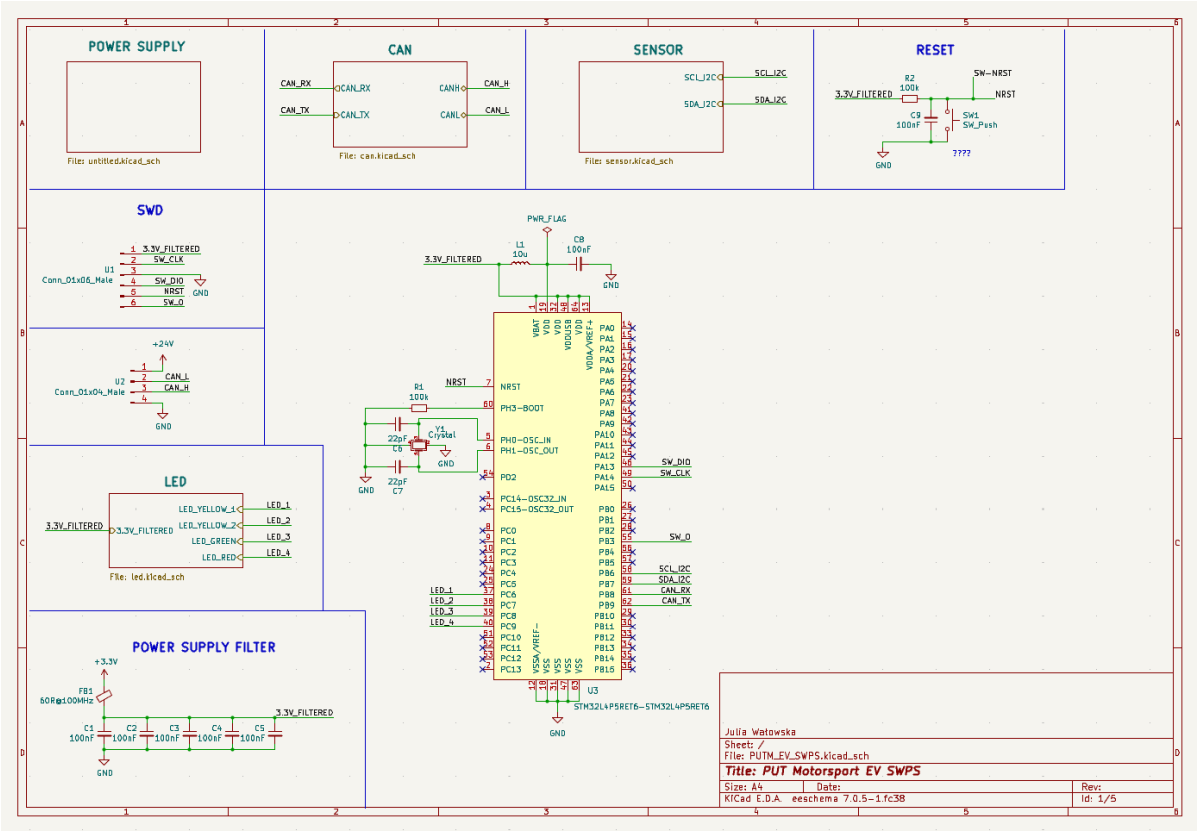
Introduction

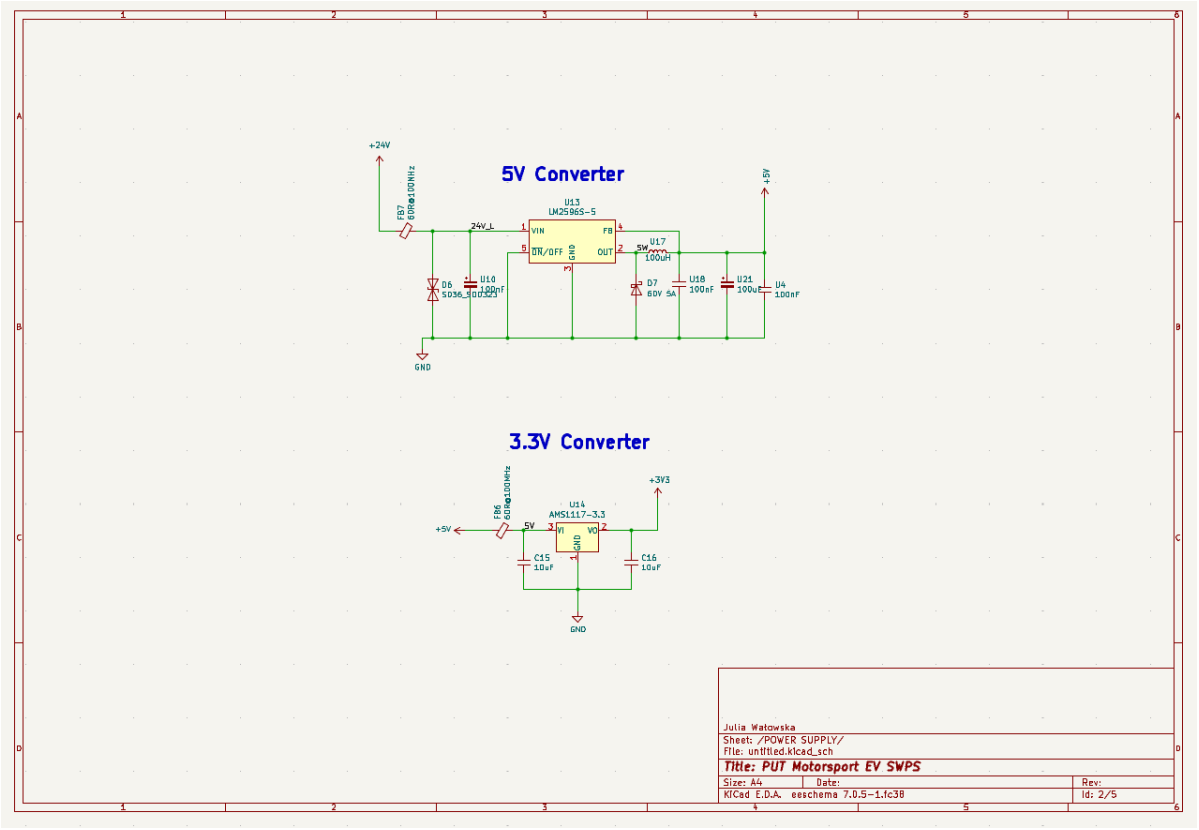
SWPS - The Steering Wheel Position Sensor is a crucial component utilized to measure the angular position of the steering wheel. Its primary function is to provide information regarding the steering wheel's position upon starting the vehicle. This data is essential for calibrating the steering system.

