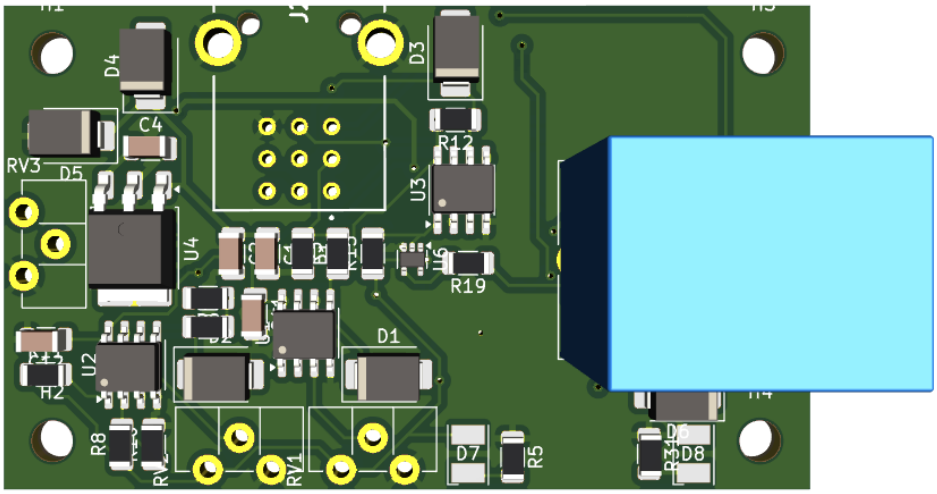
THE BSPD SYSTEM IN FORMULA STUDENT



Definition

The Brake System Plausibility Device (BSPD) is a component required for Formula Student competitions. Its function is to monitor the brake pressure and the position of the accelerator pedal to ensure the safety of the vehicle.

How it works?

The BSPD (Brake System Plausibility device) is a part of the shutdown system of the car, and it consists of a non-programmable circuit that prevents the driver from braking and accelerating at the same time, in order to prevent failures.

BSPD operates on the basis of:

1. It's open by default.

2. It only opens when the brake system pressure is more than or equal to 30 bar and the accelerator pedal delivers ≥5 kW power to the motors.

3. The action of opening the SDC(shutdown circuit) must occur if the implausibility is persistent for more than 500 ms.

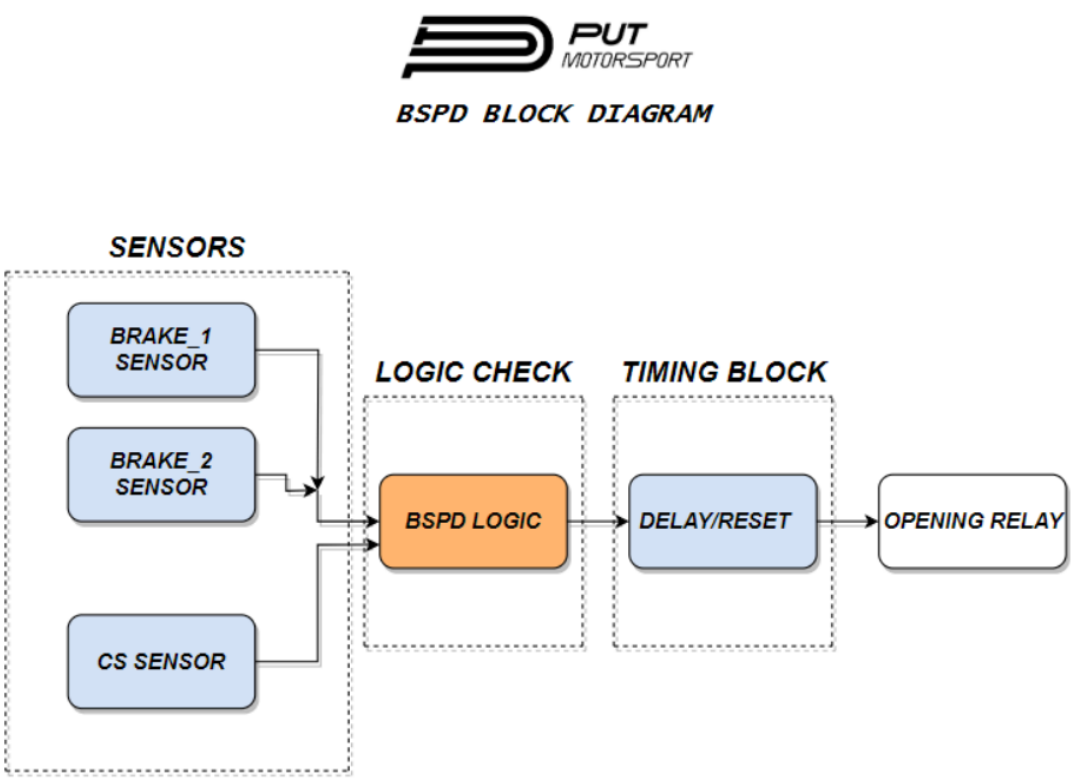
4. The BSPD must be directly supplied from the LVMS

