Introduction

TC (Traction control) is a PCB designed and assembled by members of PUT Motorsport - a Formula Student team from Poznań University of Technology. Our goal is to create a functioning racing car in order to participate in competitions all around the world - thus our PCB's need to be well thought of and carefully created with the highest precision and standards.

Features

Main features of the board are:

- wheel speed measurement
- inertia measurement
- analog measurements of various car variables
    - monocoque and water radiator temperatures
    - water pressure
    - rear suspension travel
    - motor resolver
- CAN interface
- brake light control
- ready to drive sound buzzer control

Motivation

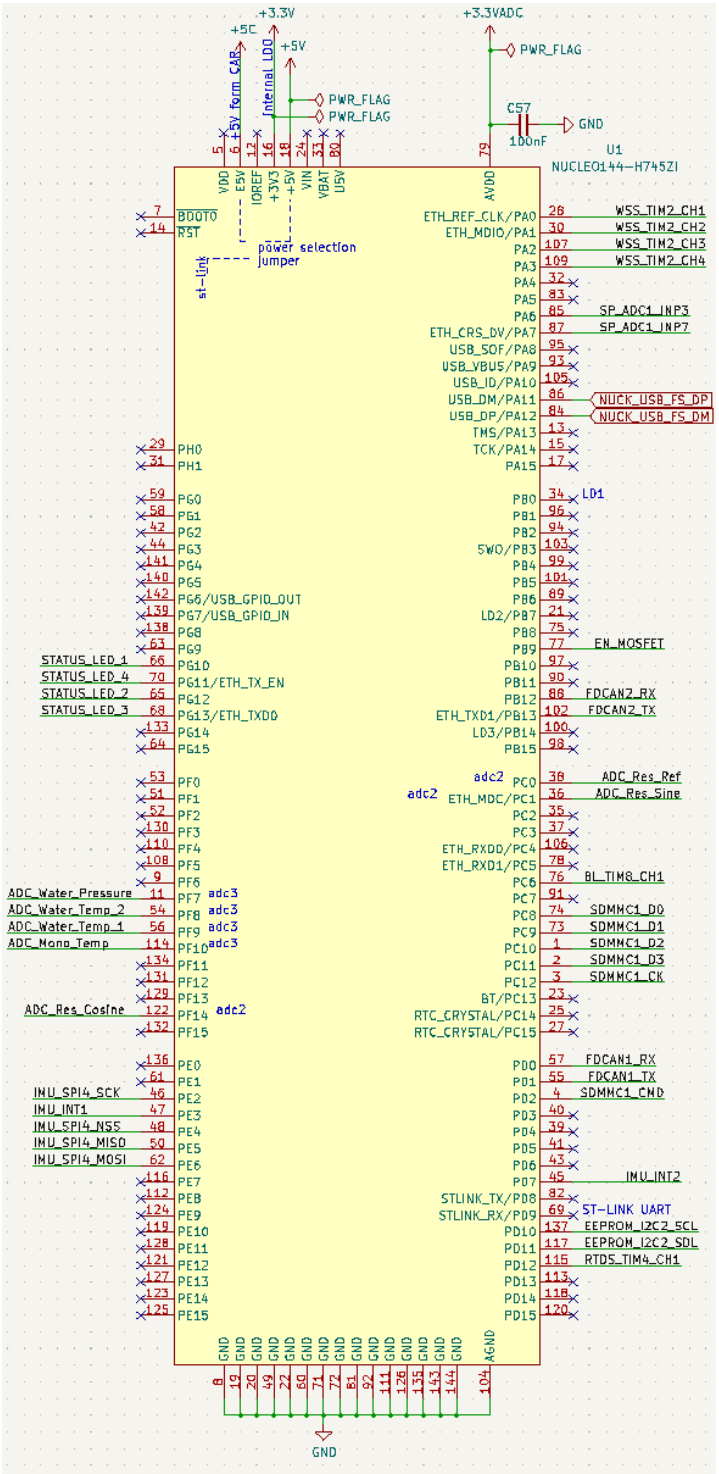
TC is one of the most important boards of the car. First of all it is responsible for controlling the brake light and ready to drive sound buzzer which are two components required by the competition rules necessary for safe operation on the track. But the main task of traction control is to regulate surface slip of the wheels. In order to achieve that, TC uses many equations and indicators such as slip ratio in order to estimate the state of the car and based on that sends appropriate commands to the frequency inverter using a dedicated CAN bus. It is also responsible for logging data to a SD card for later analysis and publishing data to the CAN bus of the entire car for other devices to use it.