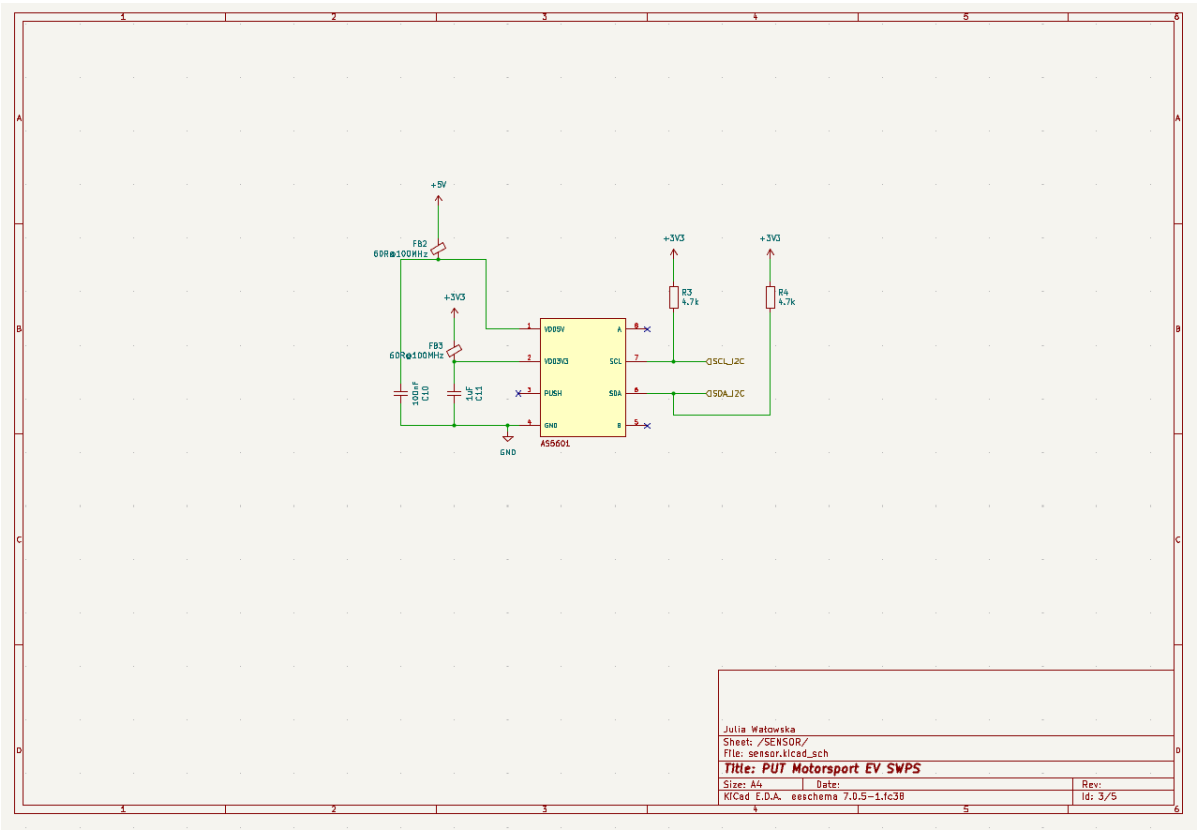
Now, let me provide you with some background information on the creation of this PCB. It is part of a larger-scale project undertaken by PUT Motorsport, the racing team associated with the Poznan University of Technology. Since 2014, we have been continuously engaged in the design, manufacturing, and testing of racing cars. These cars undergo rigorous evaluation during international competitions, where teams from all over the world participate. In the current year, our focus has been on developing and enhancing an autonomous car. It is worth mentioning that numerous design choices have been made throughout this process to optimize its performance and are dictated by the regulations that we have to follow when building a racing car.

