

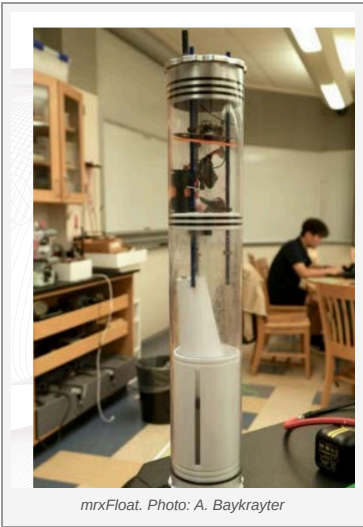
NON-ROV DEVICE – mrxFLOAT DESIGN DOCUMENTATION

MATE WORLD CHAMPIONSHIP 2026 | Vertical Profiling Float (MATE RFP Task)

The mrxFloat is MUREX's vertical profiling float, deployed to complete the MATE buoyancy task: it performs two vertical profiles through the water column and reports depth data back to the mission station after each surface. Rather than pumping water like a piston-and-cylinder system, the float changes its own volume. An open syringe driven by a continuous-rotation goBilda 2000 Series servo and a lead-screw mechanism expands and contracts the float's displacement by roughly 1000mL, which is enough to flip the float between sinking and floating on command.

The buoyancy logic is straightforward density. With no water drawn in, the float sits at about 2795g, and eight stainless steel ballast weights are mounted to the exterior by a 3D-printed bracket to bring it near neutral. When the syringe draws in 1000mL of water, the mass climbs to roughly 3795g while the float's volume stays fixed at about 2875cm³. That shifts the average density from 0.97 to 1.32, so the float descends. Reversing the syringe expels the water and the float ascends. The same volume swing, run twice, gives the two profiles the task asks for.

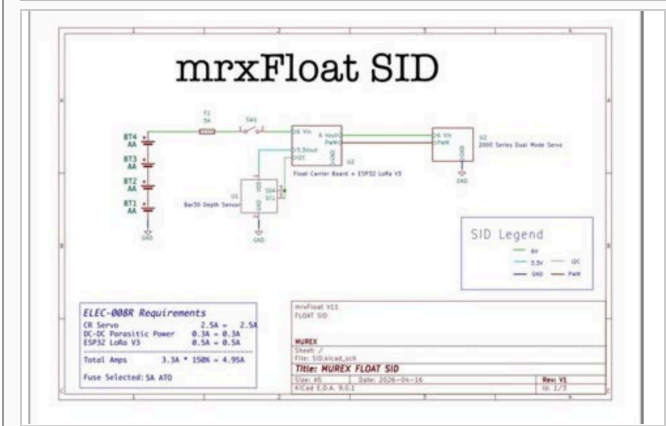
The main fuselage is 4-inch polycarbonate tubing, comfortably rated for the 14 feet of water pressure the deployment requires. We chose a volume-change buoyancy engine over a pumped-ballast design because there are fewer dynamic seals to fail and the displacement change is mechanically bounded by the lead screw's travel. Waterproofing runs on several layers of redundancy: both the syringe mount and the electronics enclosure seal with O-rings, and every penetrator and hex nut is sealed as well. In both build versions the enclosure was verified to comply with MECH-001, pressure tested to a 5m water column.



mrxFLOAT. Photo: A. Baykrayter

For control and communication, the float carries a custom mrxFLOAT Carrier Board hosting an ESP32 LoRa V3, the goBilda 2000 Series Dual Mode Servo, a 6V battery holder, an SPST switch, and an inline 5.0A fuse. We considered Wi-Fi and Bluetooth but went with LoRa for its simplicity and long range. The onboard ESP32 transmits at 915MHz, sending the company number, local time, and depth in five-second intervals throughout descent and ascent. A second ESP32 LoRa V3 on the surface receives those packets, which MUREX then graphs. Depth itself comes from a BlueRobotics BAR02 sensor read through the MS5837 library.

// mrxFLOAT SYSTEM INTEGRATION DIAGRAM



mrxFLOAT SID (incl. SID legend & ELEC-008R fuse calc). Diagram: K. Chen

Safety is built into the housing rather than bolted on after. The pressure relief system is a top cap that disengages from the tube under high internal pressure, backed by a standard BlueRobotics pressure cap rated to 12 psi. To satisfy ELEC-NDR-005, the 5.0A fuse sits within 5cm of the battery's power wire. The Carrier Board itself was a deliberate design choice: it adds screw terminals for secure connections and a wide-input (4.5–17V) 3.3V buck converter, which cleaned up the wire organization that earlier float revisions struggled with. To keep cost down, the custom endcaps are CNC'd from 6061 aluminum and the float reuses MUREX's older ROV electronics enclosure rather than buying a new pressure vessel.

The float is the product of three design iterations, narrowed with a casing-material design matrix and confirmed in the pool. Housing the float in polycarbonate keeps the internals visible for inspection, the redundant O-ring sealing keeps water out, and the bounded syringe travel keeps the buoyancy swing predictable. The result is a low-cost, repairable, self-contained profiler that surfaces, reports, and dives again without a tether.

// BUOYANCY SUMMARY	
Dry mass (no water)	2795 g
Mass with 1000mL drawn	3795 g
Fixed displacement volume	~2875 cm³
Density swing	0.97 → 1.32
Volume change per profile	~1000 mL
Pressure rating (MECH-001)	5 m column