5. After being triggered, the BSPD may become closed again either by power-cycling the LVMS or, if the opening condition is absent for longer than 10s, the BSPD resets itself.

This device is necessary for safety as it prevents situations where the vehicle continues to accelerate despite heavy braking. If such a situation is detected, the BSPD shall immediately turn off the power to the vehicle.

The whole project including both the hardware, and the firmware is open source. The repository is available at PUT-Motorsport/PUTM_EV_BSPD_2024.

Block diagram of BSPD



a. Brake_1 and Brake_2 blocks are responsible for checking the brake pressure signal from sensors

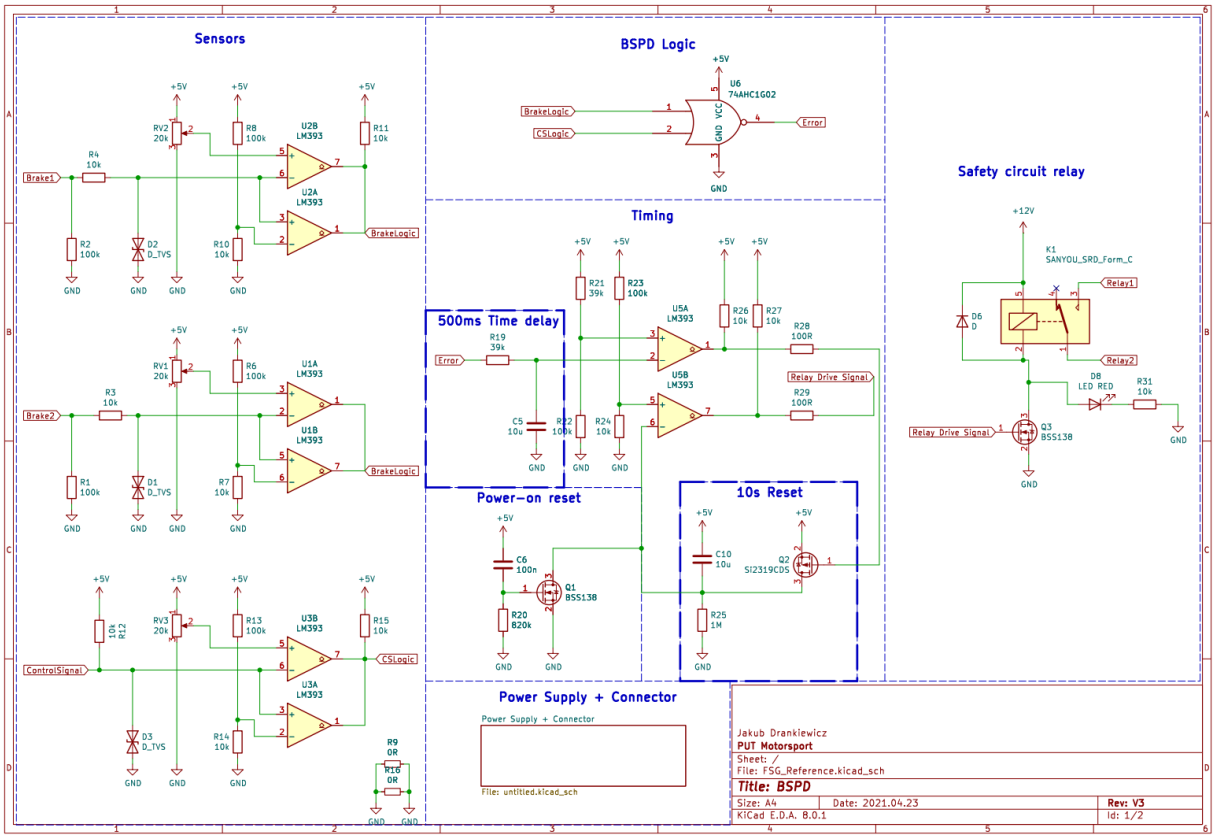
b. CS Sensor must check the power that is delivered to the motors

