A.D.A.M - *Non-ROV Device*

Sequoia Marine Solutions' 2026 non-ROV device is *A.D.A.M (Aquatic Data probe for Autonomous Monitoring)*. The main objective of A.D.A.M. is to take vertical profiles of water bodies at different heights, store the data, and transmit it back to a surface-side work station. This is accomplished through the use of a peristaltic pump as a buoyancy engine to change the density of the float in order to descend or ascend; water intake increases density to descend, and water offloading decreases the density and causes the float to rise.

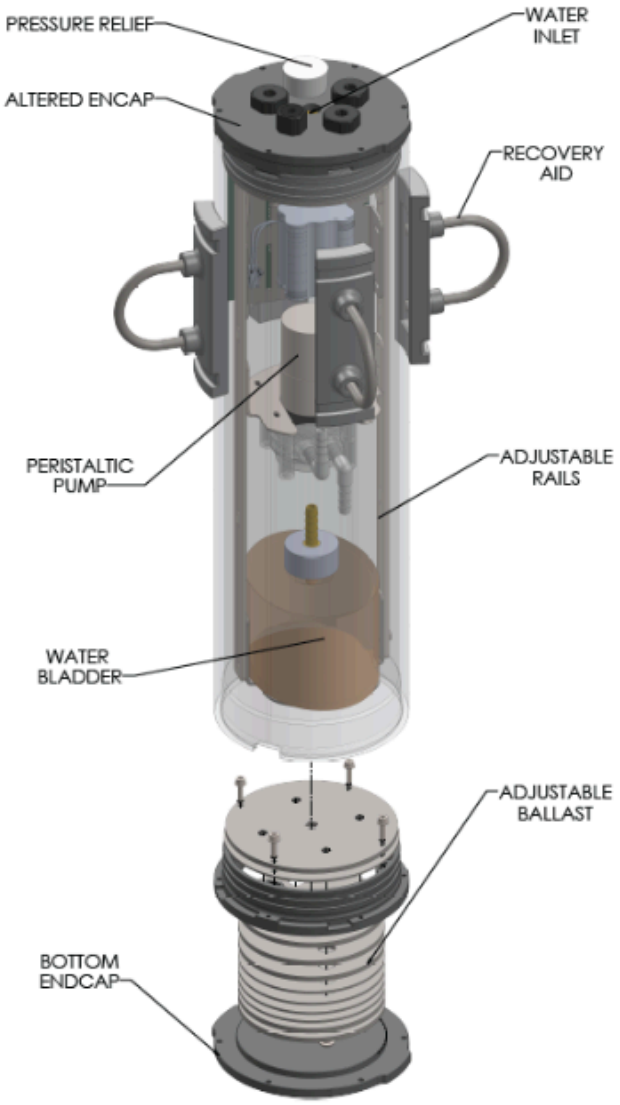


Figure 1: Assembled Float in Solidworks CAD Software

Float Chassis

After testing the peristaltic pump's operational capabilities at 2°C in a sugar solution to simulate an EGADS solution with a small and large peristaltic pump, the larger pump was selected for its higher mass flow rate (6.8 g/s). Further testing revealed that there would be no cold-start complications, so the peristaltic pump was selected as the buoyancy engine for A.D.A.M. and further designs were developed. It was also determined that a collapsible water bottle be used as a water bladder, and that the bladder remain half-full at launch to ease motor strain as well as aid in reaching neutral buoyancy at 3.6 kg.

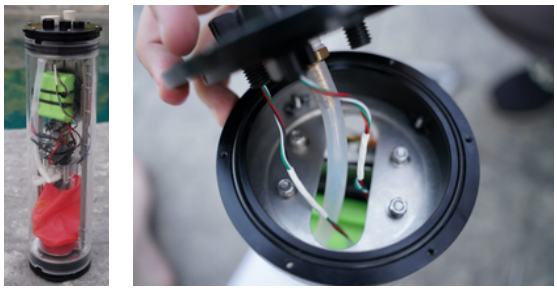


Figure 2 & 3: Assembled float; float endcap

The chassis of the float is made of cast acrylic plastic with aluminum endcaps at a 4-inch diameter. The internal structure uses a stainless steel sheet metal frame, allowing all internal electronics to be easily mounted to and removed with the top endcap. A watertight locking enclosure from BlueRobotics was selected for use, since the tube ends were pre-machined for o-ring seals.

