Mechanical Design

Based on the buoyancy engine concept, M.I.A. has designed and built MIA Float. The float utilizes a straightforward hydraulic circuit that relies on the surrounding water as its working fluid. By adjusting its weight while keeping its volume constant, the float modifies its buoyancy to achieve the necessary profiles.

Figure (1). MIA Float Device

Hydraulic Circuit

The float employs two fixed-displacement, unidirectional diaphragm-type pumps. One pump transfers water from the surrounding environment to an interior water tank inside the float body, while the other pump moves the accumulated water from the tank back to the surrounding environment.

Float Structure

The float consists of two sealed sections:

Float Body:
This section contains the hydraulic circuit components (pumps, bladder, fittings, and hoses). The body features an exchange port that allows water to enter or exit the float body.

Float Head:
This section houses the float's electrical enclosure, which contains all electrical components, including the batteries. The float head is sealed using triple stages of O-rings. Its security relies on the fit of the O-rings themselves, ensuring that the enclosure will not open in case of interior pressure buildup.

Electrical System

MIA Float is powered by Ni-MH batteries supplying 12V which drives the 2 diaphragm pumps of the buoyancy engine. A 12 to 5V voltage converter powers the ESP32 micro-controller controlling the pumps. The ESP32 also interfaces the BMP 180 pressure sensor for collecting pressure data and maintaining depth. To maintain depth at 2.5m, a PID controller is implemented on the ESP32 utilizing the BMP 180 sensor for feedback control, and dynamically controlling each pump to achieve the required buoyancy force. A key feature of the ESP32 is the inclusion of a Wi-Fi module paired with a power amplifier and antenna. This is utilized for sending each profile's data to the base station. Receiving the data is done on the topside computer with no additional hardware. Once received, depth-time data is graphed, and the float initiates the next profile.

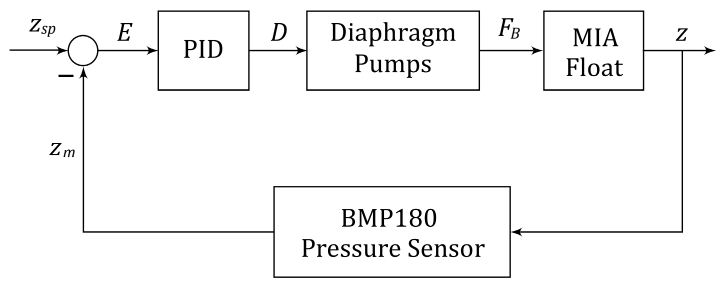

Figure (2). Control System Block Diagram

Current Measurements

The current sourced from the batteries was measured in water both while profiling and while waiting/transmitting packets.

Condition	FLA
Profiling	0.51 A
Waiting	0.14 A

Table (1). FLA Measured

Battery Selection

Using rechargeable batteries was more feasible than alkaline due to cost and longevity. Complying with MATE rules, a battery pack of **10x Ni-MHAA2500mAh** provides sufficient current to the system. A **2A fuse** protects the batteries from going over the safe **1C=2.5A** discharge rate.

Appendix

1. MIA Float Hydraulic SID

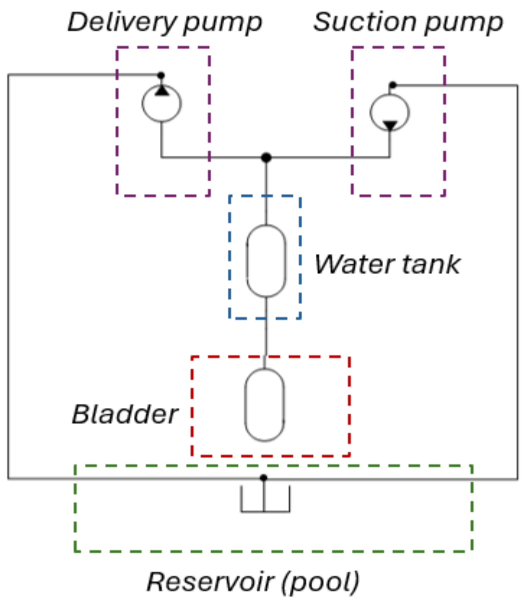

Figure (3). MIA Float Hydraulic SID

2. MIA Float Electrical SID

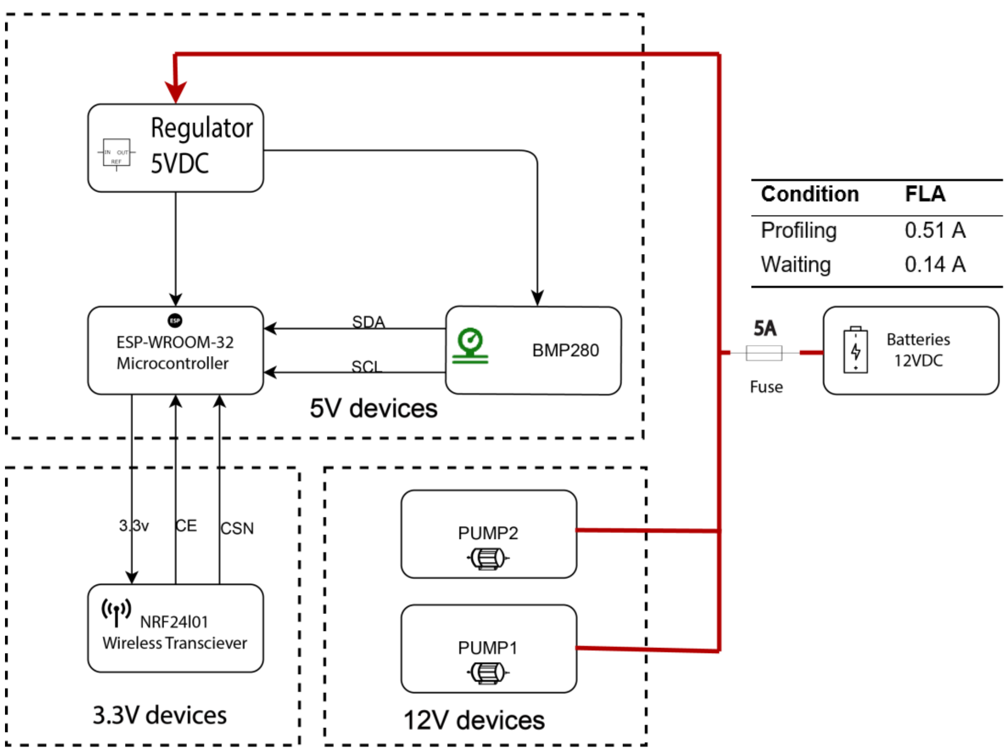

Figure (4). MIA Float Electrical SID