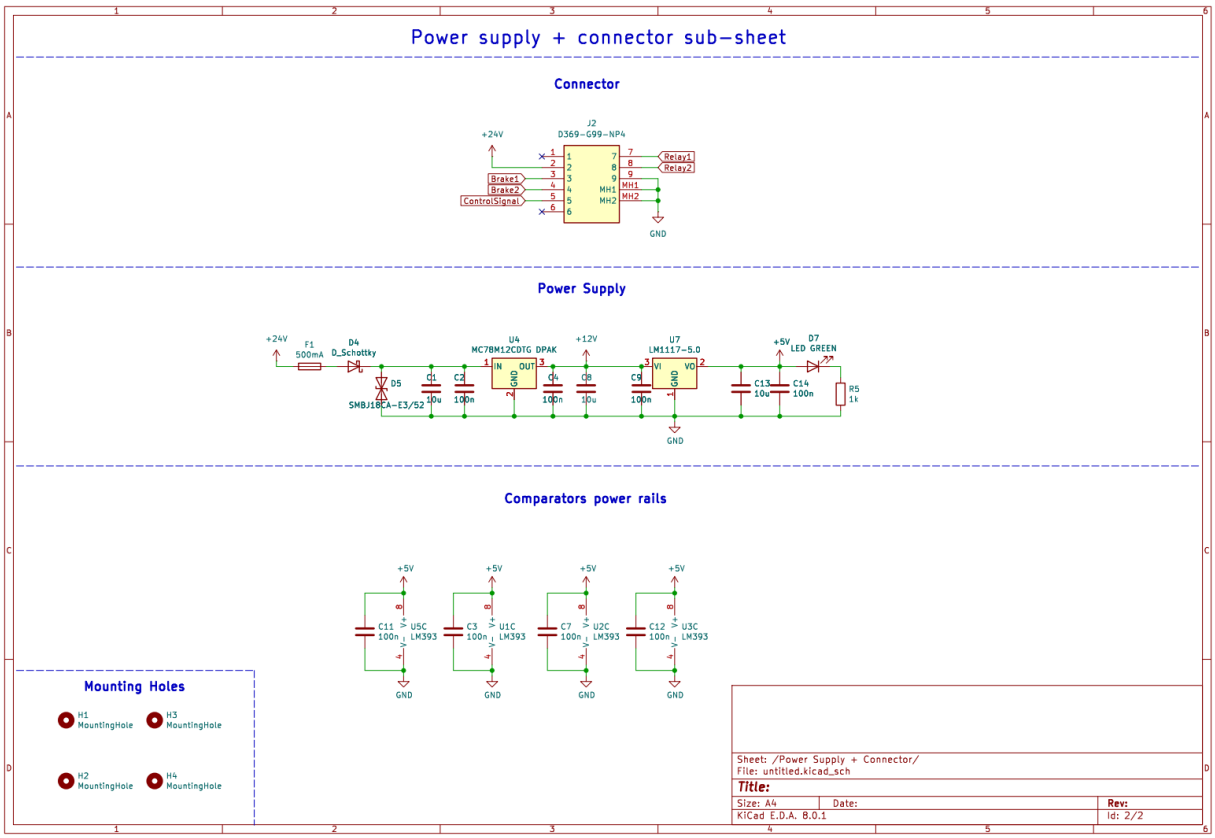
c. Logic check block is responsible for checking the BSPD opening condition

d. Timing block includes circuits like 10 second reset, power on reset, 500ms relay.