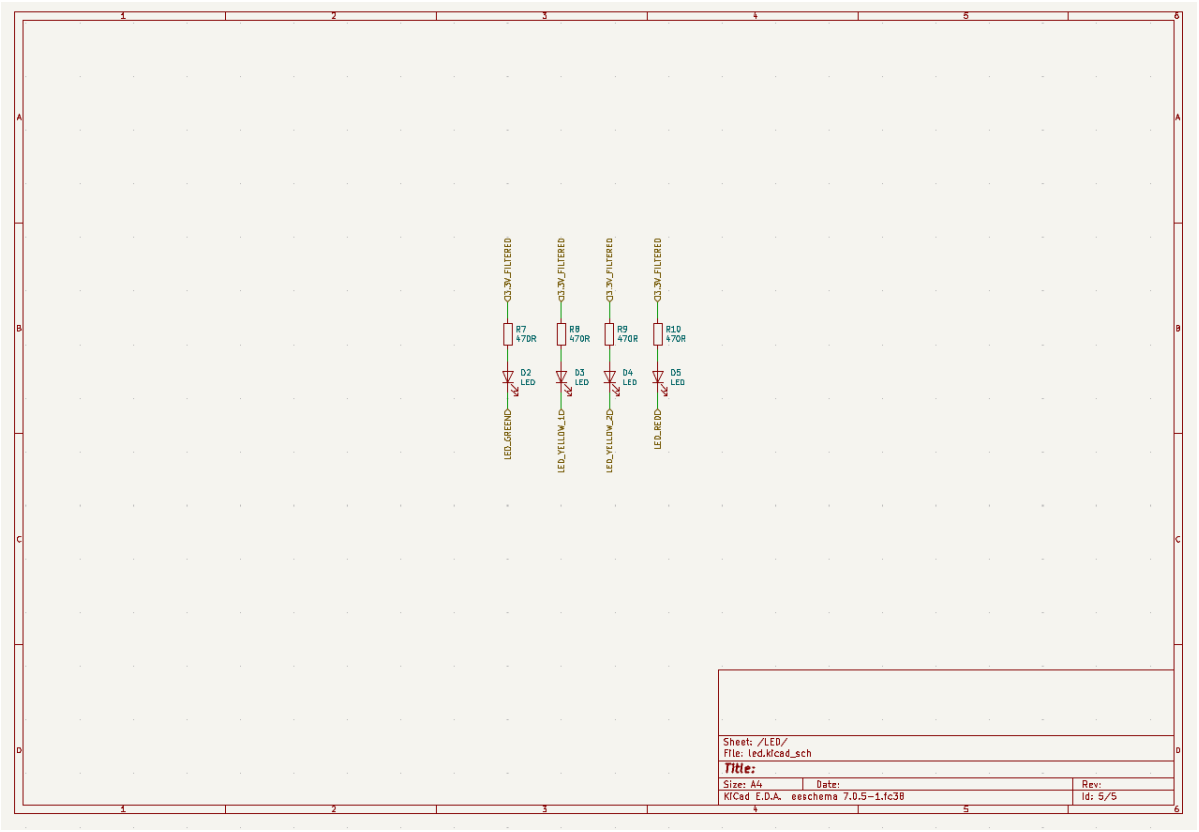
The board is built around STM32L4P5RET6 MCU. It is powered by a 5V buck converter. The position of the steering wheel is measured using a Hall-effect AS5601 sensor. The chip is a magnetic rotary position sensor designed for precise angle measurements. It offers high resolution with a fine resolution of 12 bits, making it suitable for accurate tracking of rotational positions. The chip operates contactlessly, ensuring durability and reliable performance while providing configurable options for integration into various systems.
The data is sent to the main computing device via the CAN interface. In our car, the CAN is utilized for the communication between components. The Steering Wheel Position Sensor (SWPS) transmits the current steering wheel position and diagnostic data over the CAN bus. This allows for real-time monitoring of the steering wheel position

