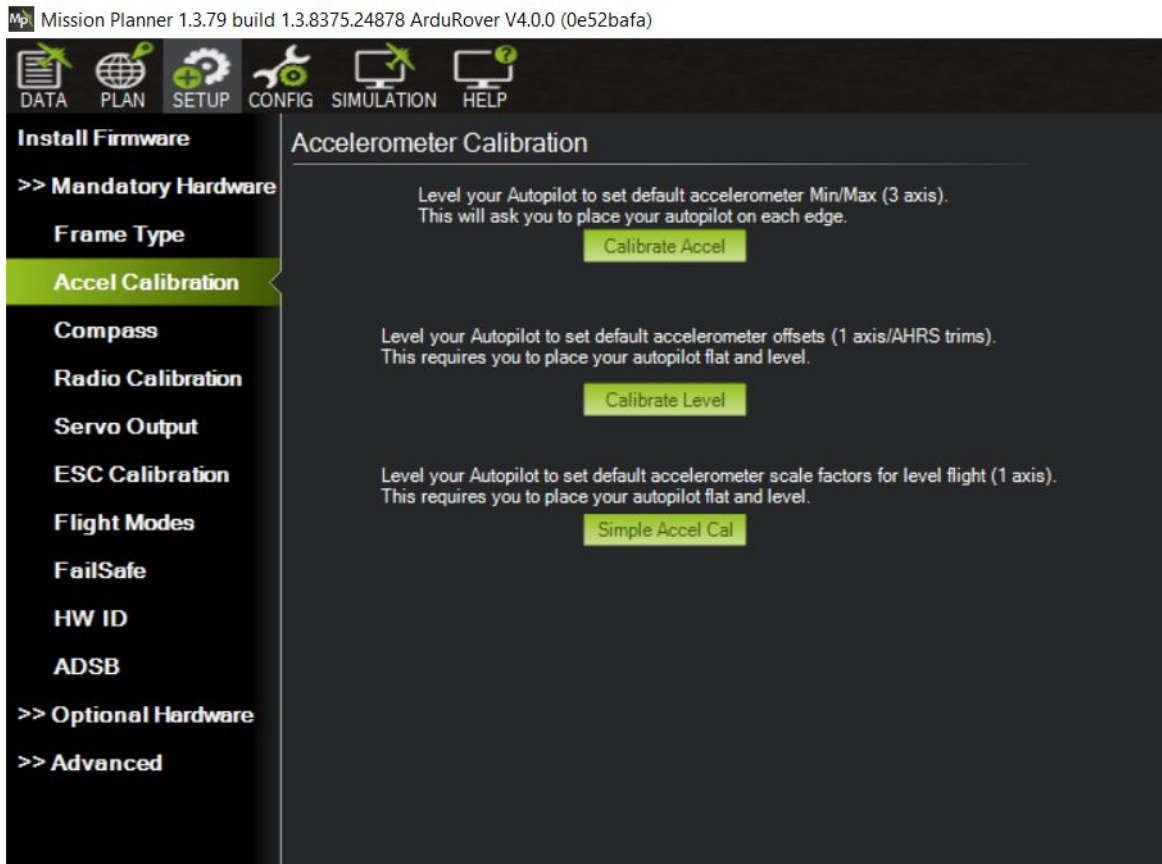


Figure 96: Accel Calibration

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

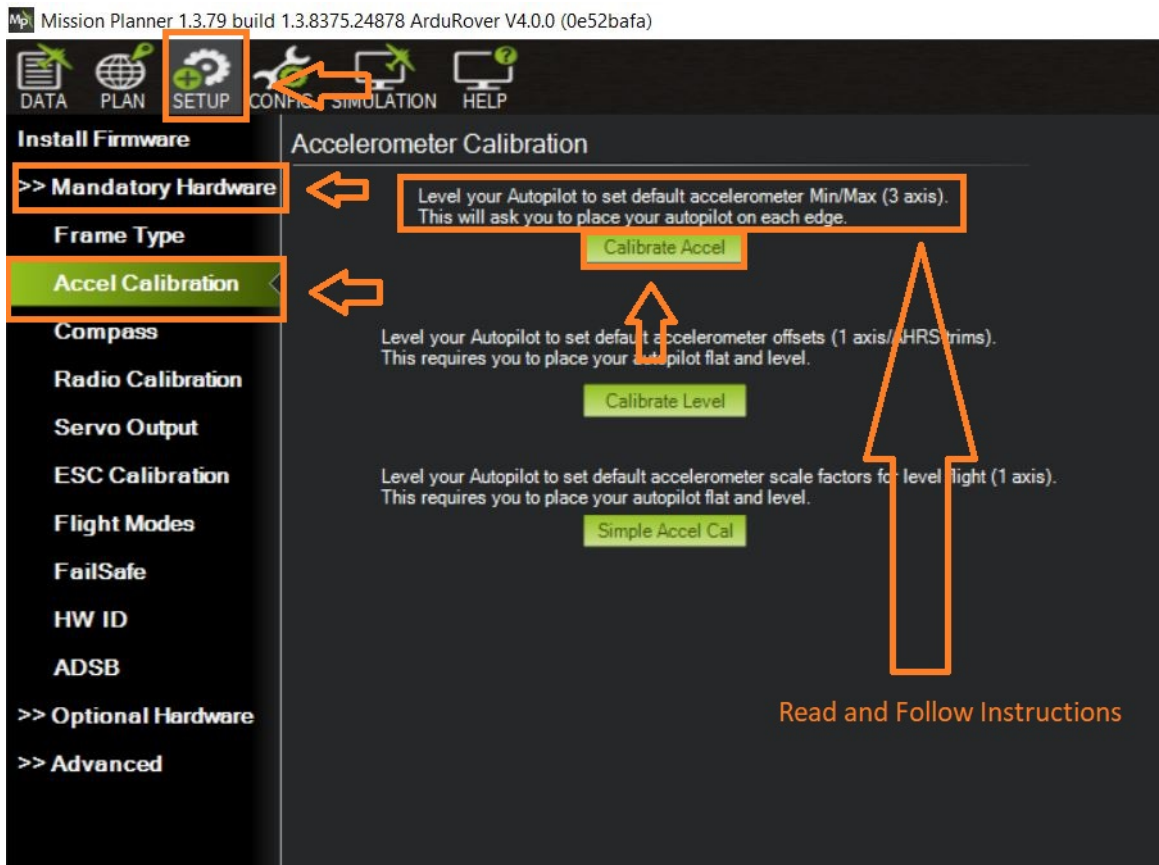


Figure 97: Accel Calibration Steps

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

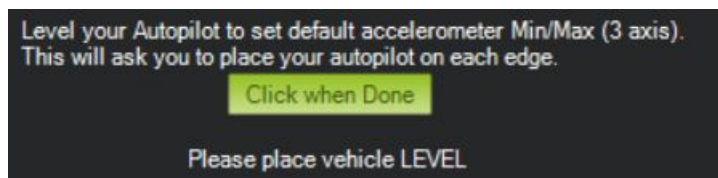


Figure 98: Accel Calibration In Process

- (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.

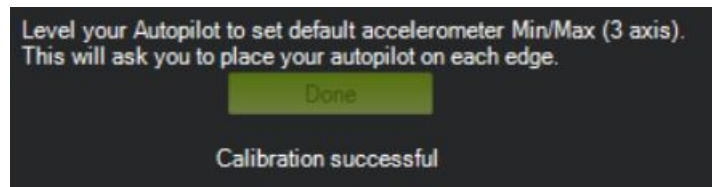


Figure 99: Accel Calibration Complete

12. Set the AutoNav™ on a level surface again.
13. Select Calibration Level. (See Figure 96)

7 Service and Maintenance

7.1 Maintaining Your Investment

Maintaining your EchoBoat™ 240 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.
- Power 24-3000 batteries charged between 22.6-24.2VDC - check every month.
- Long Range Module Battery (LiPo) storage charge of 3.6V per cell - check every month.
- Payload is dry.

7.3 Service

7.3.1 Propeller Replacement

1. USV must be powered off.
2. Remove the M6 nyloc with a 10mm wrench.



Figure 100: Thruster Assembly

3. **Be careful not to lose the alignment pin.**



Figure 101: Prop Shaft With Alignment Pin

4. Install new prop, make sure alignment pin is installed. Verify it is the correct side and orientation.



Figure 102: Alignment Pin

5. Put anti-seize on the threads and install the M6 nyloc.

7.3.2 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. Locate the two visible Phillip screws and unscrew them.



