



1. System Overview & Buoyancy Engine Description:

For the 2026 season, our standalone active buoyancy float, Crystal, underwent a major architectural overhaul. We transitioned from a heavy pneumatic piston to a dual-pump, vacuum-sealed bag system. This eliminated the bulky pneumatic cylinder, reducing the overall height from 70 cm to 28 cm and slashing the weight from 17 kg to a highly portable 4 kg. Despite the 4x size reduction, the vacuum-sealed bag system doubled the water intake capacity from 150 ml to 300 ml, expanding our variable density range (0.92 to 1.07) for incredibly smooth vertical profiling.

Control: An ESP32 microcontroller continuously reads depth data from a Bar30 pressure sensor. It utilizes a custom PID algorithm to pulse a MOSFET circuit, smoothly controlling the flow rate of the two 12V pumps to prevent the float from overshooting its target depth.

Required Visual: Insert a photo or diagram of the fully assembled Crystal float here.



Fig 1: Crystal

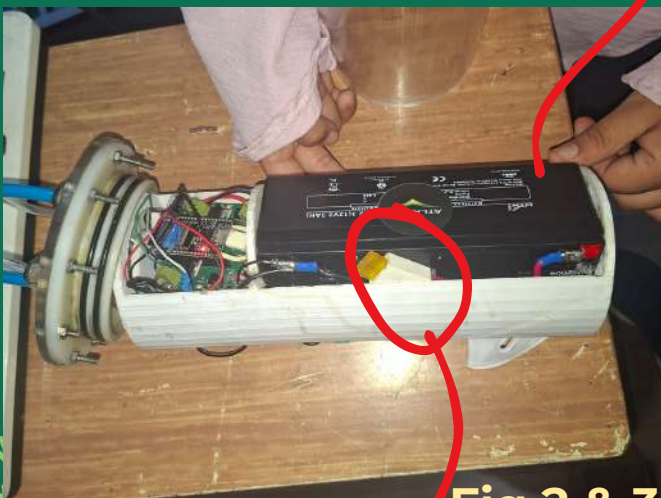
2. Battery Specifications & Safe Design

Battery Type & Specs: To ensure strict compliance with autonomous device regulations, Crystal is powered by a sealed, spill-proof 12V AGM (Absorbent Glass Mat) battery with a 5 Ah capacity.

Safety Integration: The battery is securely mounted within the chassis to prevent it from shifting inside the enclosure. The main electronics housing is face-sealed using O-rings to protect internal components.

Custom Power Switching: Instead of an expensive, standard waterproof switch, we engineered a custom power circuit using a \$3 magnetic reed switch. Placing a magnet on the outside of the hull turns the system OFF, and removing it turns it ON. This has no external moving parts that could break under pressure, making it highly reliable.

Required Visual: Insert a photo of the 12V AGM battery pack here.



5A Fuse



Fig 2 & 3 : Crystal's internal structure

3. Full Load Current & Fuse Selection

Power Management: The two 12V pumps draw a combined 4.55A continuously. To prevent the massive startup power spike from blowing our inline fuse, the ESP32 is programmed with a "staggered activation delay." This ensures the pumps never turn on at the same millisecond, keeping the power draw safely under the limit.

Hardware Protection: The entire 12V system is protected by a single 5A blade fuse located right next to the battery.

Required Visual: Insert a photo of the 5A blade fuse used on the device here.

Required Table: Insert your table of measurements here. (Make sure the table explicitly proves the max simultaneous draw is 4.55A).

4. Shore Communication

Description: Crystal operates completely independent of the main ROV. (Note: You need to add a sentence or two here explaining if/how the float communicates with the shore side receiver, or explicitly state that it executes its vertical profiles entirely autonomously with no surface communication post-deployment.

Part 2: System Interconnection Diagram (SID) (1 Page)

Since this must be a separate 1-page document, you will need to draft a schematic. Keep it clean and focused purely on the power flow.

What to draw on the SID:

- 1.Power Source: A box labeled "12V 5Ah AGM Battery".
- 2.Fuse: Draw a line from the battery positive terminal to a standard fuse symbol (usually a rectangle with a line through it, or a wave symbol). Label this specifically as "5A Blade Fuse".
- 3.Switching: Draw the connection to your "Magnetic Reed Switch Circuit".
- 4.Load: Connect this to the "ESP32 Controller & MOSFET Circuit" and branch out to the "Dual 12V Pumps".