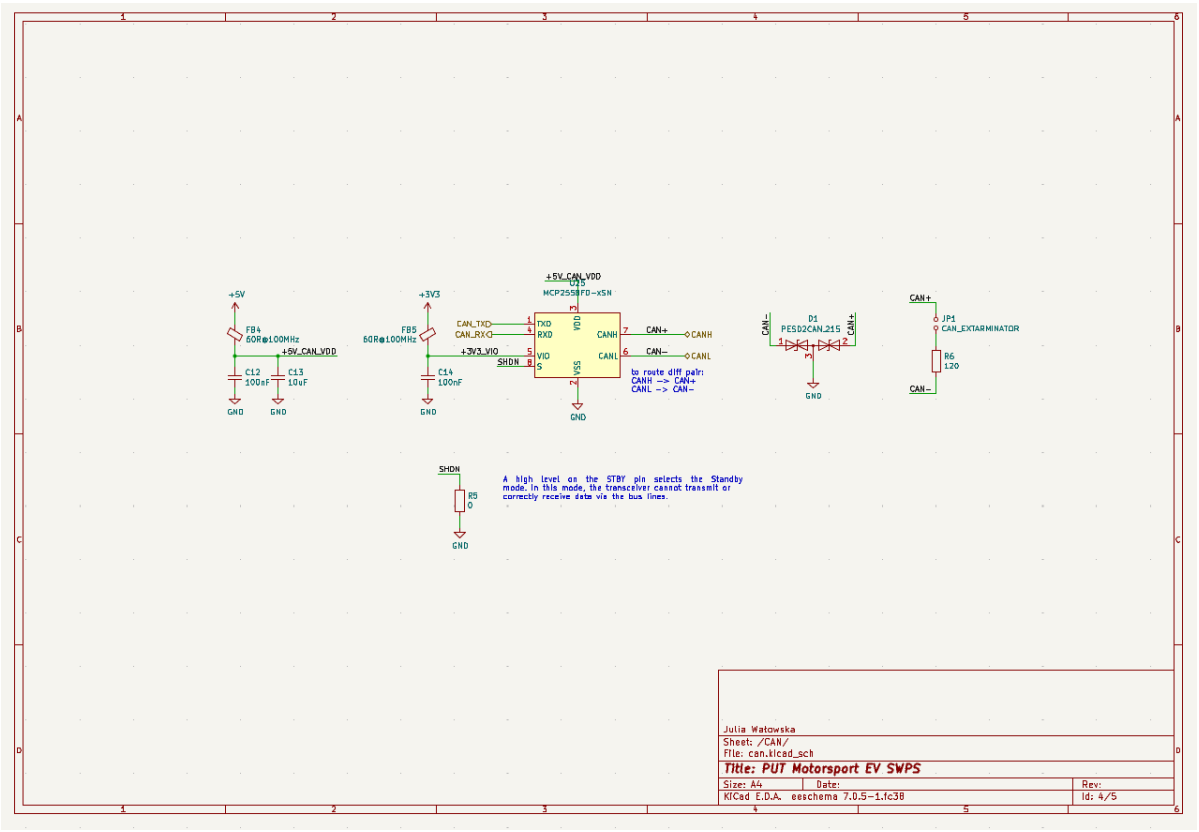
Schematics


POWER SUPPLY
CAN
SENSOR
RESET
SWD
LED
POWER SUPPLY FILTER
PWR_FLAG
STM32L4P5RET6-STM32L4P5RET6
Julia Watowska
Sheet: /
File: PUTM_EV_SWPS.kicad_sch
Title: PUT Motorsport EV SWPS
Size: A4
Date:
Rev:
KiCad E.D.A. eeschema 7.0.5-1.fc38
Id: 1/5


5V Converter
3.3V Converter
LM2596S-5
AMS1117-3.3
Julia Watowska
Sheet: /POWER SUPPLY/
File: untitled.kicad_sch
Title: PUT Motorsport EV SWPS
Size: A4
Date:
Rev:
KiCad E.D.A. eeschema 7.0.5-1.fc38
Id: 2/5

