

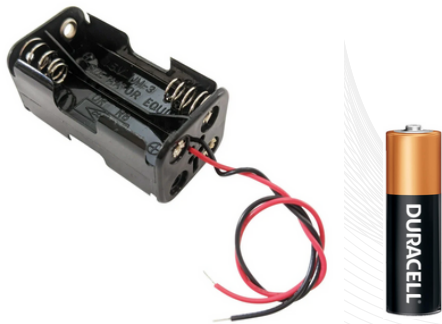
BUOYANCY MODULE (mrxFloat, Versions 1 and 2)

The compact **mrxFloat V1** consists of an open syringe moved by a continuous rotation Axon Max servo motor and lead screw mechanism, resulting in a buoyancy engine that **changes its volume by approximately 300mL**. This particular motor was chosen for its **high torque and fast rotational speed**, which alongside the lead screw allows the float's density to change rapidly.

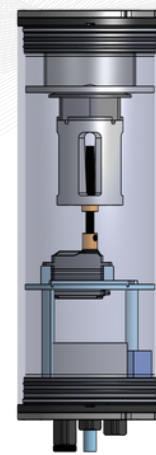
The initial mass of the mrxFloat rests at about 1495 g, but weights have been added to make it neutrally buoyant. Once 300mL of water is taken through the syringe, the mass increases to 1795g while the volume of the float stays constant at 1760 cubic centimeters. Thus, the intake of water changes its density from 0.96 to 1.17 g/cubic centimeter, resulting in descension. The inverse is repeated for ascension.

mrxFloat V1 is constructed with a 4" acrylic tube and operated with a buoyancy engine of a continuous rotation servo and lead screws. The mrxFloat is 31.4cm in height. The top section of the float holds the electronics, which consist of 4 AA batteries, an inline 5.0A fuse, a 6V to 3.3V buck converter, and an ESP32 LoRa V3. The selected quad AA battery pack indeed fulfills the electrical specifications of the float (6V nominal and FLA 4.2A). The actuator is screwed through a nut and can extend 10cm vertically. Another ESP32 LoRa V3 transmits and receives signals, consisting of the local time, ROV team number, and pressure information. The LoRa radio protocol was selected for its long-range, reliability, and ease of use. MUREX considered options like Wi-Fi and Bluetooth but preferred the simplicity and long range of LoRa 915 MHz.

Following safety specification ELEC-NRD-004, a 75.0A fuse is attached within 5cm of the power wire of the battery. The enclosure has been verified to **comply with MECH-001** (pressure tested to 5m water column depth). The pressure relief system consists of a top cap which disengages from the acrylic tube in the event of high pressure, which is also paired with a standard blue robotics pressure cap rated to 12 psi. The depth sensor collects data in 5-second intervals throughout the ascension and descension period.



4 AA Batteries and Holder. Photo: Amazon



L to R: 2024 float, 2025 mrxFloat V1 diagram, mrxFloat V1 photo.
 Render: A. Sivarasa, Photos: F. Liu

Unfortunately, due to **mrxFloat V1** not initially working as intended, we pivoted to the **mrxFloat V2**. It features an acrylic enclosure with aluminum endcaps, and a thruster mounted on the bottom. The enclosure holds a 12V Nickel metal hydride battery, a XILO ESC flashed with BlueESC firmware, an inline 5.0A fuse, a 12V to 3.3V buck converter, and an ESP32 LoRa V3. The selected NiMH battery pack with 2000mAh rating indeed fulfills the electrical specifications of the float (12V nominal and FLA 4.2A).

For communication, MUREX considered options such as Wi-Fi and Bluetooth, but preferred the simplicity and long range of LoRa 915 MHz. The ESP32 LoRa V3 in the float transmits signals (915 mHz) consisting of the ROV's company number, local time, and depth in five second intervals throughout its descent and ascension. The data packets are all sent at once after the float has completed a profile, at the press of a button on a surface-side ESP32 LoRa V3. It receives these signals and data points in which MUREX can then graph.

Using the **BlueRobotics BAR02 Depth sensor**, and their MS5837 library, the ESP32 is able to successfully communicate the depth of mrxFloat.

In both versions, the enclosure has been verified to comply with MECH-001 (pressure tested to 5m water column depth). The pressure relief system consists of a top cap that disengages from the acrylic tube in the event of high pressure, which is also paired with a standard BlueRobotics pressure cap rated to 12 psi. Additionally, to follow safety specification ELEC-NDR-005, a 5.0A fuse is attached within 5cm of the power wire of the battery.