Figure 103: RCU 2x Screw Locations

3. Remove the module bay cover.
4. Remove the battery cover. (Figure 14)
5. Disconnect the battery.



Figure 104: RCU Final Screw Locations

6. Locate the additional two Phillip screws and unscrew them.
7. Carefully split case of the RCU.

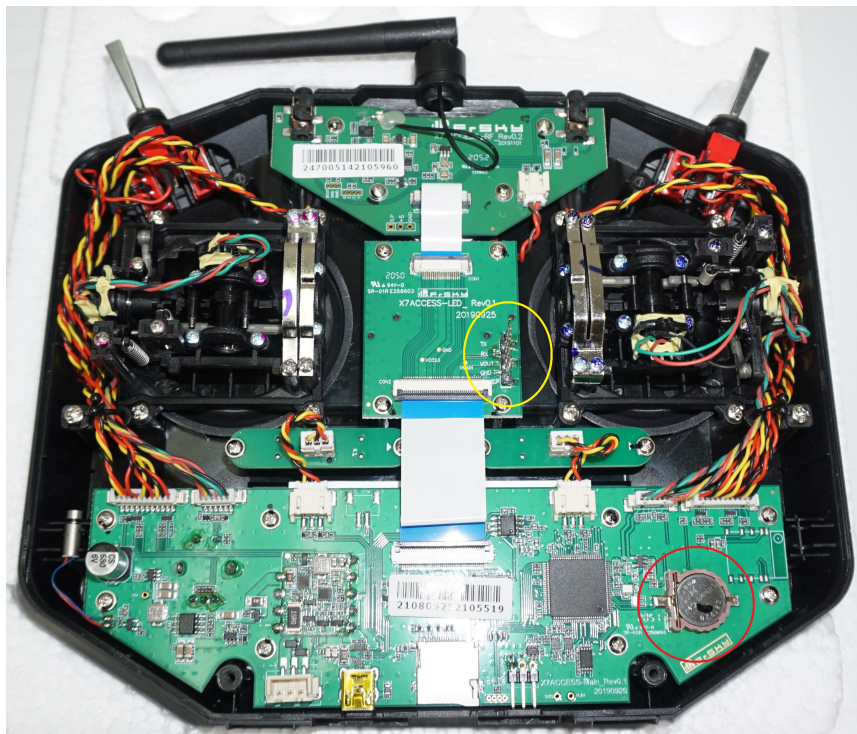


Figure 105: RCU RTC Location

8. Locate the RTC battery(circled red) 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 105) slide through the slot (Figure 14).
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.
- Inspect gaskets for wear or damage.
- Seals are lubricated with silicone-based lubricants.
- Anti-seize on hardware.
- Electronics are functioning.
- Batteries are fully charged.
- Check all hardware is tight.
- Inspect drain plug gasket.
- Ensure all connectors and cables are properly connected.

7.4.2 After Recovery

- Inspect propellers for damage or fouled debris.
- Hull inspection for damage, cracks, or signs of wear.
- Remove drain plug and inspect for water in bilge.
- Inspect interior of boat for any water intrusion or leaks.
- 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. Do **NOT** spray directly at the main hatch seal. Do **NOT** pressure wash sonar components.
- 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.
- Inspect gasket for wear or damage.
- Lubricate seals with silicone-based lubricants.
- Anti-seize on hardware.
- Remove and lube drain plug.
- Electronics are functioning..
- Battery maintenance.
 - Power 24-3500 should be stored between 22.6-24.2VDC (Never drop below)
 - Long Range Battery should be stored at 7.2VDC
- Replenish any parts that were pulled from the spares kit.
- Stored with hatches open for circulation.

Trailer:

- Check tire pressure.
- Check bearing oil/grease level.
- Check bolts are tight.
- check leaf springs aren't broken.