Mandatory Text to include anywhere on this 1-page drawing:

- Full Load Amps in Water: 4.55A
- Fuse Size Selected: 5A

Component	Operating Voltage	Max Current Draw (A)	Max Power (W)
ESP32 Microcontroller & Logic	5V (via Buck)	0.10 A	0.50 W
Bar30 Pressure Sensor	3.3V (via ESP32)	0.05 A	0.16 W
Intake Pump (12V DC)	12V	2.20 A	26.40 W
Drain Pump (12V DC)	12V	2.20 A	26.40 W
Total Simultaneous Peak Load	--	4.55 A	53.46 W

Fig 4: Power Calculations Table

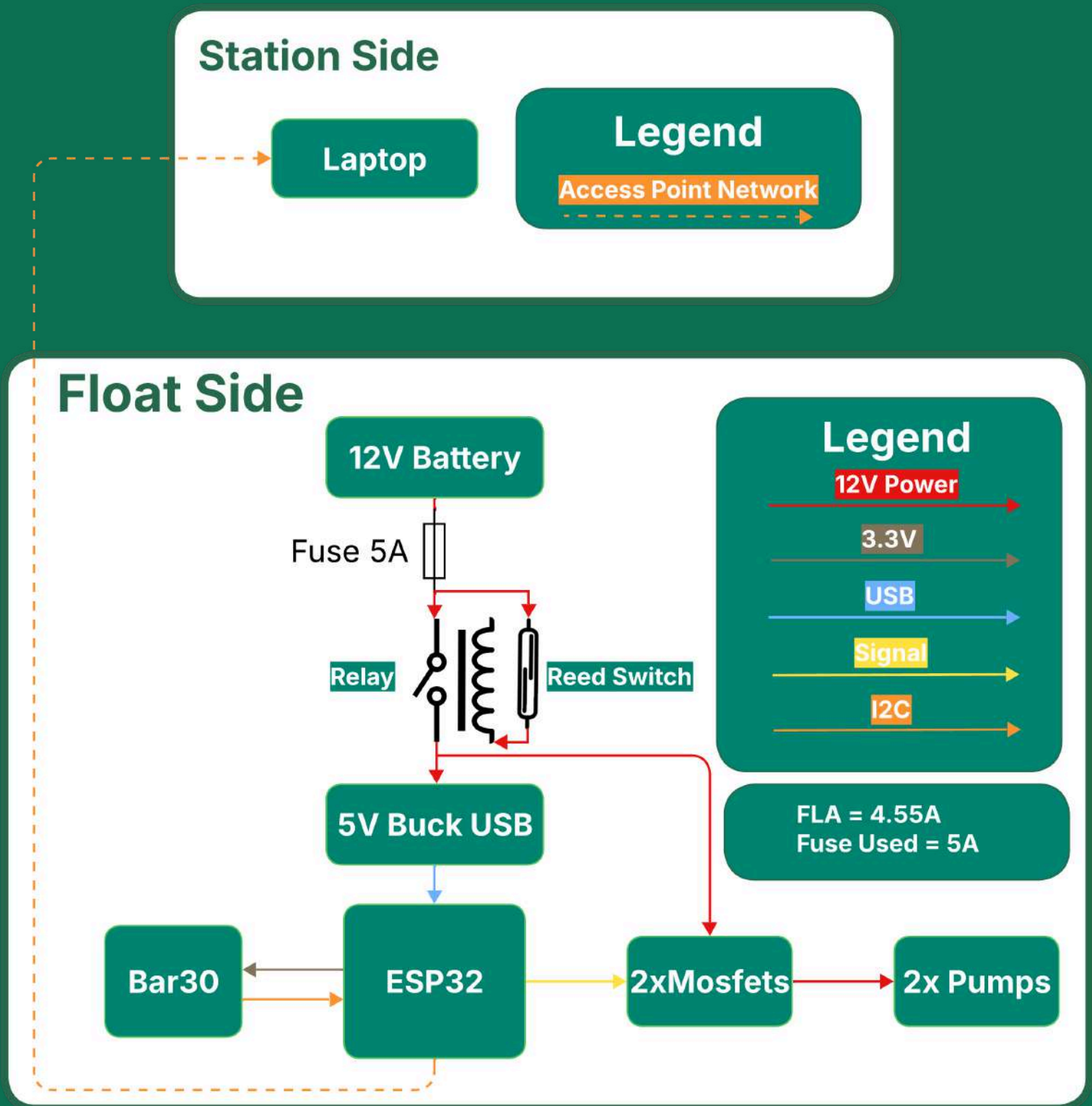


Fig 5: Crystal's SID by Zeyad Amr