e. Opening relay block delivers a signal to SDC, which disconnects the power

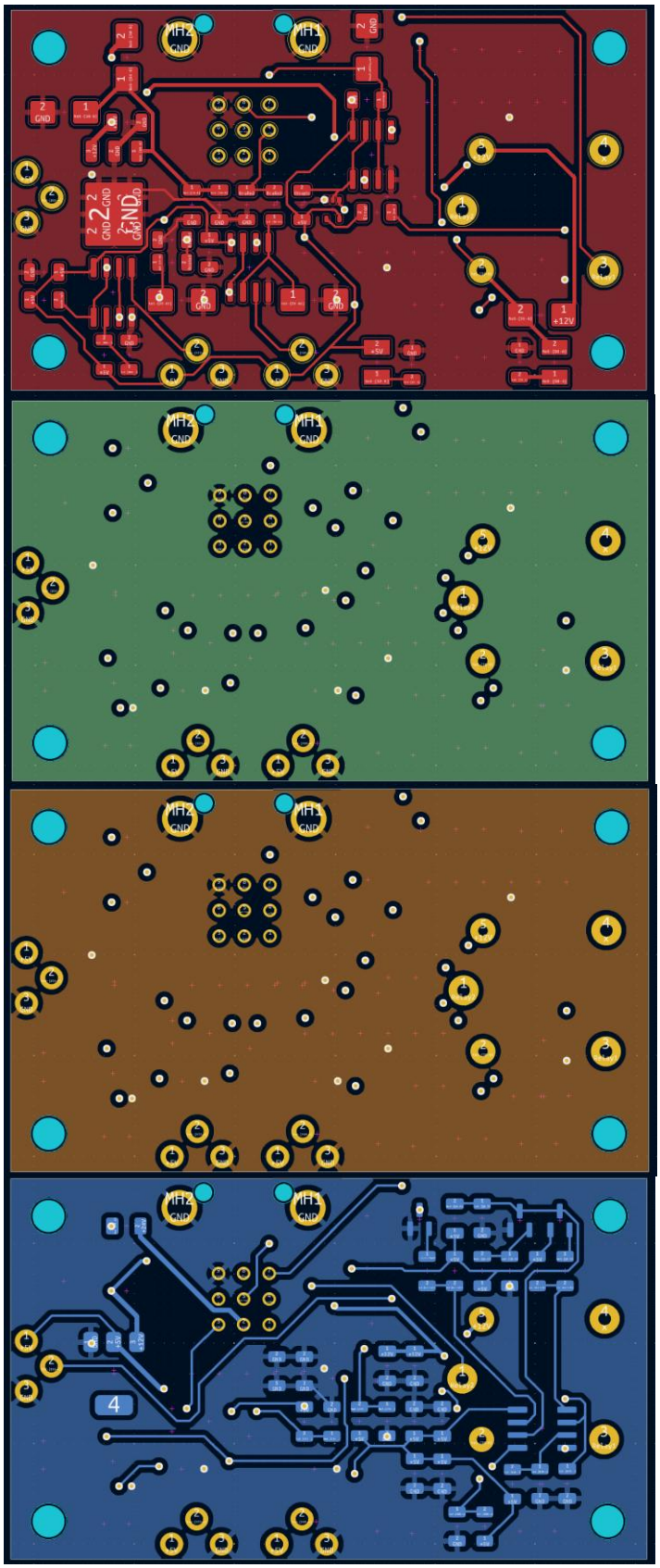
Schematic


Sensors
BSPD Logic
Timing
Safety circuit relay
500ms Time delay
Power-on reset
10s Reset
Power Supply + Connector
Jakub Drankiewicz
PUT Motorsport
Sheet: /
File: FSG_Reference.kicad_sch
Title: BSPD
Size: A4
Date: 2021.04.23
KiCad E.D.A. 8.0.1
Rev: V3
Id: 1/2

