

Phoenix Robotics

Non-ROV Device Document “Sub-Zero”

The purpose of the non-ROV device, or Vertical Profiler, is to complete *Task 4: MATE Floats Under the Ice*. This task was inspired by the National Science Foundation-funded GO-BGC project, which launches research profiling floats across the Earth’s oceans. The Vertical Profiler consists of four sections: the weight compartment, electronics tray, buoyancy engine housing, and sensor cap.

First, the weight compartments located at the bottom of the float consists of a four-inch PVC pipe connected to a four-inch sleeve. Four holes were drilled into the sleeve to remove any air bubbles that can affect the buoyancy during operation. Inside the compartment is a one-inch pipe with a rubber stopper. This is the pressure relief valve that releases the rubber stopper in any instance where too much pressure is built up inside the system. Inside the four-inch pipe, there are also weights that help to set the buoyancy of the profiler. These weights consist of lead and sand bags that measure to 7.23 kg in weight, producing the neutral buoyancy of the system. The reason for choosing lead is because it is a very dense material and also comes in many forms, allowing members to use balloons filled lead pellets that are located at the bottom and fit snugly, leaving space for any additional weight. The balloons surround the center of the 1-inch PVC pipe inlet connected to the pressure relief valve.



Figure 1: Non-ROV Device



Figure 2: 12-Volt Battery Pack

Further up the profiler is where the electronics tray is located. The switch and the fuse are located in the weight compartment but still connected to the tray. This year, the switch selected is a stainless steel push button switch that is sealed from the exterior with a bottle cap and silicon divider wax. This switch is then hooked up to the electronics with the power wire going through a five-amp fuse that then is hooked to a battery pack to prevent electrical overcharge from happening if accidents occur. From there, the battery powers an ESP 32 board, an MDD10A Cytron motor driver, a 12 volt Direct Current (DC) motor, and

a Micro SD Card Module all located on the tray. The I²C converter and Bar 30 sensor are located closer to the top of the Vertical Profiler. This year's Vertical Profiler moved from an interchangeable battery pack to a shrink wrapped Nickel-Metal Hydride (NiMH) battery pack that houses 10 batteries to follow proper regulations and keep a steady power supply within the voltage limitations. These electronics were chosen because when put in the tray, they fit perfectly in the profiler's housing. The Cytron motor driver board is being used this year since members are using a 12-volt DC motor over a servo system for the buoyancy engine design. The purpose of this is to preserve consistency and time during runs. In previous years, using servos caused inconsistent results when doing cycles, including not being able to sink below sea level, not excreting enough water to return, and easy corrosion of the motor itself when using it to perform cycles. With all these factors, the company decided to look for a better, more suitable motor for the tasks provided this year. The motors discovered came in four different Rotations Per Minute (RPM), including 200 RPM, 100 RPM, 50 RPM, and 30 RPM. When testing, a discovery was made that the 100 RPM was best suited for efficient movement of the syringe for cleaner and quicker runs. This motor is connected to a lead screw, which has an aluminum block that slides up and down the screw with the plunger of a 100-milliliter syringe. This allows the syringe to take in or expel water to move the Vertical profiler up and down for proper cycles. The reason a 100-milliliter syringe was used instead of a 60-milliliter syringe like last year's model was because it gives the Vertical Profiler easier density variability.



Figure 3: 5-amp Mini Blade Fuse

In addition to this, the I²C converter and the Bar02 sensor can be found on the top of the Vertical Profiler. The sensor connects to the I²C converter, and the data is then read by the ESP32, which collects it in packets and saves it in the SD card. The SD card reader then sends the information to the ESP32 to send through a web serial, which gives all the data with a singular command. This code is repeated constantly without stops to ensure the data returns altogether when returning to the surface. The reason for choosing this method instead of other ideas like using an antenna or setting a timer for the information dump is due to a few factors. One of these factors is that having an ice sheet above the Vertical Profiler prevents the use of an antenna and would be hard to work with, since there is a set depth to rise at for *Task 4 MATE Floats*. The other factor was that finding the timing to command a data packet is unnecessary for the purposes of this year, since the Vertical Profiler is not able to return to the surface on its own, instead being dragged by an ROV to be received, which could vary in time and speed.

