

VERTICAL PROFILING FLOAT

PHYSICAL DESIGN AND RECOVERY

System Overview: The X18-Float is an Independent, Autonomous float that utilizes a variable-displacement buoyancy engine and explicitly does not use thrusters, propellers, or water jets for vertical movement. It operates via an internal power source and wireless radio link, completely free of physical surface tethers.

The chassis is an acrylic cylindrical pressure hull sealed with O-ring flanges. A top-plate U-bolt provides an ROV grasp point for retrieval, and a manual vent beneath it relieves internal pressure during transit. As a fail-safe, the O-ring caps are engineered to pop off if internal pressure exceeds external pressure.

Physical Specifications:

- Overall Height: 49.022 cm (Compliant with 50 cm limit)
- Overall Diameter: 11.43 cm (Compliant with 18 cm limit)



Figure 1. Vertical Profiling Float



Figure 2. Buoyancy Engine Mechanism

BUOYANCY ENGINE

Mechanical Logic: The buoyancy engine consists of a 12V Actuonix L12-50-210-12-P linear actuator connected to a syringe plunger. The actuator drives the plunger to draw in or expel water, changing the float's displacement and density.

Design and Reliability: This syringe based method was chosen for its mechanical simplicity and reliability compared to complex oil bladder systems. To ensure durability, the connection between the actuator and plunger uses a 3D printed part designed with fillets to minimize stress concentrations. This part incorporates a degree of freedom to prevent the actuator from exerting off-center forces that could crack the syringe.

Ballasting: The float is ballasted with steel shot to achieve near neutral buoyancy at the start of the mission, allowing the small volume changes from the syringe to effectively control ascent and descent.

BATTERY DESIGN AND SAFETY

Configuration & Housing: Power is supplied by an onboard series string of ten 1.2V AA rechargeable NiMH batteries, providing a nominal 12V DC rail. The cells are secured in a 3D-printed, circular "donut" holder that faces the terminals outward for rapid access and integrates the LoRa antenna assembly.

Fusing & Safety Statement: High-efficiency regulators step the 12V rail down to 5V for the Blue Robotics Bar30 depth sensor and 3.3V for the Adafruit Feather RP2040 and RFM95W LoRa radio. A 2A fuse is placed on the main control PCB within 5 cm of the battery positive terminal to protect against overcurrent and linear actuator inductive spikes. The device complies with standard MATE workmanship, uses marine-grade sealing, and poses no environmental hazards.