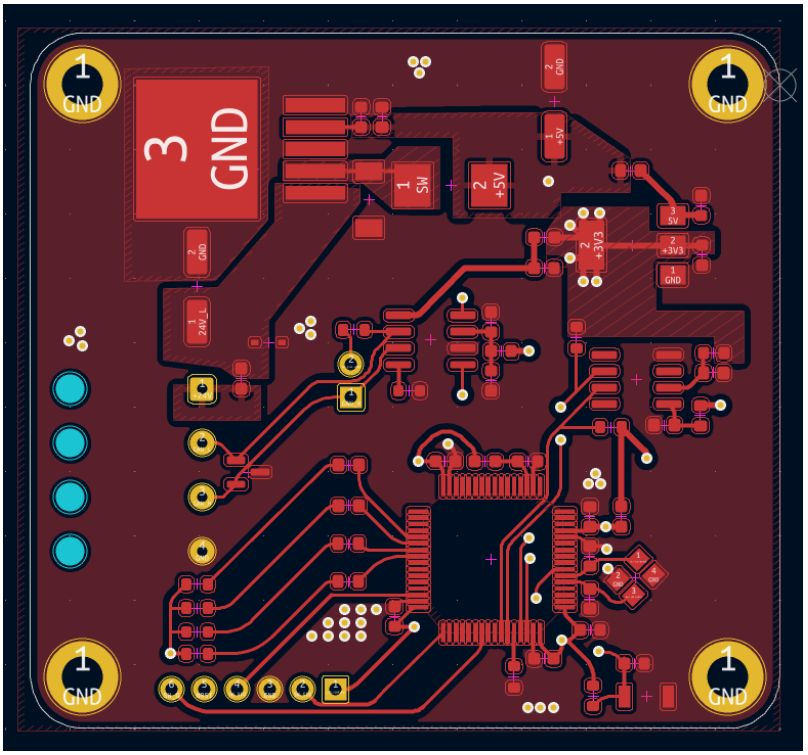

+5V
FB2
60R@100MHz
+3V3
FB3
60R@100MHz
100nF
C10
1uF
C11
GND
VDD5V
VDD3V3
PUSH
GND
A
SCL
SDA
S
AS5601
+3V3
R3
4.7k
+3V3
R4
4.7k
SCL_I2C
SDA_I2C
Julia Watowska
Sheet: /SENSOR/
File: sensor.kicad_sch
Title: PUT Motorsport EV SWPS
Size: A4
Date:
Rev:
KiCad E.D.A. eeschema 7.0.5-1.fc38
Id: 3/5

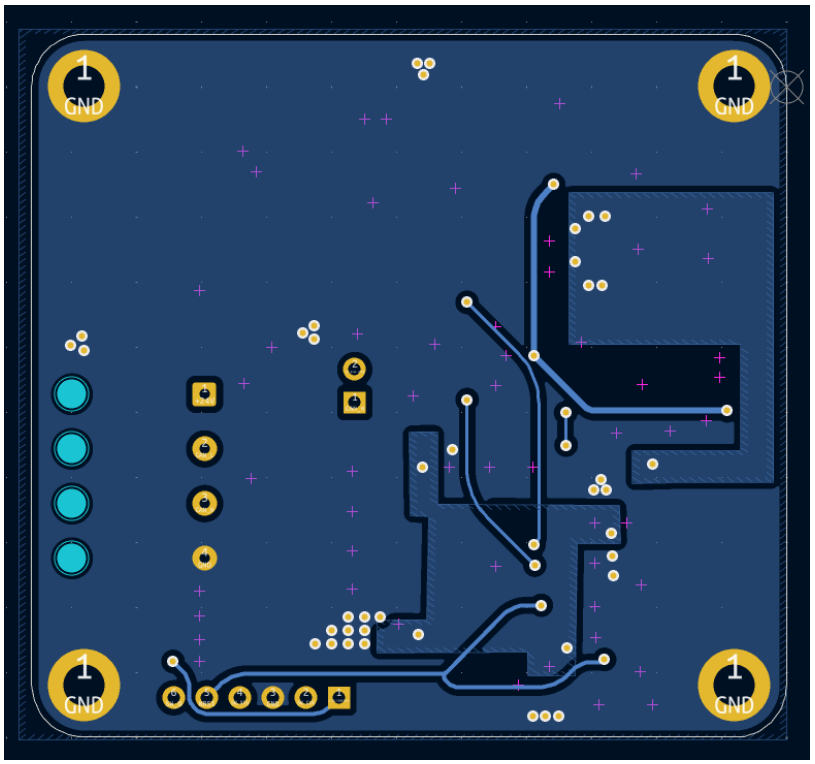

+3.3V_FILTERED
R7
470R
D2
LED
LED_GREEN
+3.3V_FILTERED
R8
470R
D3
LED
LED_YELLOW_1
+3.3V_FILTERED
R9
470R
D4
LED
LED_YELLOW_2
+3.3V_FILTERED
R10
470R
D5
LED
LED_RED
Sheet: /LED/
File: led.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. eeschema 7.0.5-1.fc38
Id: 5/5


+5V
FB4
60R@100MHz
+5V_CAN_VDD
C12
100nF
C13
10uF
GND
GND
+3V3
FB5
60R@100MHz
C14
100nF
GND
+5V_CAN_VDD
U12
MCP2558FD-xSN
CAN_TXD
CAN_RXD
+3V3_VIO
SHDN
TXD
RXD
VIO
S
VDD
VSS
CANH
CANL
7
6
CAN+
CAN−
CANH
CANL
to route diff pair:
CANH -> CAN+
CANL -> CAN−
GND
D1
PESD2CAN,215
CAN−
CAN+
1
2
3
GND
CAN+
JP1
CAN_EXTARMINATOR
R6
120
CAN−
SHDN
R5
0
GND
A high level on the STBY pin selects the Standby mode. In this mode, the transceiver cannot transmit or correctly receive data via the bus lines.
Julia Watowska
Sheet: /CAN/
File: can.kicad_sch
Title: PUT Motorsport EV SWPS
Size: A4
Date:
Rev:
KiCad E.D.A. eeschema 7.0.5-1.fc38
Id: 4/5