$$\mathrm{SR}\left(\mathrm{v_x}\left(t\right), \omega_l(t)\right) = \frac{r_{dyn}\omega_l(t) - \mathrm{v_x}\left(t\right)}{\max\left(r_{dyn}\omega_l(t), \mathrm{v_x}\left(t\right)\right)}$$

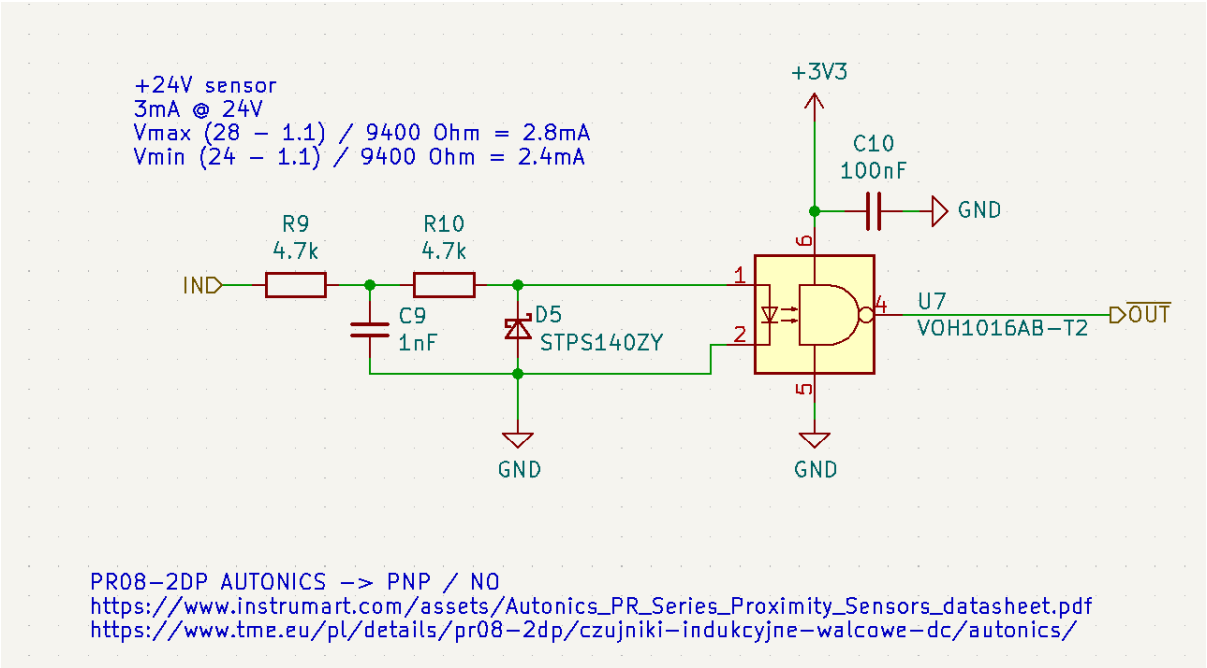
The equation for slip ratio

The brain

Main computational force of the board is an STM32H743ZIT6 MCU on Nucleo 144 Development Board.