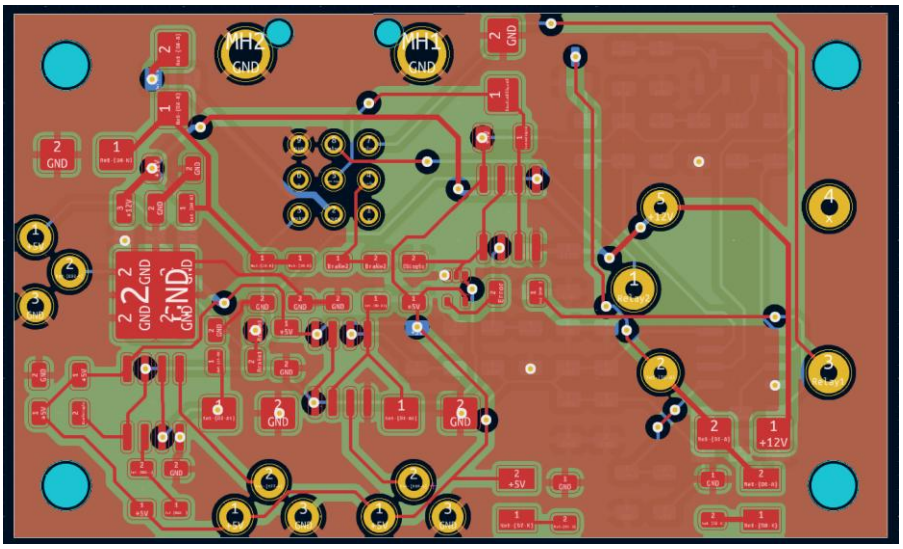

Power supply + connector sub-sheet
Connector
Power Supply
Comparators power rails
Mounting Holes
H1 MountingHole
H2 MountingHole
H3 MountingHole
H4 MountingHole
Sheet: /Power Supply + Connector/
File: untitled.kicad_sch
Title:
Size: A4
Date:
KiCad E.D.A. 8.0.1
Rev:
Id: 2/2

PCB Layout

The PCB consists of these layers shown below:

