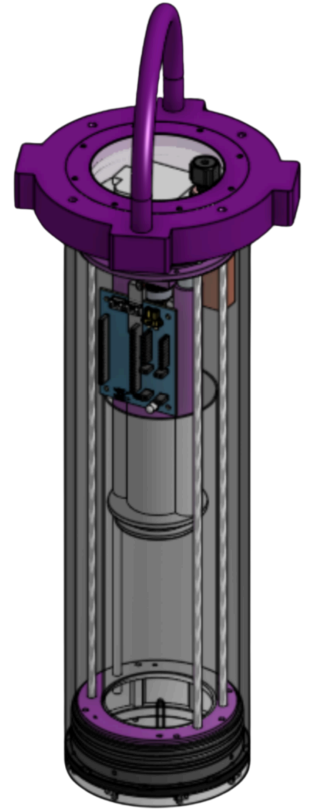


Non-ROV Device Documentation — Float

Mechanical Design

Our float, shown in Figure 1, controls buoyancy using a lead screw driven by a NEMA 17 stepper motor to actuate a 500mL syringe. As the motor extends the syringe plunger, displaced volume increases and the float rises. As it retracts, volume decreases and the float sinks. This mechanical approach provides precise, repeatable buoyancy adjustment without pumps or valves. A custom 3D printed coupler converts the motor's rotational output into linear motion along the lead screw. A limit switch at the end of syringe travel acts as a hardware failsafe, cutting motor movement before the syringe can be overextended.

The float is housed in a Blu-Sub 115mm diameter, 400mm length acrylic tube enclosure, giving an outer volume of approximately 4.15 liters. With a 500mL syringe providing the full buoyancy range, the displacement-volume ratio is 0.120:1, allowing the float to generate large buoyancy changes quickly and respond aggressively to depth corrections. All internal components are mounted on a custom PCB secured inside the enclosure. The Blue Robotics pressure-rated switch mounted on the endcap allows the float to be powered on and off without opening the housing.



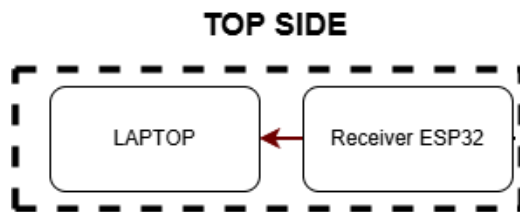
Electrical Design

The float is controlled by a Heltec ESP32 LoRa V3 microcontroller mounted on a custom-designed PCB. The PCB integrates a TMC2209 stepper motor driver, an MP1584EN step-down converter to regulate 12V to logic-level voltage, and JST PH connectors for low-current sensor connections with XT30 for power. The Bar02 pressure sensor communicates with the ESP32 over I2C and provides depth measurements with 0.16mm resolution for precise depth-hold control. The TMC2209 driver provides software-configurable current limiting for the NEMA 17 stepper motor, keeping current draw within safe operating limits.

Two Tenergy NiMH 6V 2000mAh battery packs are wired in series to supply 12V to the system. Each pack's positive wire is protected by an individual 2A inline fuse. A 3A main line fuse is located on the positive output wire before the PCB, keeping total fuse current well within MATE's 5A maximum requirement. The Heltec V3's integrated LoRa module transmits depth, pressure, and temperature data wirelessly to a topside receiver after each profile cycle. The surface laptop reads the incoming data and plots depth versus time in real time, allowing the team to monitor profile behavior and verify task completion from the surface.

Depth control is handled by a PID controller running on the ESP32, using Bar02 pressure readings as feedback. The PID loop drives the stepper motor to adjust syringe position until measured depth matches the target setpoint, correcting for overshoot and steady-state error to maintain stable depth holds.

SID For Non-ROV Device



Fuse Calculations

ESP32 & Sensors: 650mA max
 Motor: 2000mA max
 Waiting Mode: 650mA max
 Buoyancy Change Mode: 2.65A Max

KEY

Power
 Ground
 USB
 PWM
 I2C
 Analog Signals

FLOAT CONTROL SYSTEM

