Thruster Board

The thruster board was developed for the purpose of managing the eight PWM signals sent to the ESCs. It has a current sensor system for each thruster. In the latest update, it has been completely redesigned to add an individual protection system to the thrusters and improvements in power supply connections and external communication.

PWM Signal

The control of the PWM signal is done through an atmega 2560 microcontroller, responsible for generating the signal for the ESCs. But what exactly is the PWM signal. The PWM (Pulse Width Modulation) signal is a way to control the power of components. Let's say we have a switch that turns on and off, when turned on it delivers all available power, but when turned off it doesn't deliver any power. Suppose we have control of the time the switch is turned on or off, so we will also have control of the power that reaches the component. For example, if we have a switch turned on for 25% of the time and the rest turned off, we will have an average of 25% of the time with power and 75% without power, in this way the power applied to the component will be 25%.

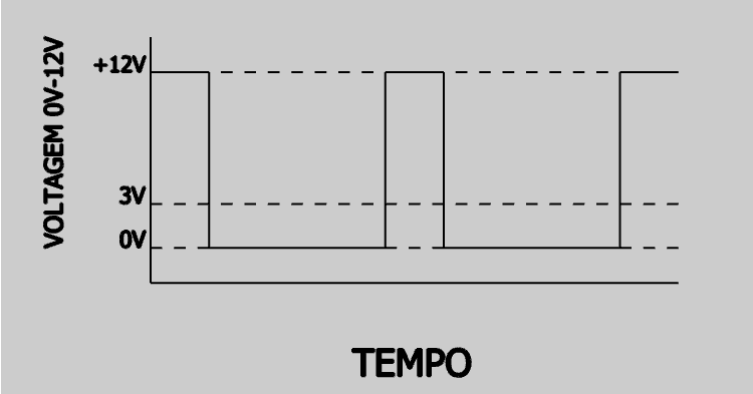


Image 1: Gráfic of the PWM signal.

ESC

The ESC (Electronic Speed Controller) is responsible for applying the PWM signal to the thrusters, thus controlling the speed. It has two variations, Brushed (with brush) and Brushless (brushless). The ESC to be chosen depends on the thruster used, currently the AUV uses brushless three-phase thrusters, only the ideal for the AUV is Brushless. The difference between the two ESCs is that Brushed only uses the PWM signal to control the power of the thruster, while Brushless uses the PWM signal together with a microcontroller built into the ESC, with pre-defined software to trigger in sequences of coils. They are mechanically coupled to the board through 3D printed support.

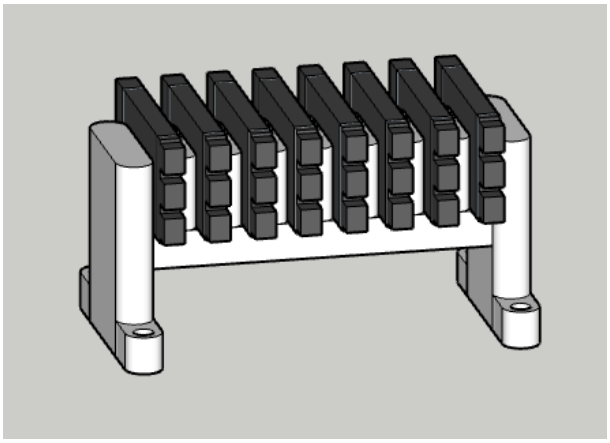


Image 2: 3D Suport for the ESCs.

Current Sensor

Each current sensor has an IC (Integrated Circuit) ACS712-30A, so it is possible to read each thruster and send the data to be processed by the microcontroller atmega 2560.

Protection System

The thruster board has eight protection systems, with the purpose of protecting the thrusters from current surges and short circuits, so each protection system will be assigned to a thruster. The system uses components such as mosfets, resistors, bipolar diodes, zenners and SCRs.

Comunnication and Consumption

The aforementioned systems require a high power consumption, for this reason the board has two 24-pin ATX connectors, in order to support the energy demand, one being used only for power supply and I2C communication (Inter-Integrated Circuit). The I2C is the protocol used to communicate with Nvidia Jetson (central board, in charge of operating the AUV), the second connector makes the communication with the thrusters.

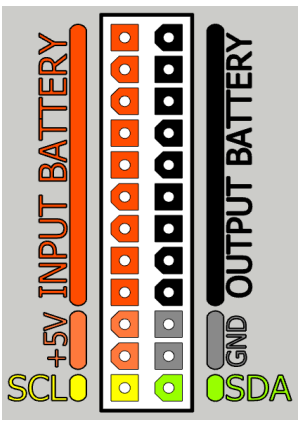
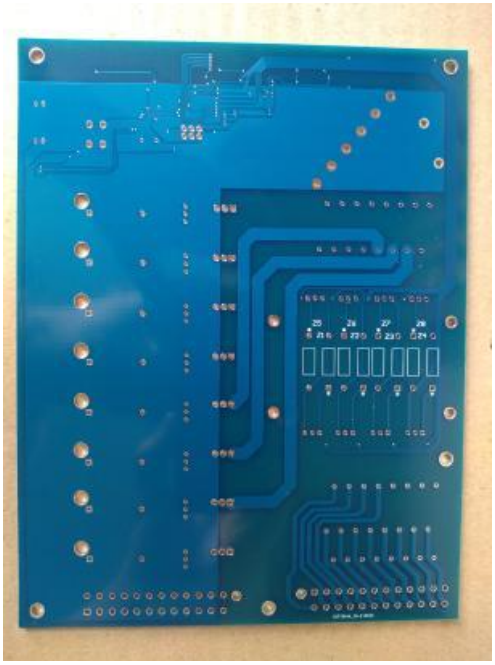


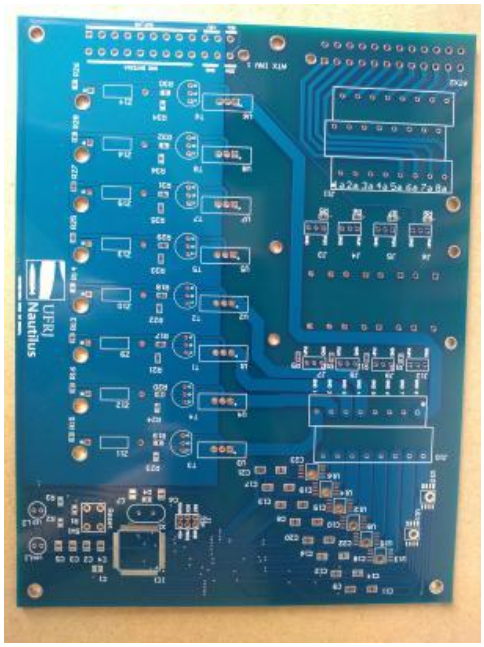
Image 3: Pinout ATX24 consumption.

Usage Example

Let's say the AUV needs to travel a distance, in a short period of time. If it only had fixed speed, it would not be able to complete the course in time or would be too fast, as a consequence the AUV would not have control over its route and the avoidance of obstacles. Having the use of the propeller plate, which is responsible for controlling the speed and protecting it, there will be more flexibility when concluding a path, being able to decelerate and make the contour if it sees an object or accelerate if necessary.

For our AUV project, we are using the amazing JLCPCB thruster board! Here are some pictures of our board:





A big thank u to JLCPCB

$2 for 1-4 Layer PCBs.

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