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 106: Beaufort Sea State

8.2 Block Diagrams

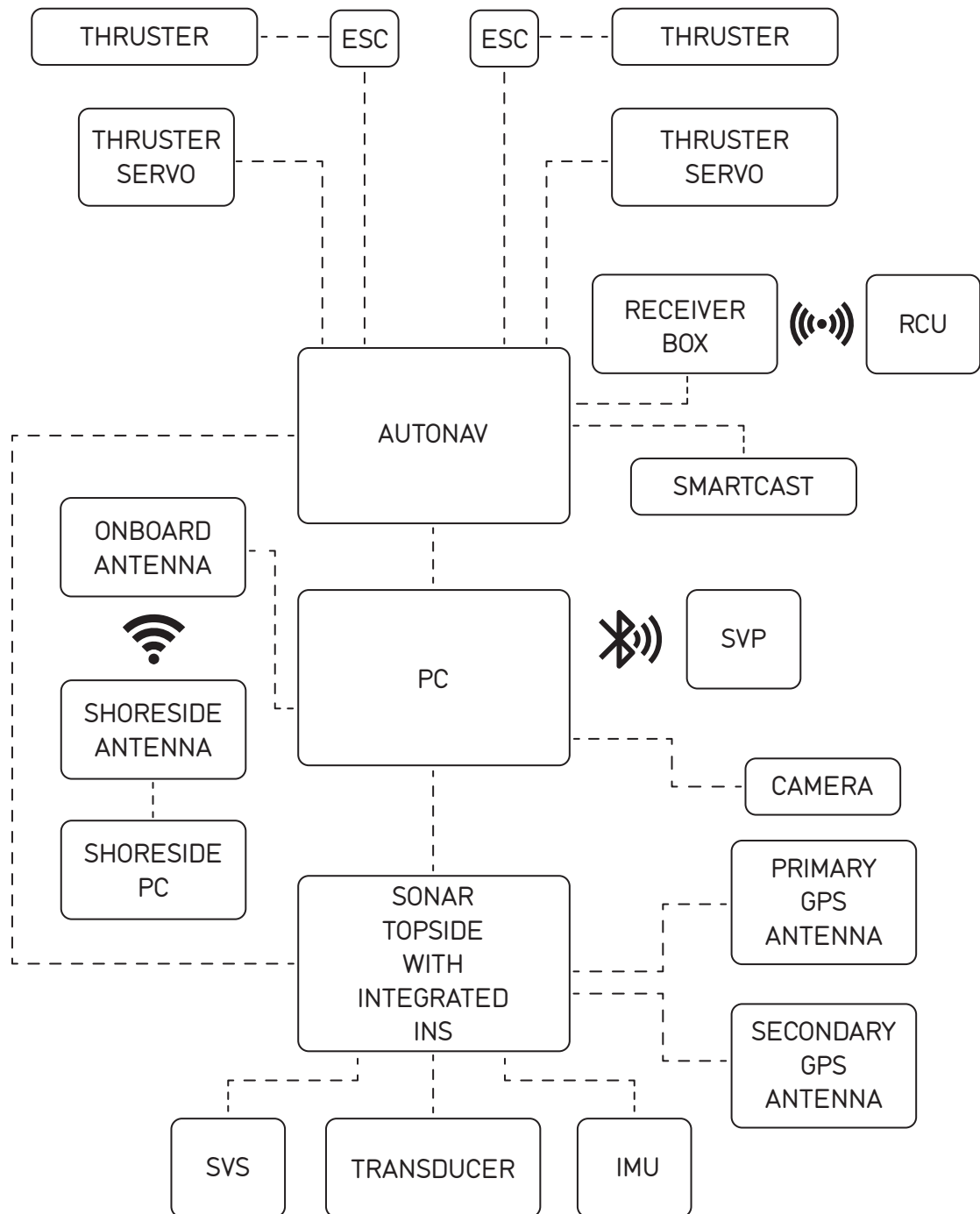


Figure 107: EchoBoat™ 240 Block Diagram

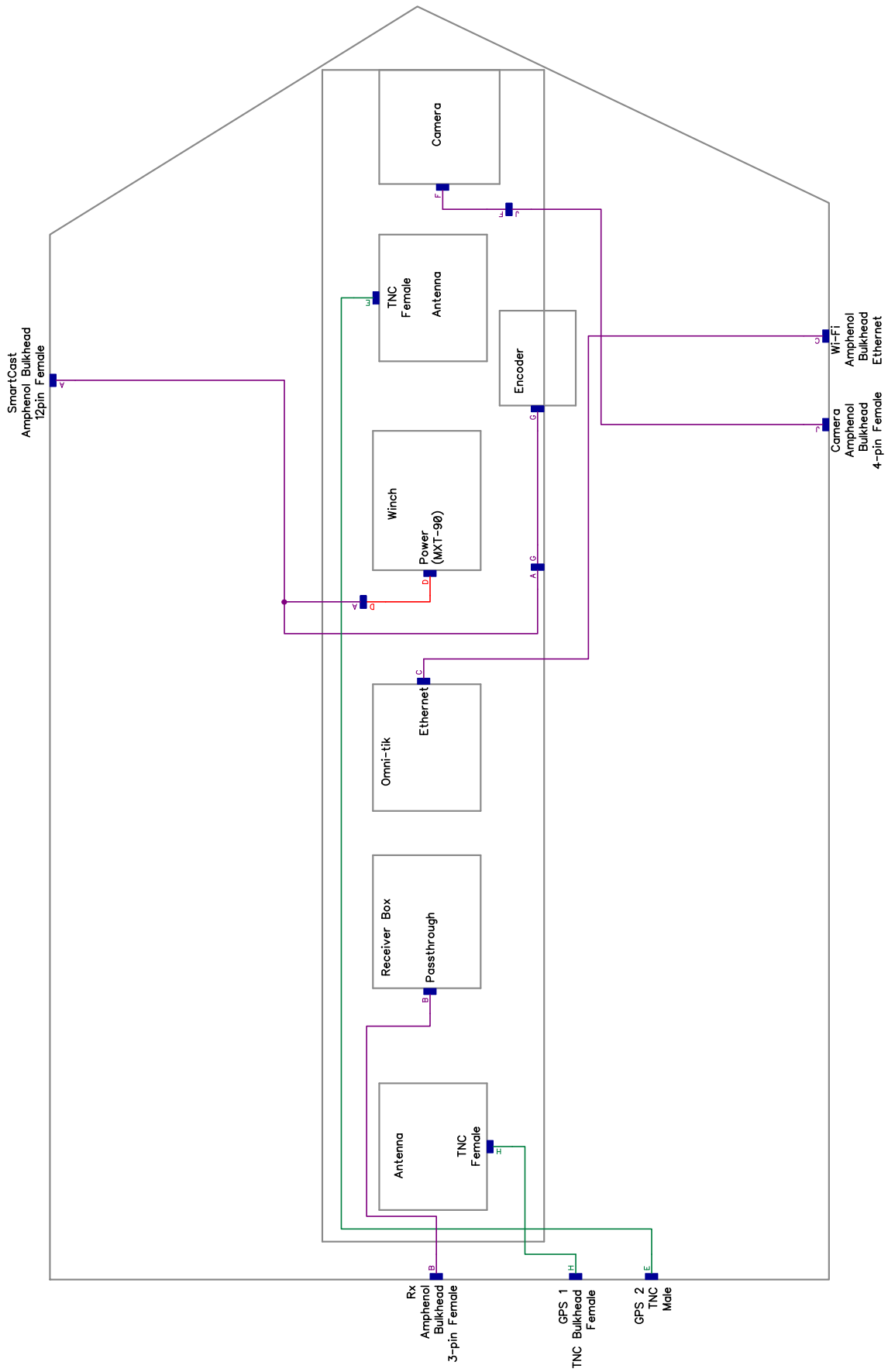


Figure 108: EchoBoat™ 240 Mast Electrical Diagram

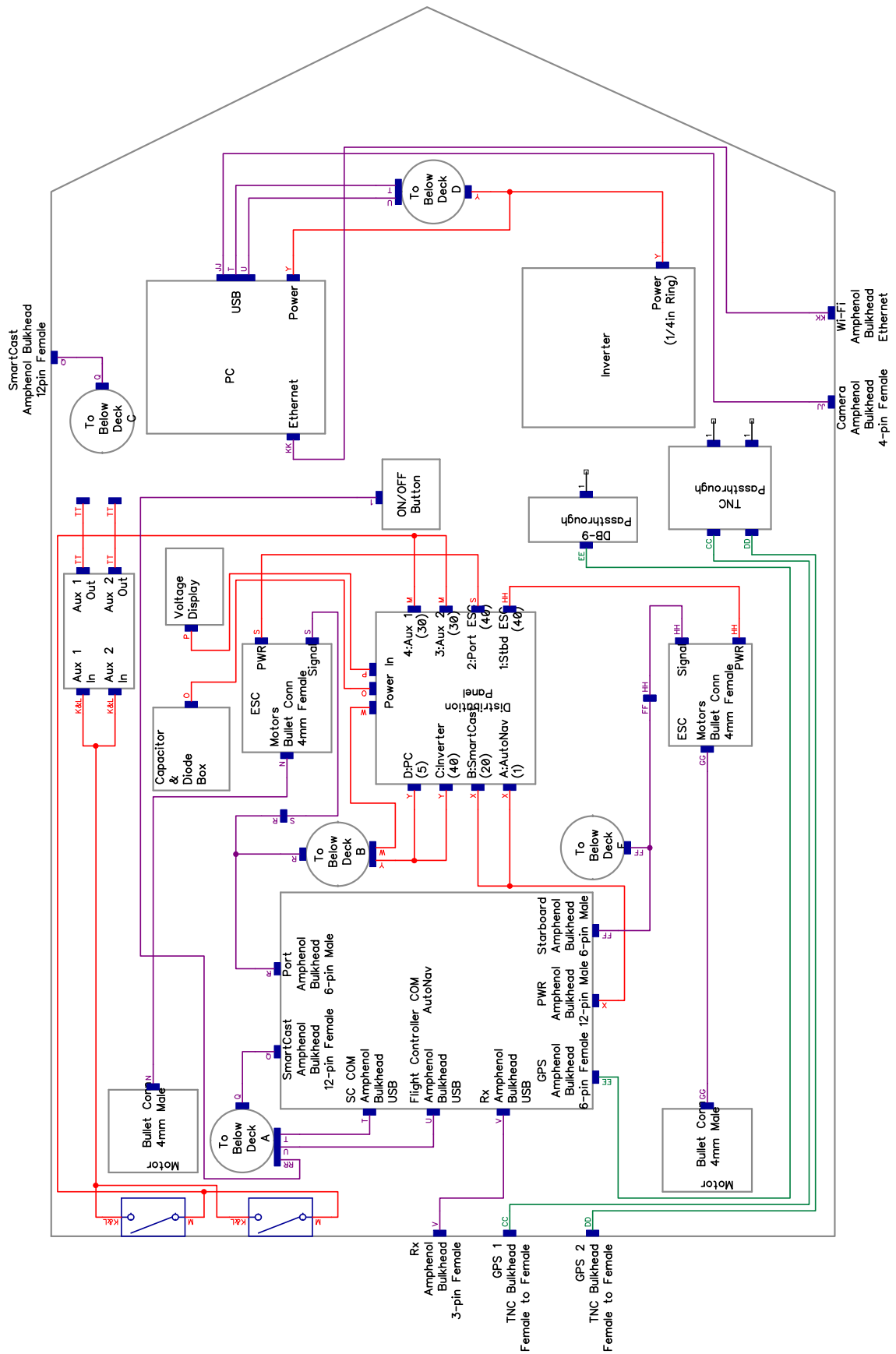