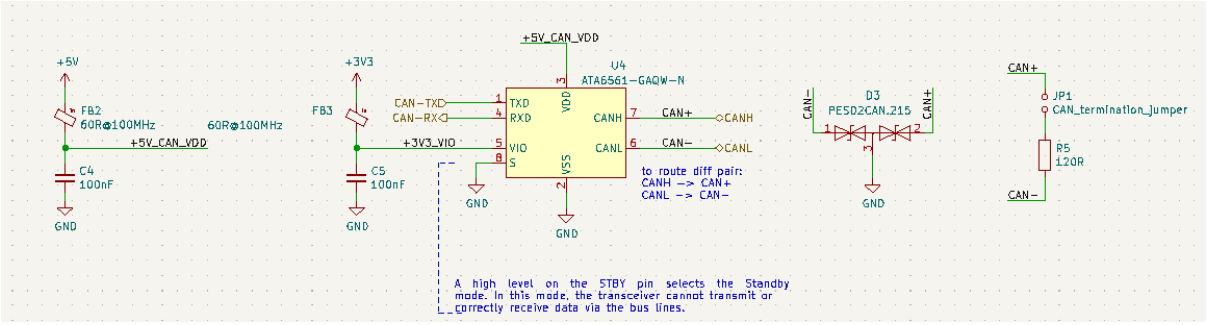


Wheel speed measurement

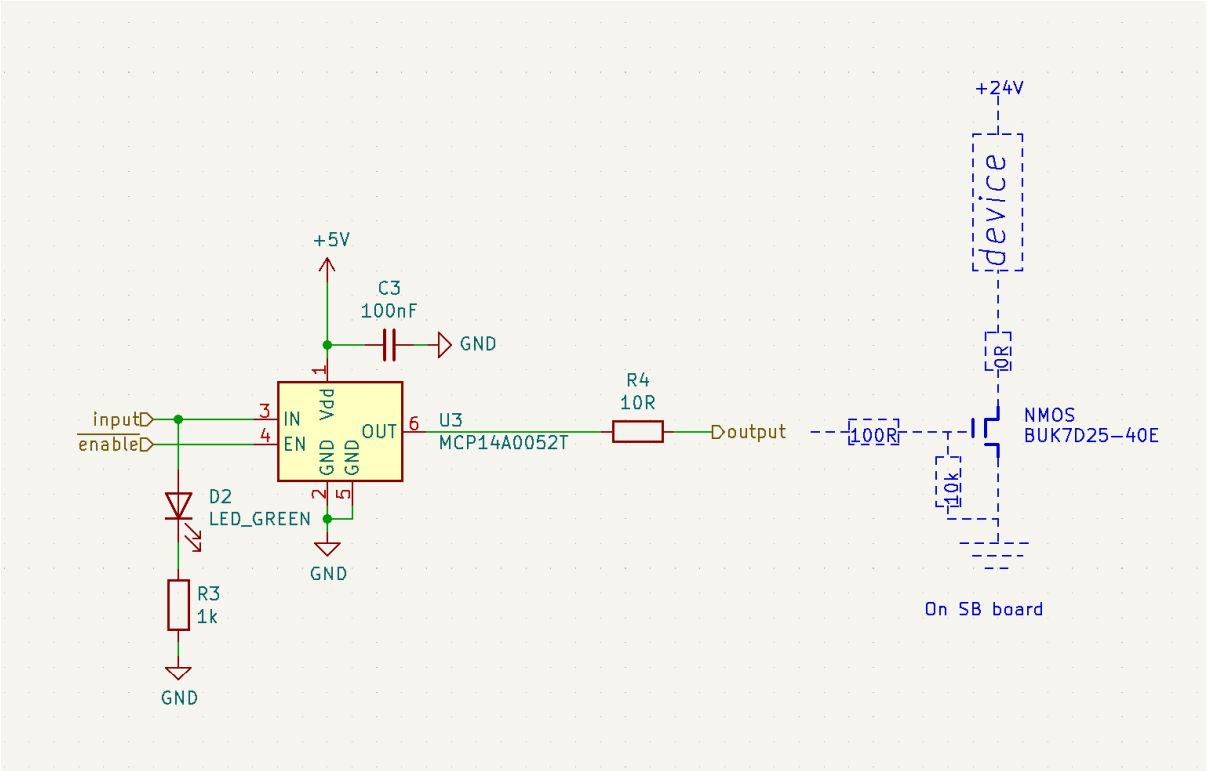


CAN interface

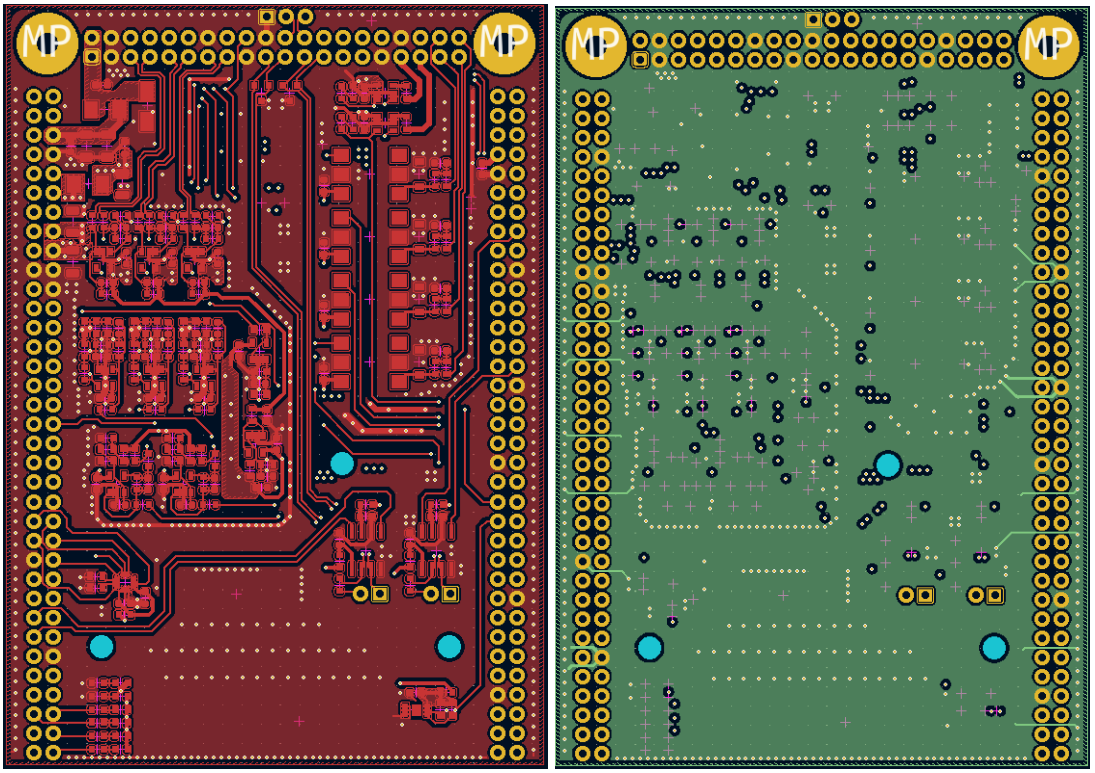
Our car uses CAN bus for device communication. TC sends different frames containing valuable data such as car state, suspension position, cooling water temperature and pressure and wheel speeds.