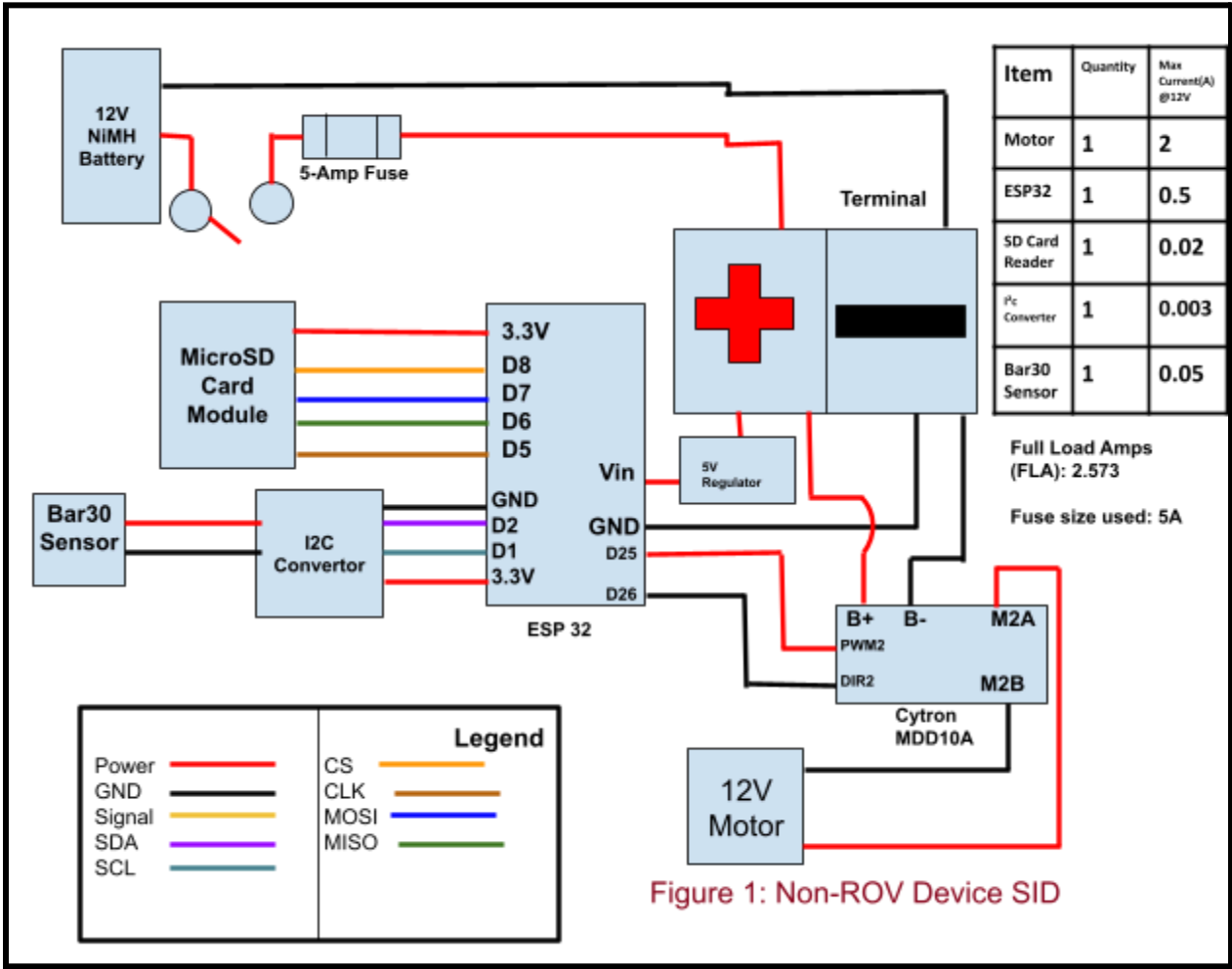


Figure 4: Non-ROV Device SID