Figure 109: EchoBoat™ 240 Internal Electrical Diagram

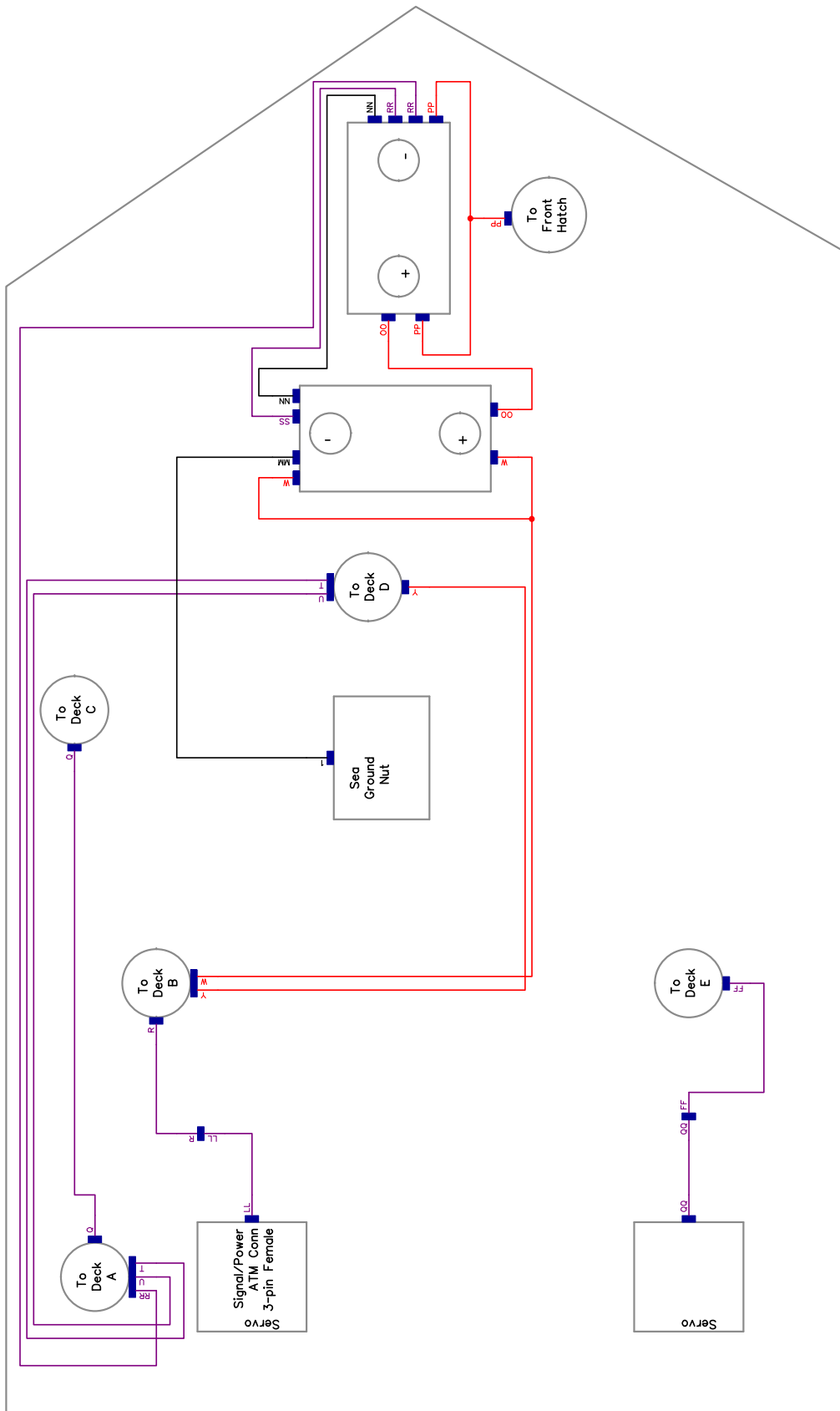


Figure 110: EchoBoat™ 240 Below Deck Electrical Diagram

8.3 Electrical Diagrams

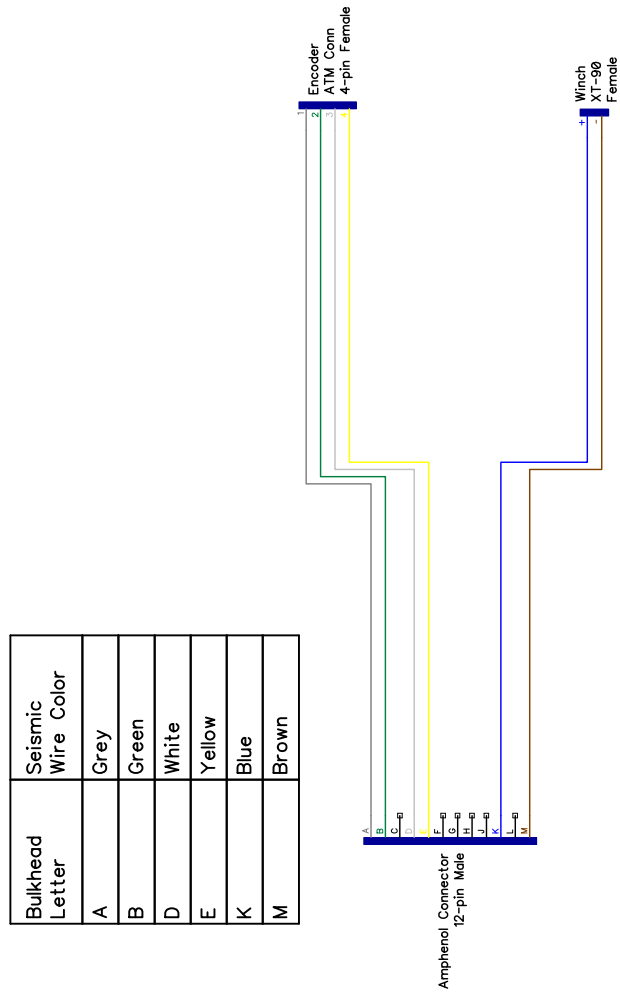


Figure 111: Cable A - SmartCast External Cable

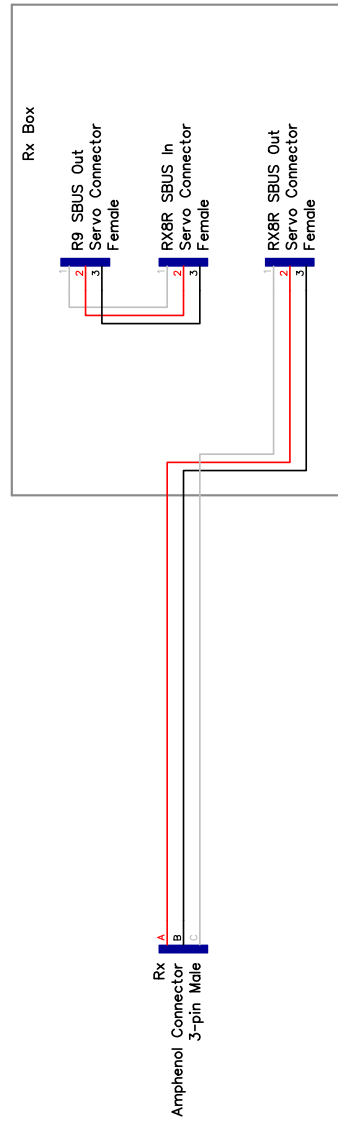
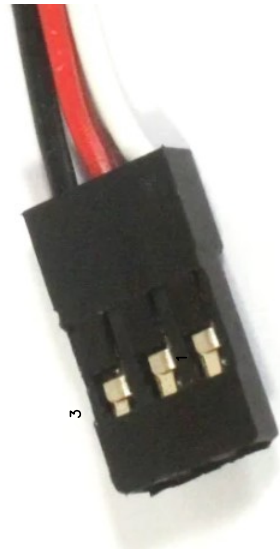