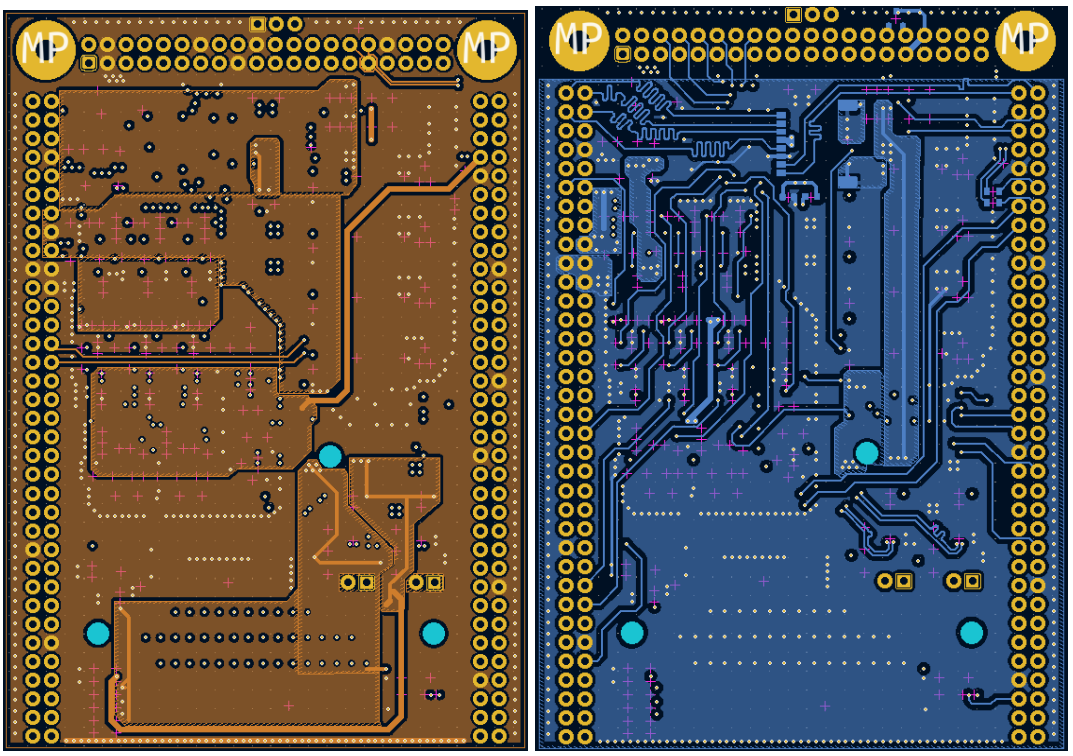


Brake light control



Multilayer design

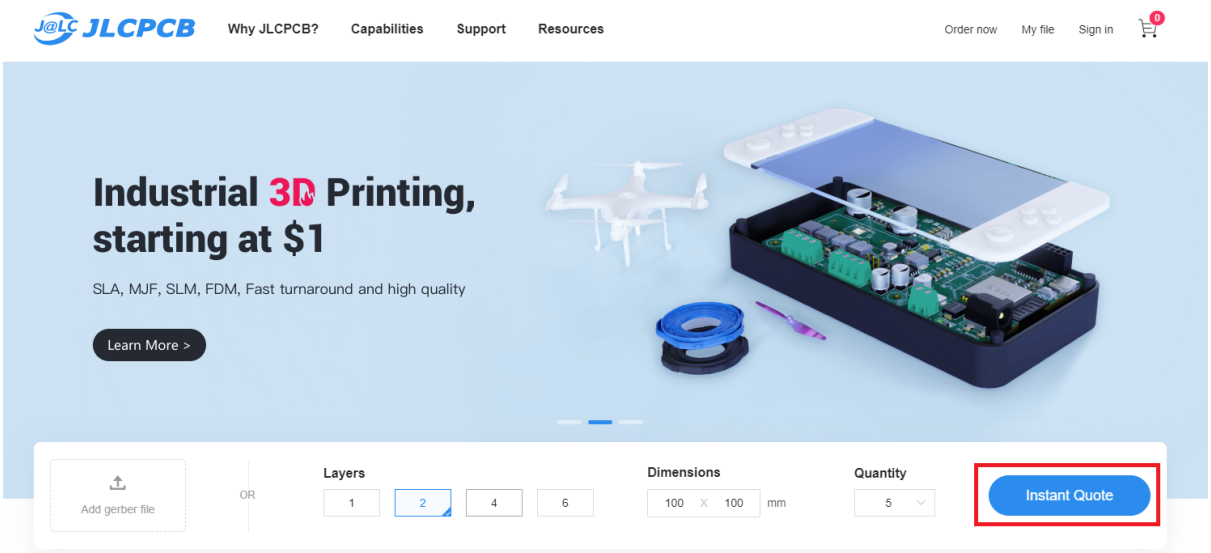




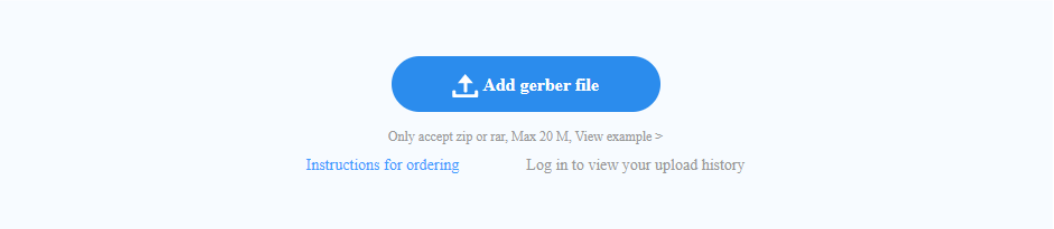
When designing race cars there are two main considerations that apply to every component - it’s size and weight. The smaller and lighter - the better. That’s why it is common for us to design multilayer boards. Such boards are really hard to manufacture that's why we partnered with one of the best PCB manufacturers in the business - JLC PCB!