5A and 3A ATO Fuse. Photo: Amazon

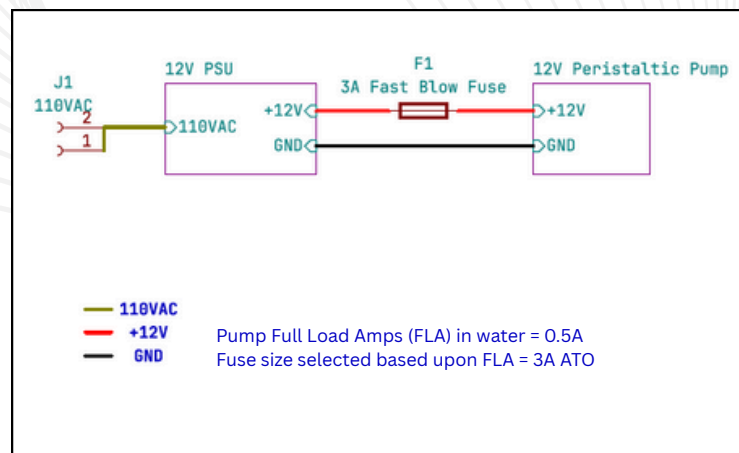


12V NiMH Battery. Photo: Amazon



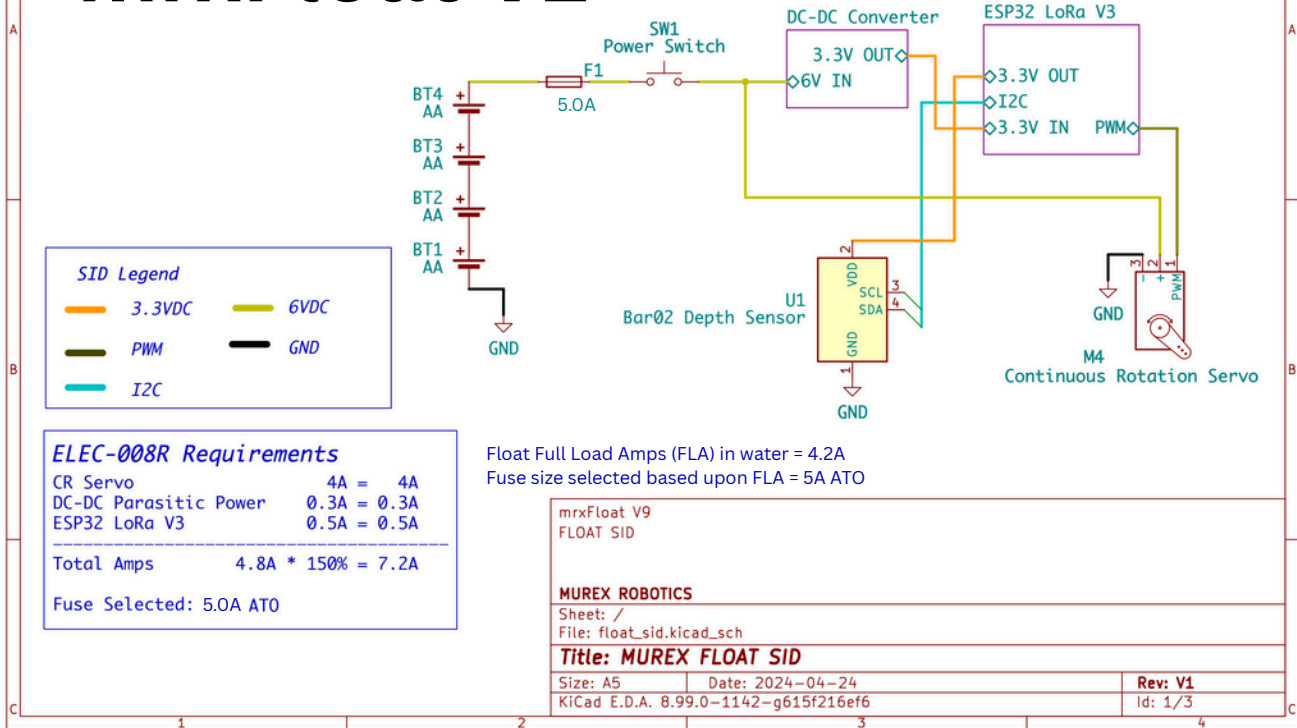
mrxFloat V2. Photo: F. Liu

Independent Peristaltic Pump



12V PSU and Peristaltic Pump. Photos: Amazon

mrxFLOAT V1



mrxFLOAT V2