Figure 112: Cable B - Receiver Box Cable

Camera Wire Color	ATM Connector Pin Number
Red	1
Green	2
White	3
Black	4

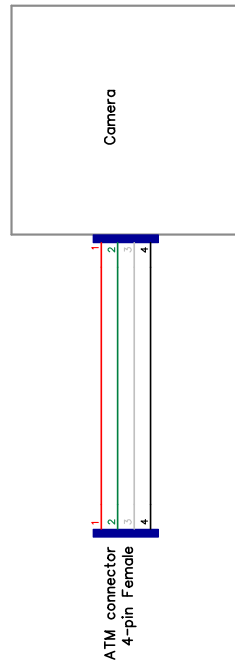


Figure 113: Cable F - Camera

Encoder Wire Color	ATM Connector Pin Number
Grey	1
Green	2
Red	3
Blue	4

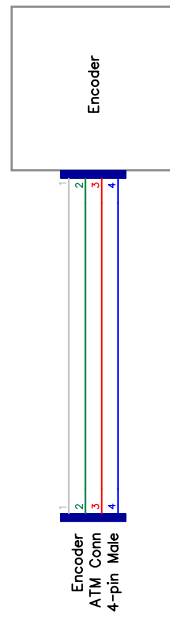


Figure 114: Cable G - SmartCast Encoder



Figure 115: Cable J - Camera External Cable

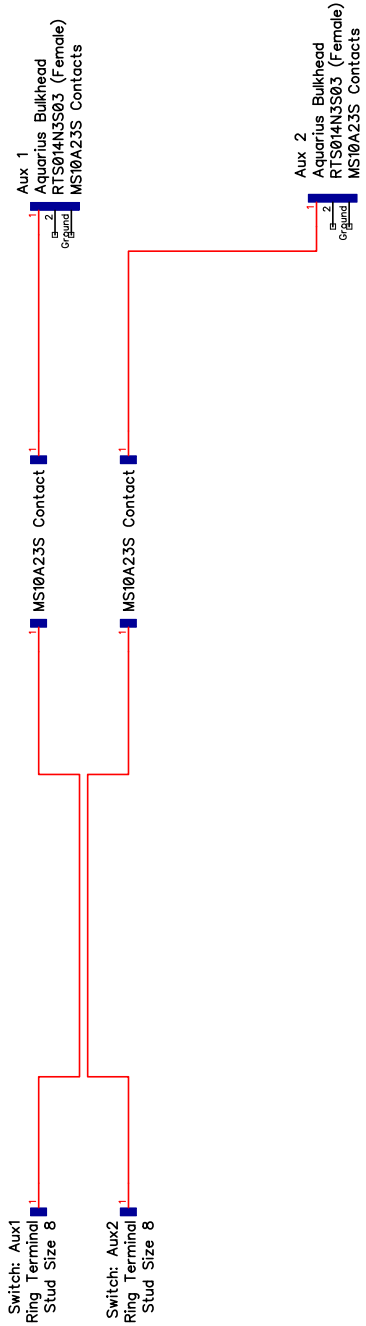


Figure 116: Cable K - AUX Power Bulkhead Cable

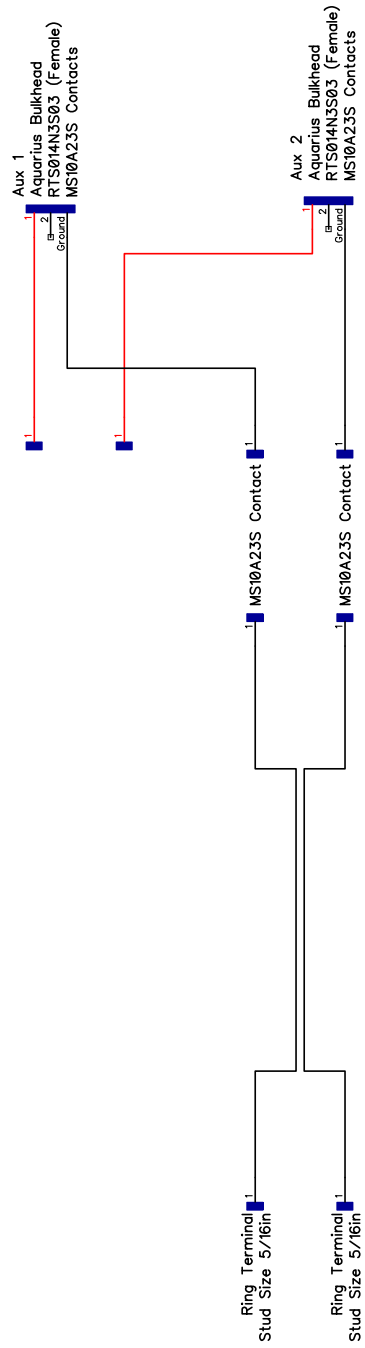


Figure 117: Cable L - AUX Ground Bulkhead Cable

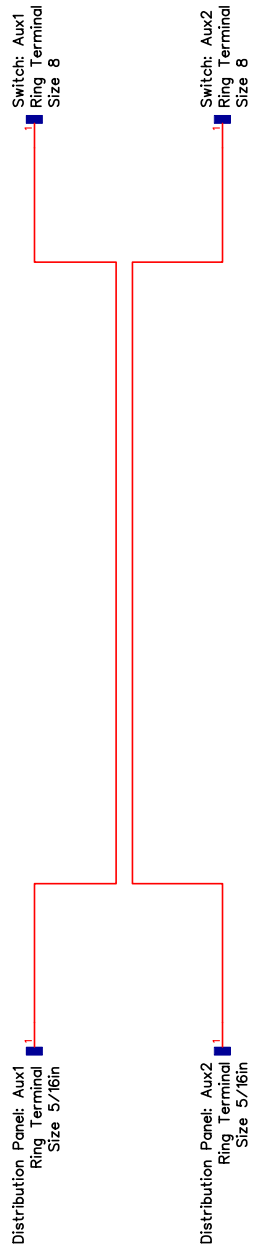


Figure 118: Cable M - AUX Power to Fuse Panel Cable

Motor	ESC	Motor	ESC
Blue	C	Blue	A
Green/Yellow	B	Green/Yellow	B
Brown	A	Brown	C