PETG printed, PVC, and polycarbonate tubes were previously considered and rejected due to design constraints; waterproofing and water resistance were prime concerns, and each of the options was found to be not watertight after rigorous testing. All internal components, excluding the ballast, are supported by the top flange, allowing for easy removal and maintenance. The ballast is attached to the bottom flange and is adjusted by adding and removing cylindrical plates (approximately 4%, 2%, and 0.5% of the original mass). The ballast is located at the bottom flange to lower the center of gravity; in case of rotation, a stabilizing moment couple will be generated that will help ensure the float remains upright.

Buoyancy Engine

Before selecting the peristaltic pump as the final buoyancy engine design, the pump itself was tested for performance in an ice tank; to determine the capabilities, two sizes were tested (small - 1.27g/s & large - 6.80g/s) for their flow rate and consistency with relation to the water density. Although both pumps retained a constant flow rate at room temperature, the temperature decrease led to increased variation in flow rate (9.7% C.V.). To further simulate working conditions in Canada, the pumps were left in the freezer to test cold starts, but this did not noticeably affect the flow rate. Thus, the final decision to use the peristaltic pump as the buoyancy engine was made.

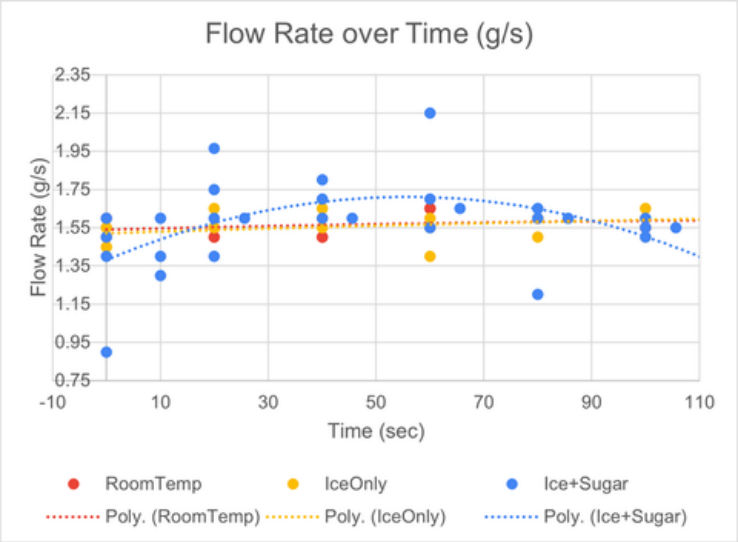


Figure 4: Flow Rate vs. Time Graph

Controls & Electronics

For the control system, A.D.A.M. features a custom built printed control board for housing all required electronics and facilitating physical and digital operations. The control board features a Raspberry Pi Pico 2 microprocessor capable of managing motor control, wireless communications, and data acquisition. A.D.A.M. also uses a DRV8871 motor driver to ensure effective braking and supply of power to the motor. This system features a NCP1117 voltage regulator to ensure stable input power from the 12V, rechargeable NiMH AA battery connected via Tamiya connectors. A rating of 2000 mA/hr ensures sufficient power for ~1hr underwater operation, alongside a 2A blade fuse connected in series with the positive battery input at 5 cm from the edge of the source, providing more than sufficient overcurrent protection for the 1.65A FLA. In addition, A.D.A.M.'s onboard control unit features a RFM95W LoRa radio module and a spring antenna to allow effective wireless communications between the float and the surface side work station, consisting of another Pi Pico 2, and a RFM95W connected to the surface laptop via USB.