Manufacturing

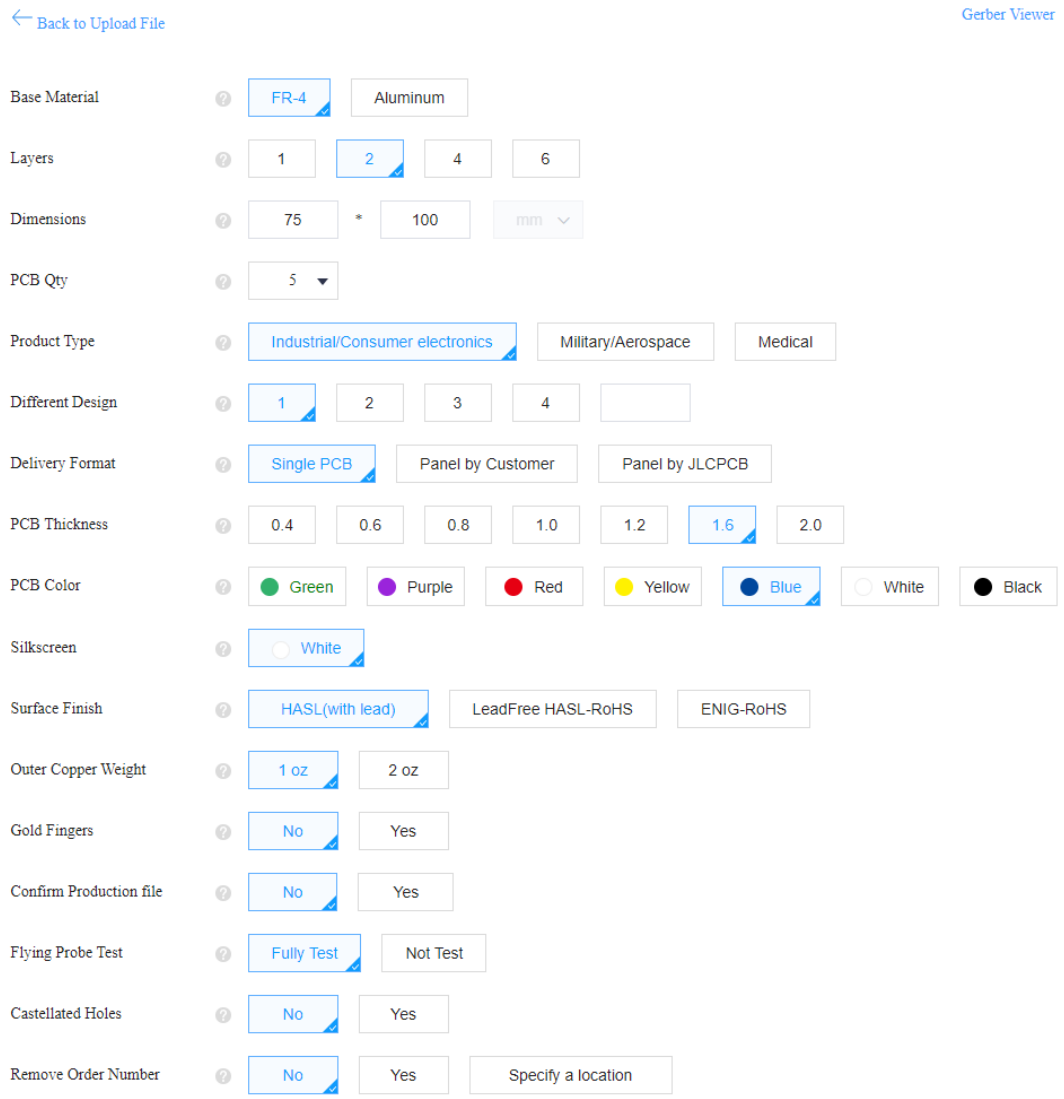
PCBs designed by our team are manufactured by JLCPCB - a hardware production company that specializes in batch PCB production. You can create PCBs with up to six layers, and order a batch size that fits your needs. Batch production is beneficial since during PCB assembly, many things could go wrong and the board could get damaged, that’s where excess copies come in handy. If unlike us you don’t enjoy assembling PCBs, JLCPCB has got you covered as PCB assembly is also a part of their offer! To order a PCB of your design, simply go to jlcpcb.com and click the “Instant quote” button.



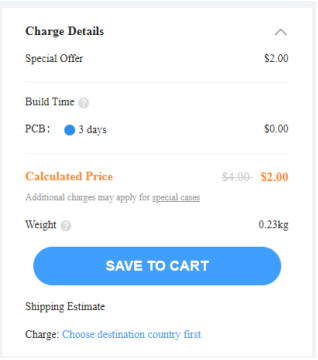
You will be forwarded to the order editor where you'll find plenty of options to customize your batch of PCB to fully meet your needs. Firstly you'll need to upload your gerber files archived into .zip or .rar format.



After the files have been uploaded successfully, you'll see a board preview. The preview as well as the summary view will change accordingly to options you have chosen. Some of the options (like dimensions or layer number) will be pulled from the gerber files you have uploaded.



After you've customized the board, you can proceed to the checkout located at the right side of the editor.



Each and every board we've received from JLCPCB is of highest quality and we've always enjoyed working with them!