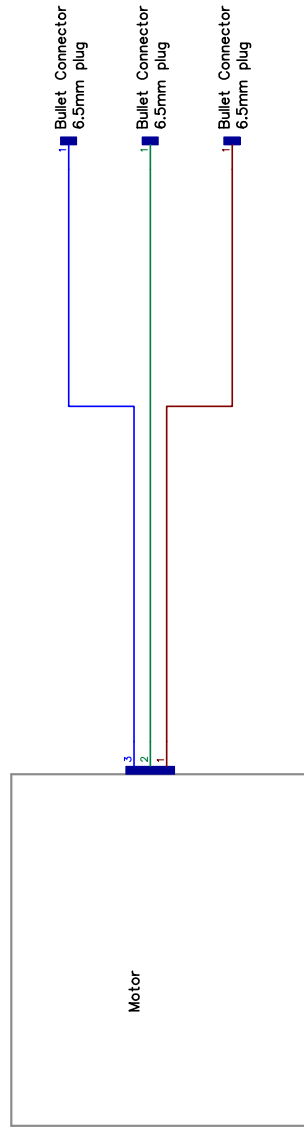


Figure 119: Cable N/GG - Thruster

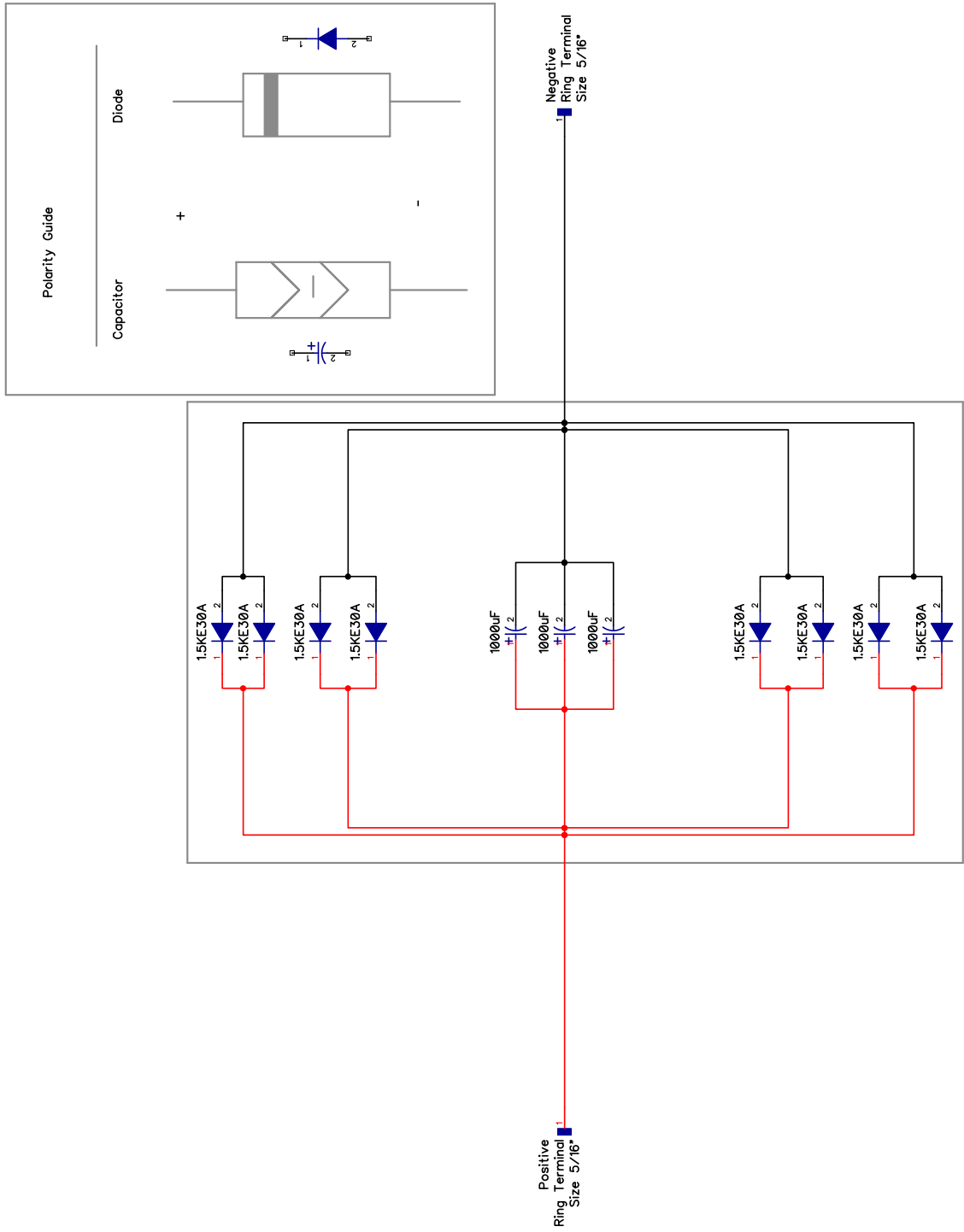


Figure 120: Cable O - Circuit Protection Enclosure

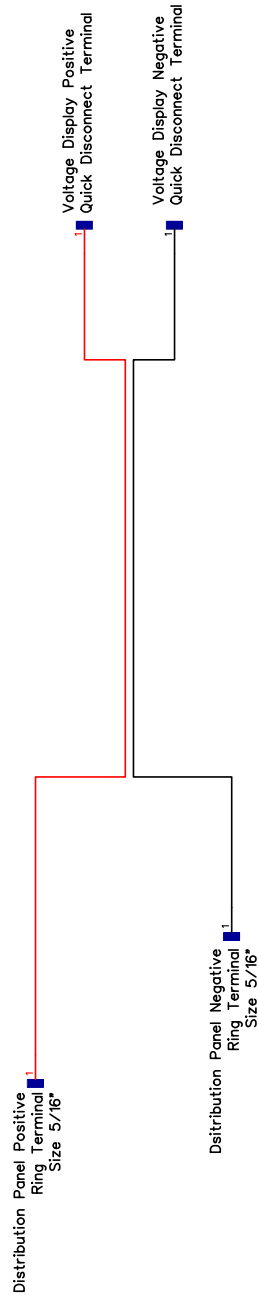


Figure 121: Cable P - Voltage Display Cable

Amphenol Pin	Seismic Color
A	Grey
B	Green
D	White
E	Yellow
K	Blue
M	Brown

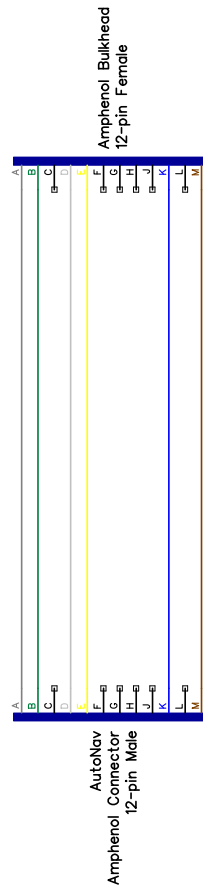


Figure 122: Cable Q - SmartCast Internal Cable

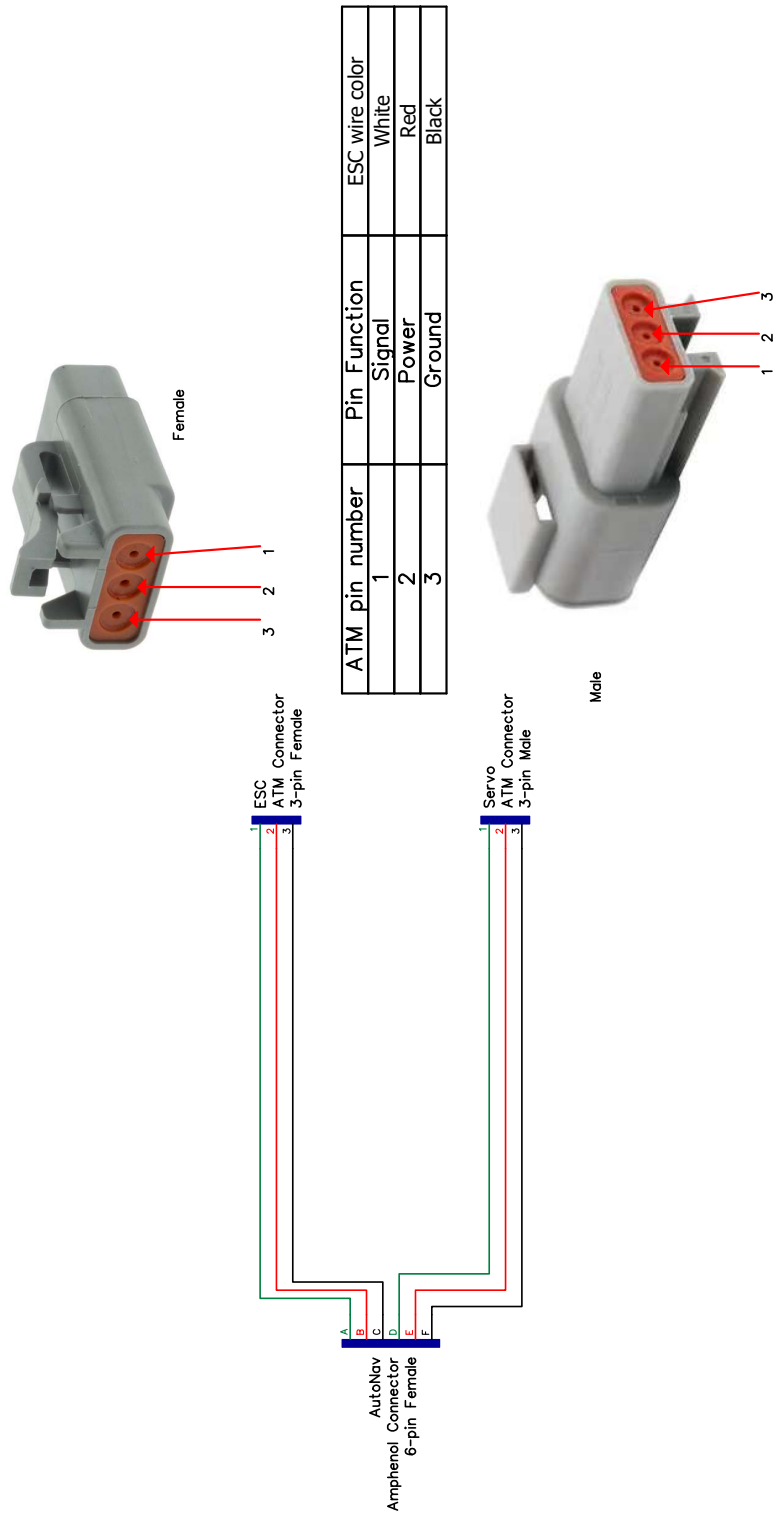
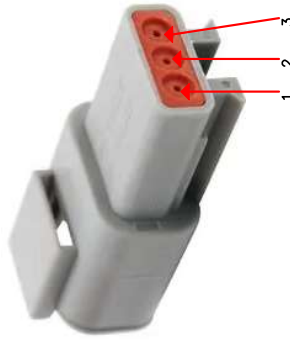
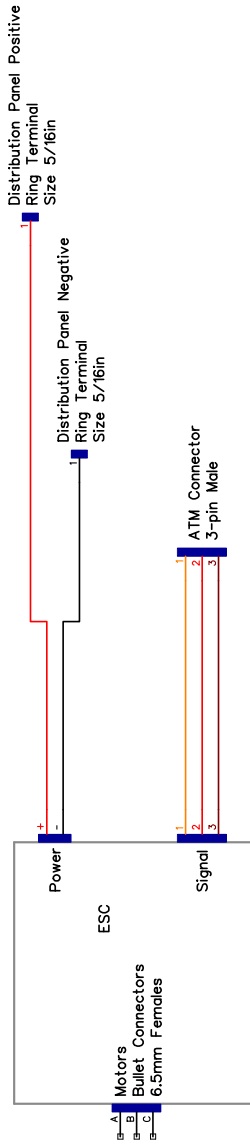


Figure 123: Cable R/FF - Propulsion Cable



ESC Wire Color	ATM Pin Num
Orange	1
Red	2
Brown	3

Port	ESC	Motor	Stbd
Motor Blue	C	Blue	ESC A
Green/Yellow	B	Green/Yellow	B
Brown	A	Brown	C