Component	Maximum Current Draw (mA)
Peristaltic Pump	1400 mA
Depth/Pressure Sensor	1.25 mA
Raspberry PI Pico 2	250 mA

Table 1: FLA Measurements

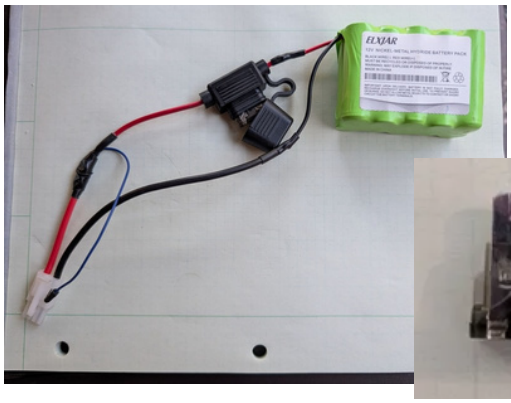


Fig. 5 & 6 (left to right): NiMH AA battery; 2A fuse

All of the aforementioned design features have been consolidated onto a singular PCB. This not only promotes spatial efficiency as the board design is compact, but also provides a maintainable control medium that is both efficient and effective, helping to achieve a corporate goal of designing all electrical hardware in-house.

A.D.A.M. is programmed using Micropython, simulated using the Thonny IDE, and communicates via LoRA using a 915 MHz wireless frequency. Upon deployment, A.D.A.M. will remain on the surface of the water until such time as LoRA communication is established. Once the float is connected to the on deck work station, A.D.A.M. executes a PID loop, with the depth sensor as the feedback device. This control loop allows the float to vertically profile to 2.5 meters below the surface, and 0.4 meters below the surface respectively. Data packets are collected during each vertical profile, and are transmitted to deck side personnel upon recovery.