Figure 3. Battery Holder

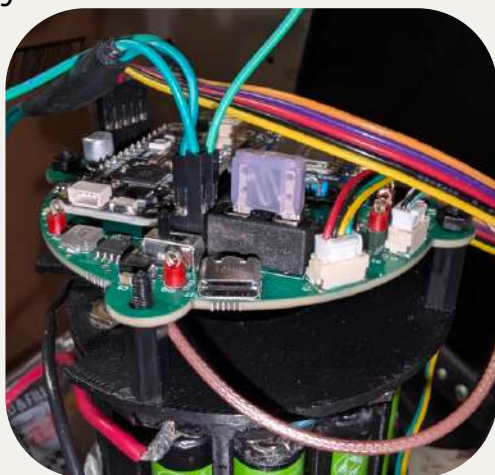


Figure 4. 2A fuse

FULL LOAD AMPERAGE (FLA) TABLE

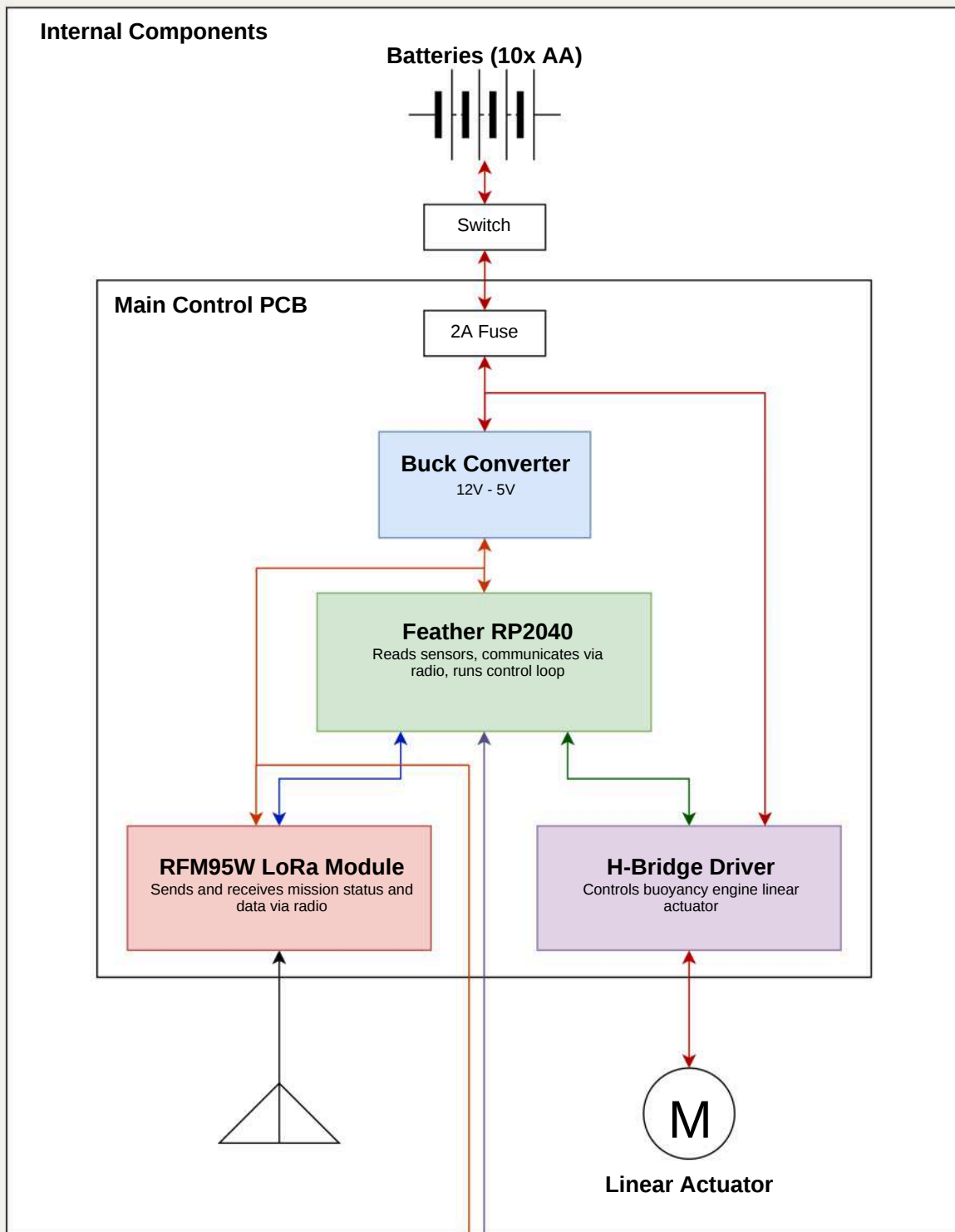
OPERATING MODE	MEASURED FULL LOAD AMPS (FLA)
Waiting Mode (MCU and Sensor Active)	0.029 A
Buoyancy Change Mode (Actuator Active)	0.056 A

Figure 5. FLA Table

COMMUNICATION PROTOCOL

The float runs a "Silent Dive" protocol via a Semtech SX1276 LoRa radio link:

- **Packet Structure:** Formatted in fixed 36-byte binary packets (1-byte opcode, 2-byte sequence, 32-byte payload, 1-byte XOR checksum). The 32-byte payload explicitly embeds the assigned MATE Company ID, Time Data timestamp, and Bar30 pressure/depth values.
- **Pre-Dive Handshake:** The surface station transmits configuration parameters (CMD_SET_PID, CMD_SET_DEEP_TARGET) and a calibration command (CMD_ZERO_DEPTH) to tare the sensor. Receipt of CMD_BEGIN_PROFILE (0x04) initiates the dive.
- **Silent Profiling:** The radio is disabled underwater to conserve power. The float autonomously samples the Bar30 sensor every 1 second, saving up to 1,000 data points to internal memory.
- **Surface & Data Dump:** Upon surfacing, the float broadcasts a CMD_DONE_PROFILE (0x05) heartbeat every 3 seconds. Once the surface station sends CMD_SEND_DATA (0x01), data is transferred sequentially; each packet requires a surface CMD_ACK (0x07) to prevent data loss until a CMD_DATA_DONE (0x06) packet terminates the sequence.



Fuse Calculation

12V	{	Linear Actuator: 246 mA
		Feather RP2040: 25 mA
5V	{	Radio: ~100 mA
		Depth Sensor: 1.25 mA

~130mA @ 5V = ~65 mA @ 12V

Total Current @ 12V: 246 + 65mA = **311 mA max current**

Choose 2A fuse to allow for current spikes from linear actuator motor

Legend

	12V
	5V
	GPIO
	SPI
	I2C