Figure 124: Cable S/HH - ESC

Pinout	Color
1	Red
2	Green
3	White
4	Black

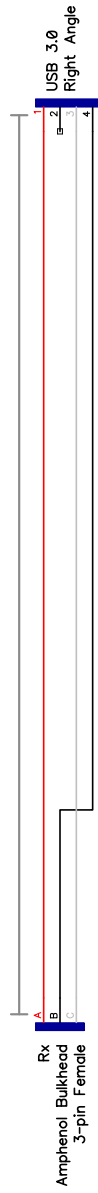


Figure 125: Cable V - Receiver Internal Cable

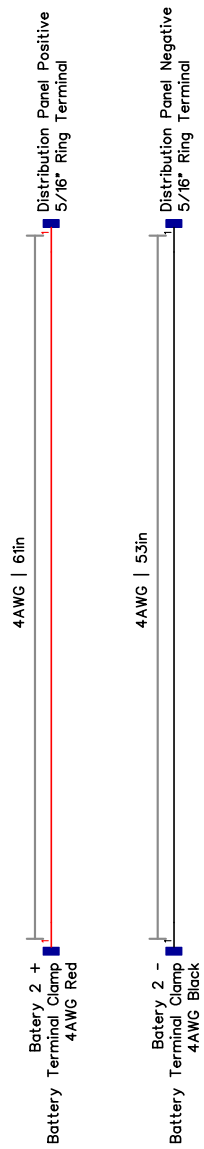


Figure 126: Cable W - Battery Power Cable

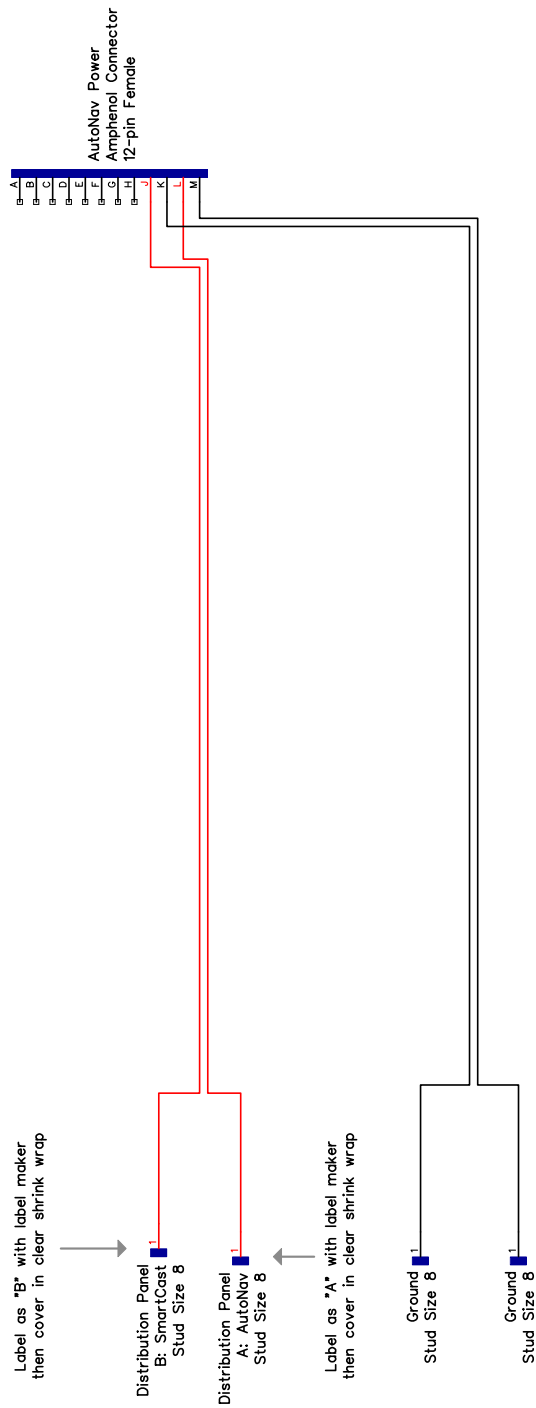


Figure 127: Cable X - AutoNav™ Power Cable

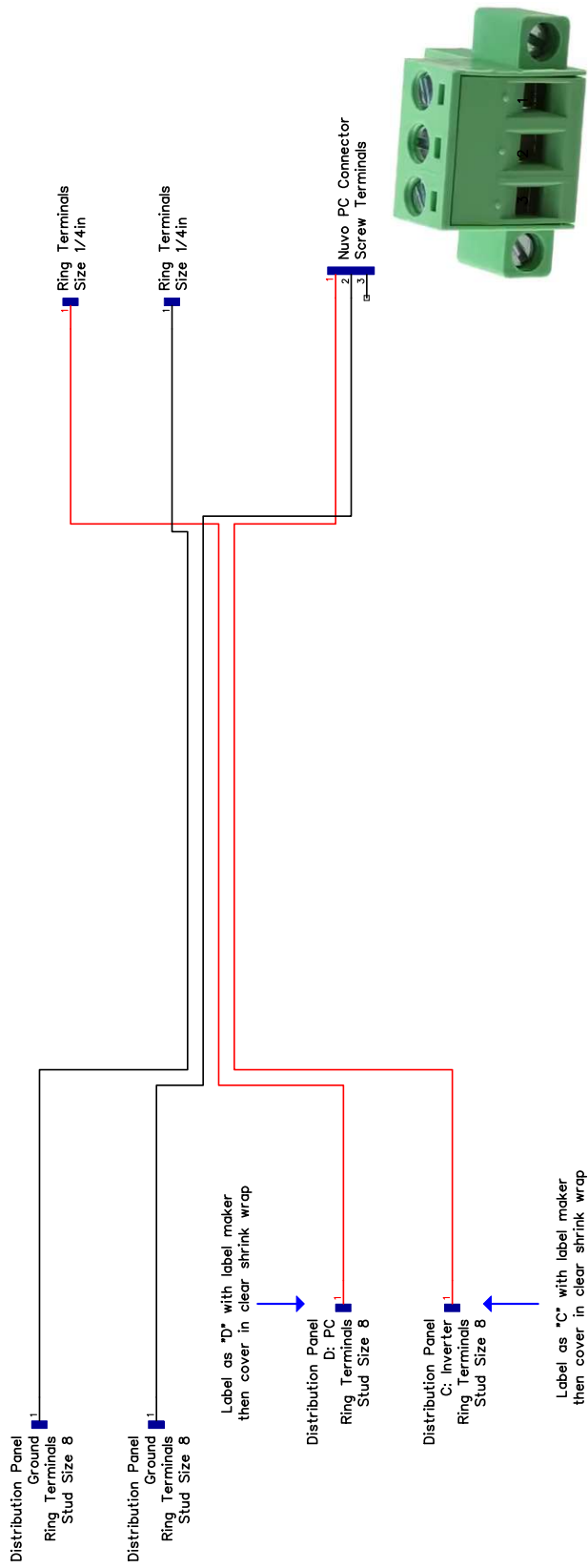


Figure 128: Cable Y - Equipment Power Cable

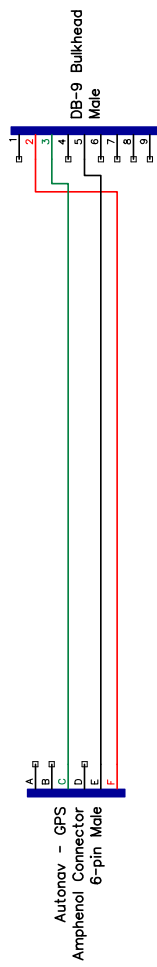


Figure 129: Cable EE - AutoNav™ GPS Cable

Pinout	Color
+	Red
D+	Green
D-	White
-	Black



Figure 130: Cable JJ - Internal Camera Cable

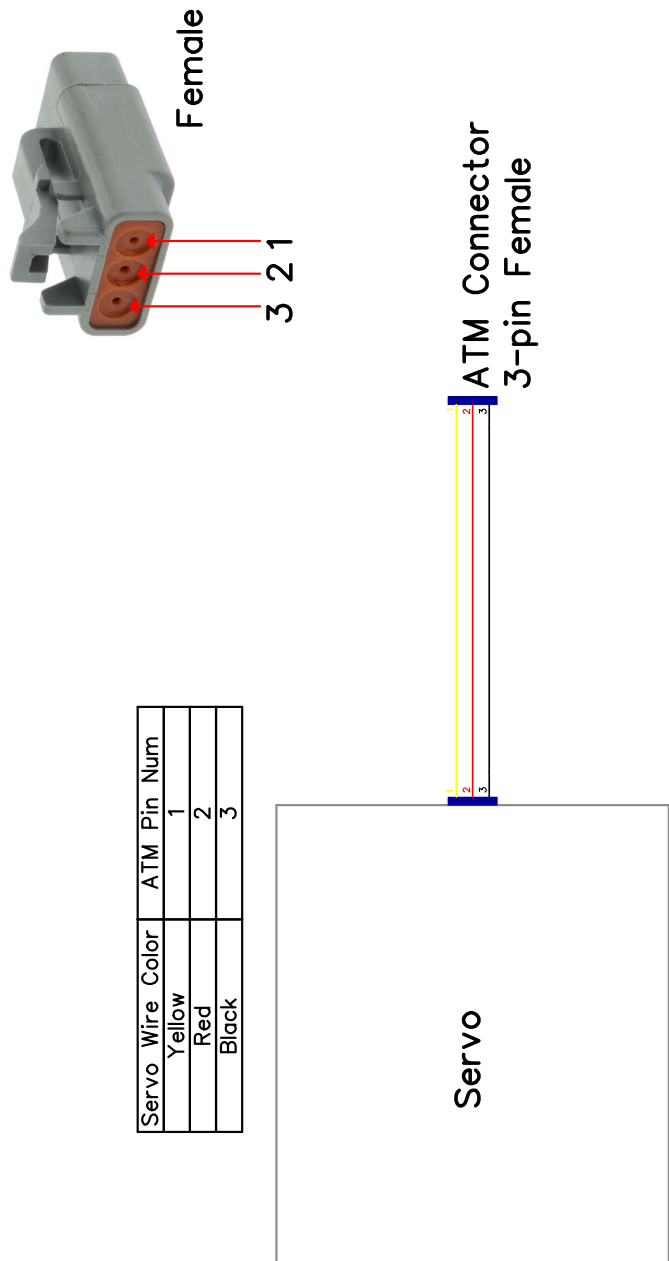


Figure 131: Cable LL/QQ - Thruster Servo



Figure 132: Cable MM - Sea Ground