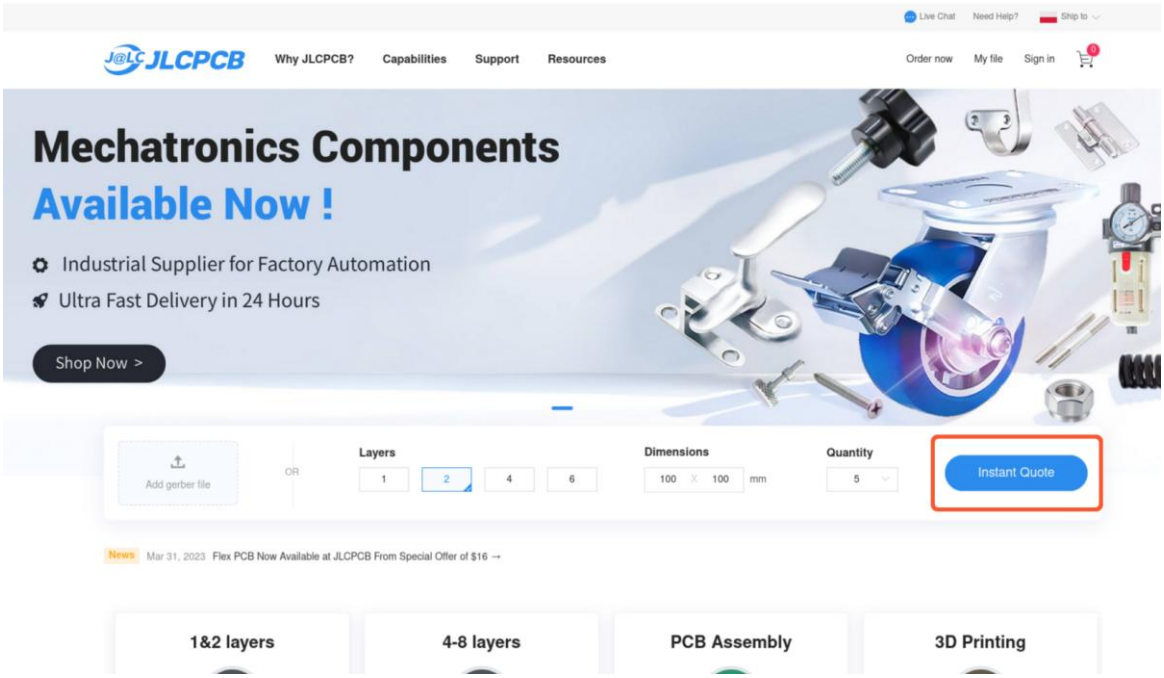


Everything as a whole:

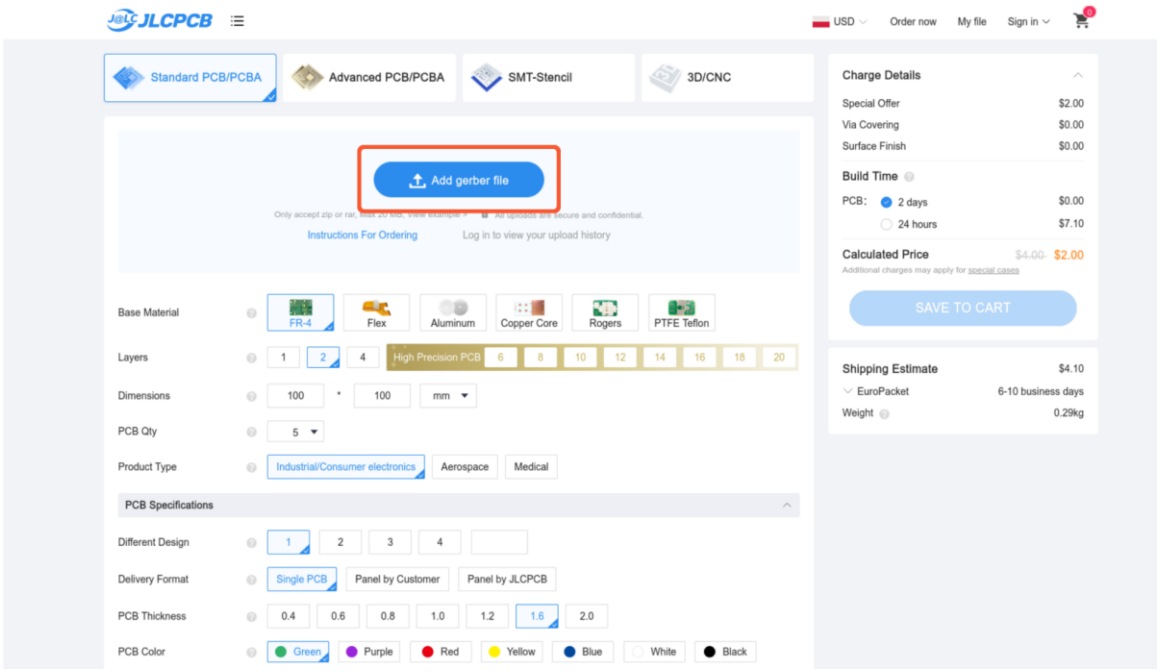


Ordering a PCB from JLCPCB

Now that we've got our PCB design done, it's time to place an order. For that, you just have to go to https://jlcpcb.com/HAR, and click on the "Instant Quote" button.