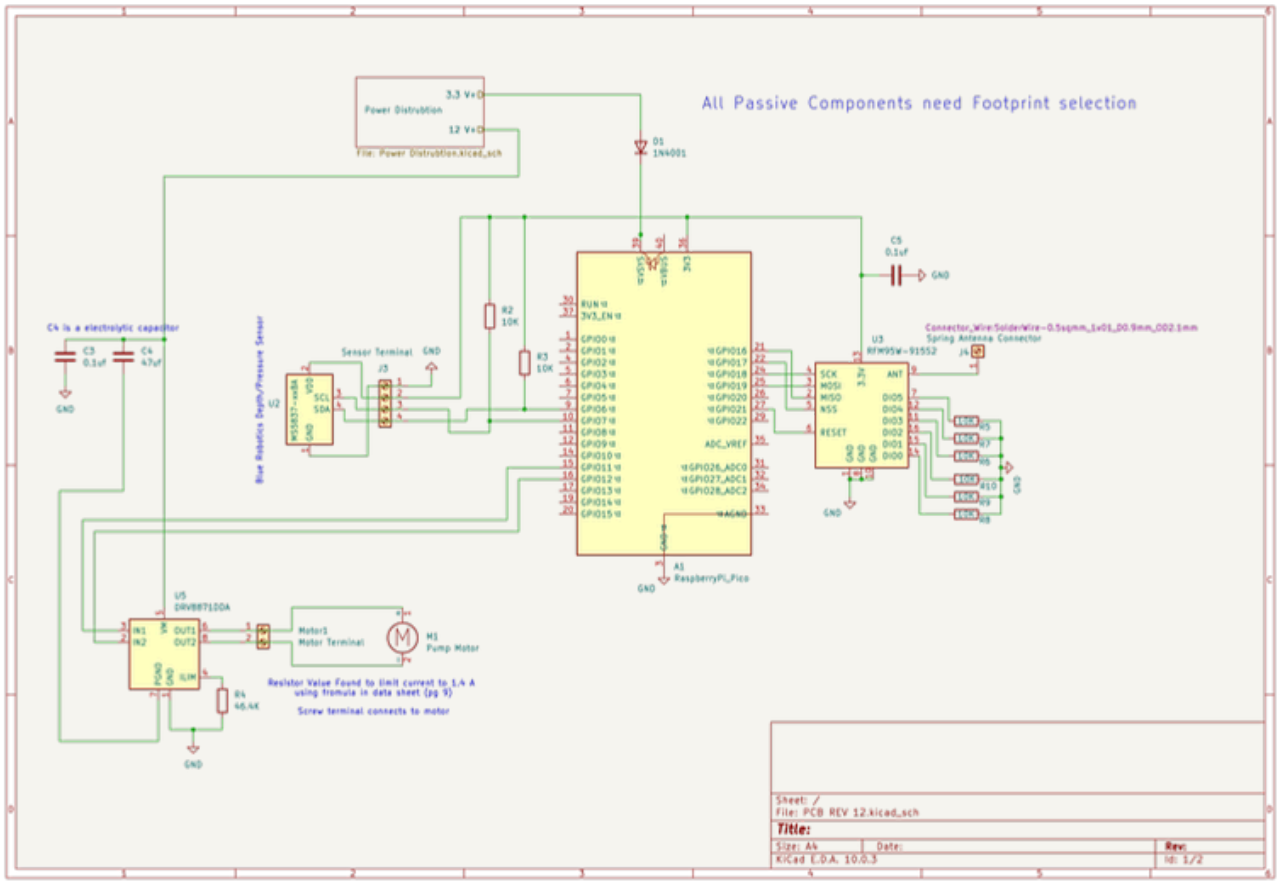


Figure 7: Detailed PCB Schematic

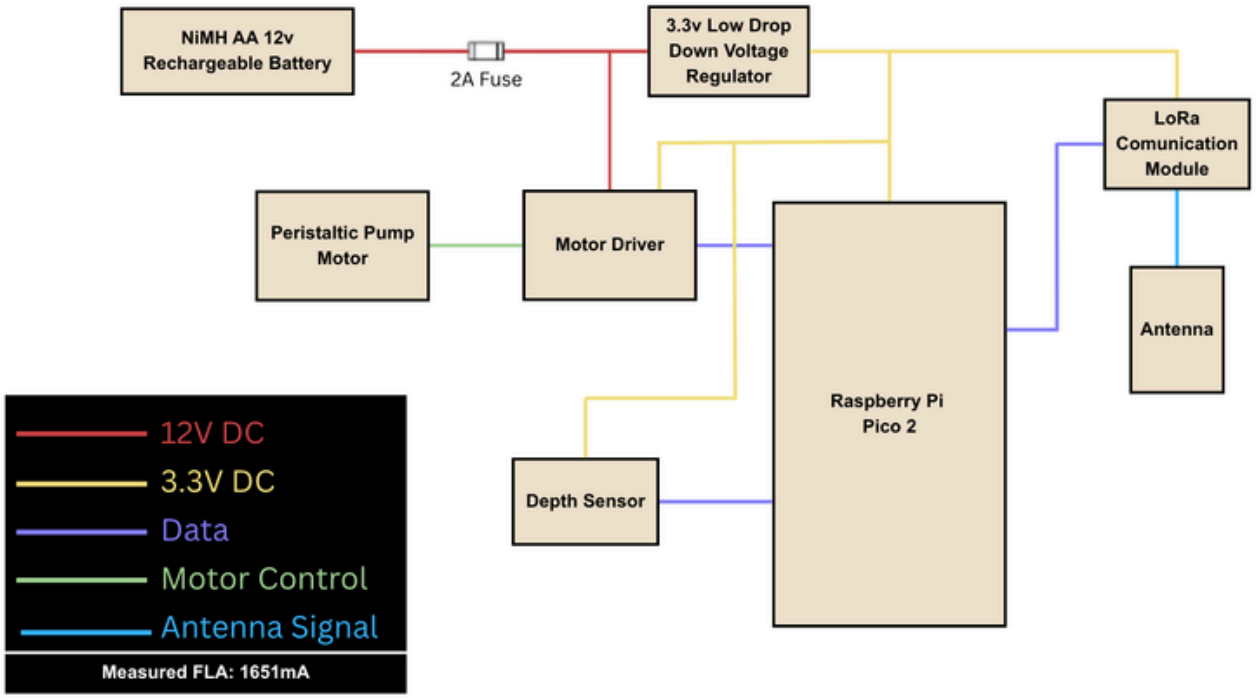


Figure 8: Float SID