Figure 133: Cable NN - Negative Battery Parallel Cable



Figure 134: Cable OO - Positive Battery Parallel Cable

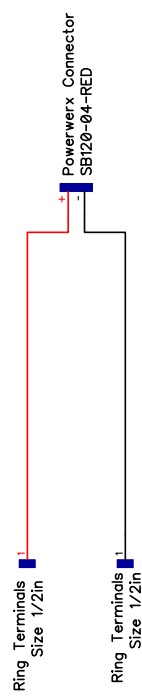


Figure 135: Cable PP - Battery Charging Cable

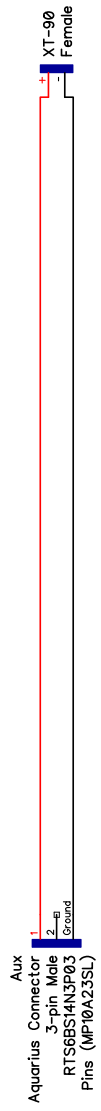


Figure 136: Cable TT - AUX Cable

8.4 Mechanical Diagrams

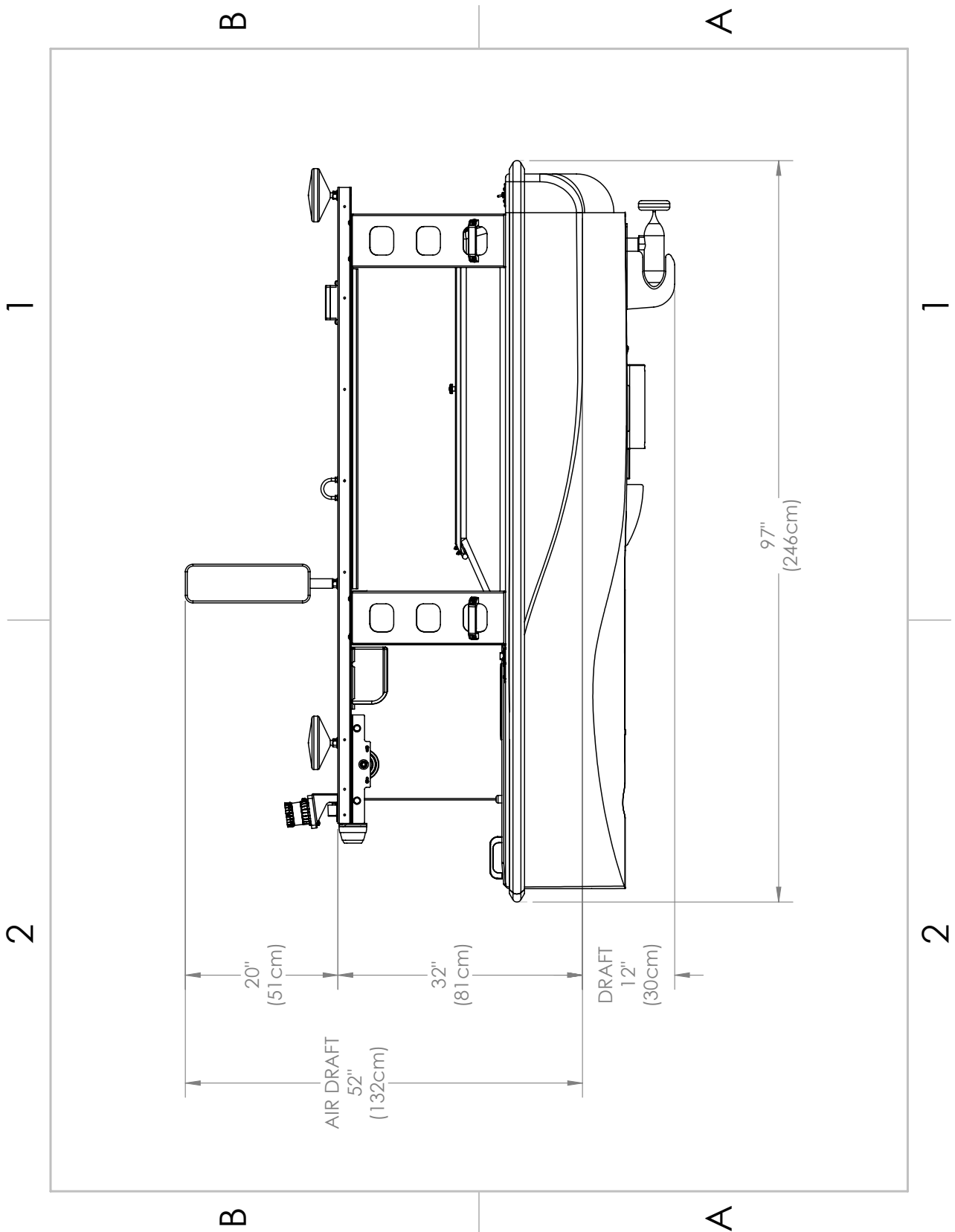


Figure 137: Side View Diagram

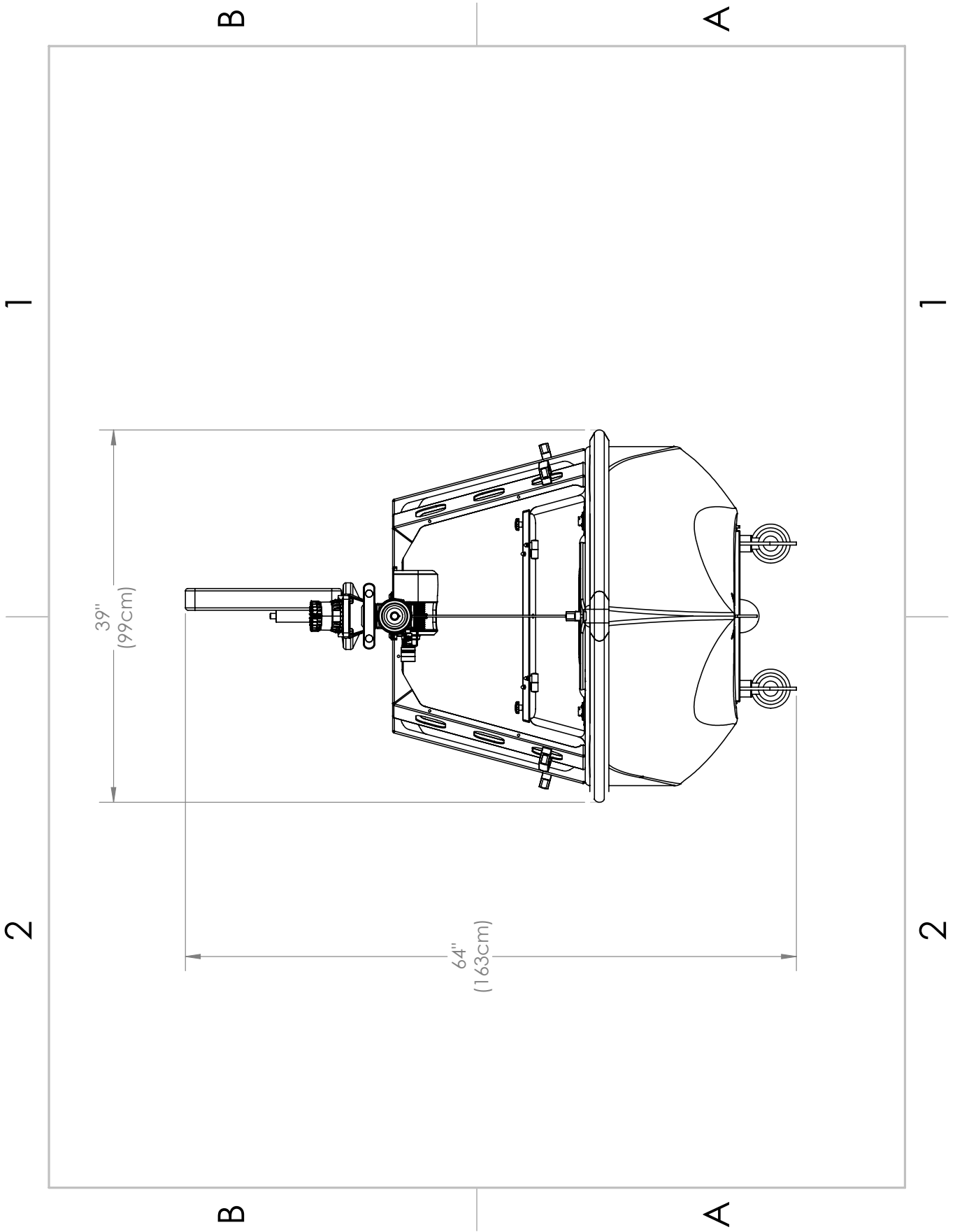


Figure 138: Front View Diagram

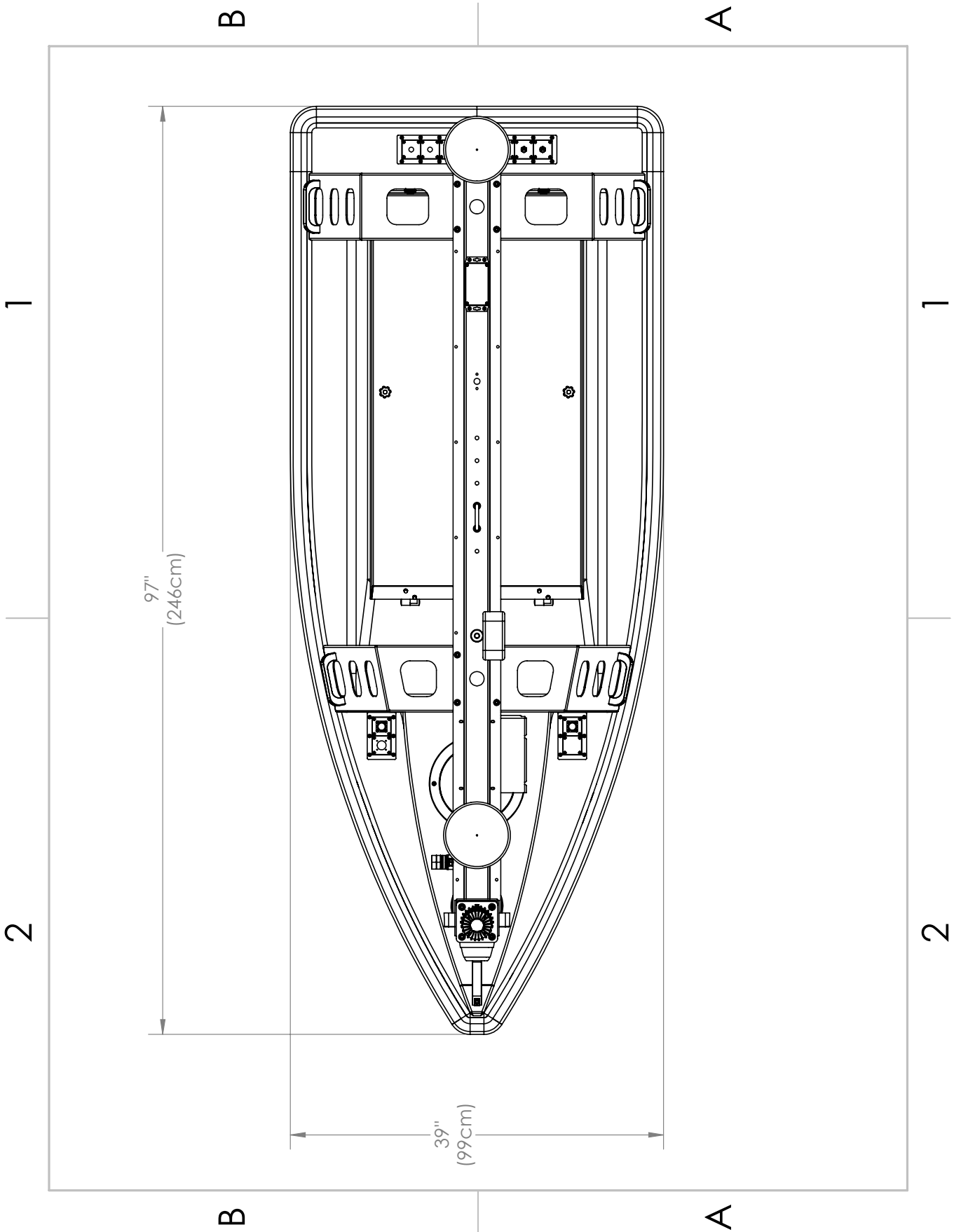


Figure 139: Top View Diagram

Revision History

Revision	Date	Author(s)	Description
1.0	2.1.2024	BA	Created
1.1	2.29.2024	BA	Added Beaufort Sea State Chart
1.2	3.7.2024	BA	Added Voltage Tester and RCU RTC Battery Replacement