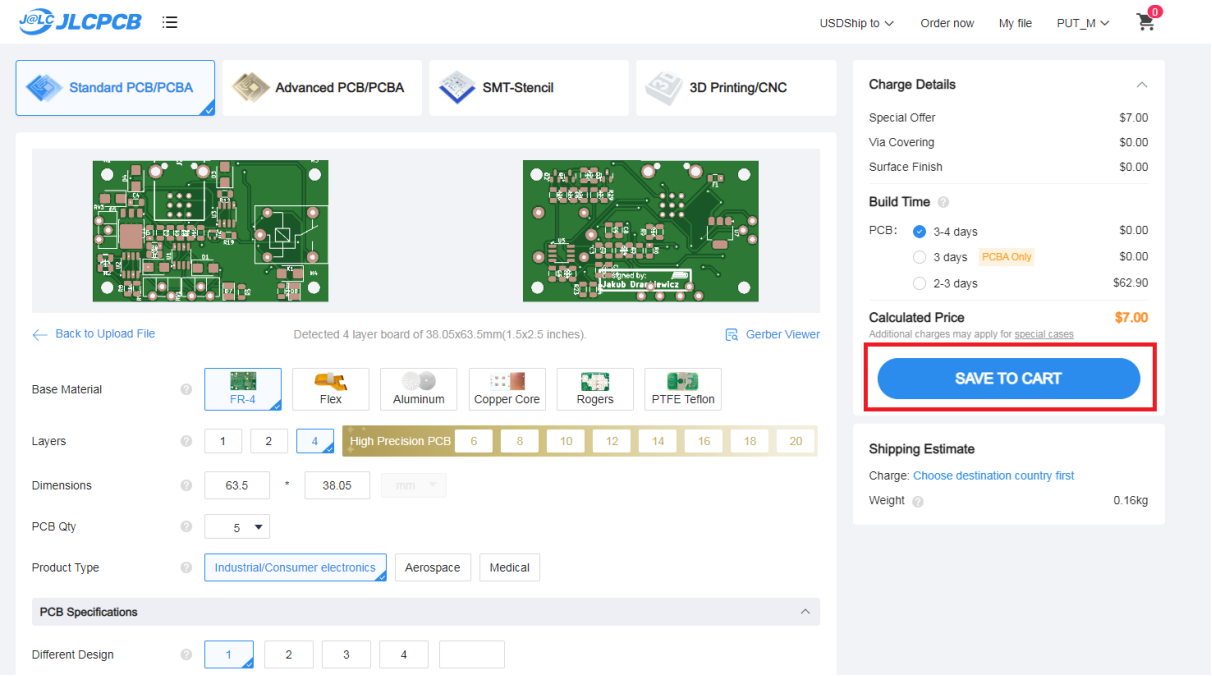


You don't have to worry about any settings for now — you will be able to adjust every option on the next page.



Upload the production files using the "Add Gerber File" button. After that, you will be able to see a preview of your PCB.

Some options will be adjusted according to your design.



Next, you can change the settings according to your preferences. Every option here is clearly marked and described. Hover over a question mark to get a detailed description.

After the last glance at your PCB using the “Gerber View” function, you can now place your order. In the case of this project, it was only $2 for 5, 2-layers PCBs! It only takes around 3 to 4 days to manufacture such board. (The production time has been extended from the usual 2 days due to the choice of a custom solder mask color).

To place the order, click on the “SAVE TO CART” button. Fast and cheap, right?

Why we Choose JLCPCB

JLCPCB (Shenzhen JLC Electronics Co., Ltd.), is one of the largest PCB prototype enterprises in China and a high-tech manufacturer specializing in a quick PCB prototype and small-batch PCB production. JLCPCB's dedication to quality is unmistakable. We are delighted to have found a partner that combines **premium quality** with **low prices** and **fast production times**.

In short, if you're looking for a PCB fabrication house that offers a winning combination of top-notch results, low prices, and rapid production times, look no further than JLCPCB. Our PCB projects have never been more efficient and cost-effective, and we are thrilled with the experience.

Thank you, JLCPCB! ❤