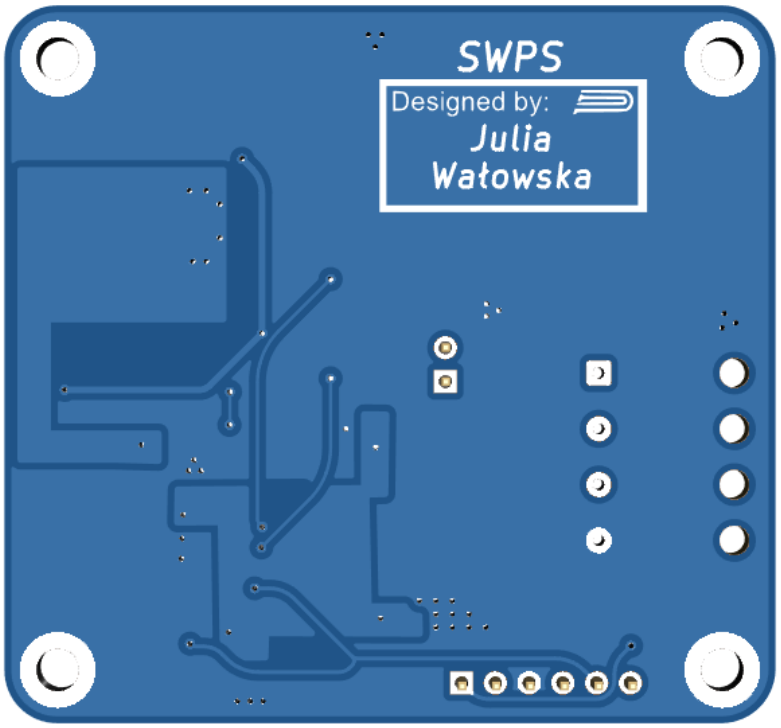
PCB Layers

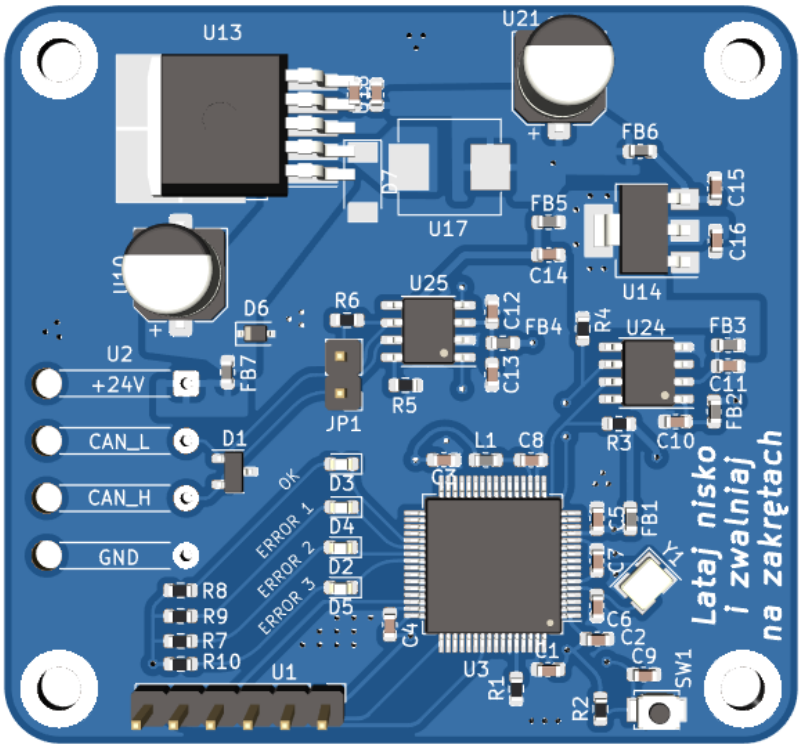
Created PCB has 2 layers. The following layers are presented from the first to the last.





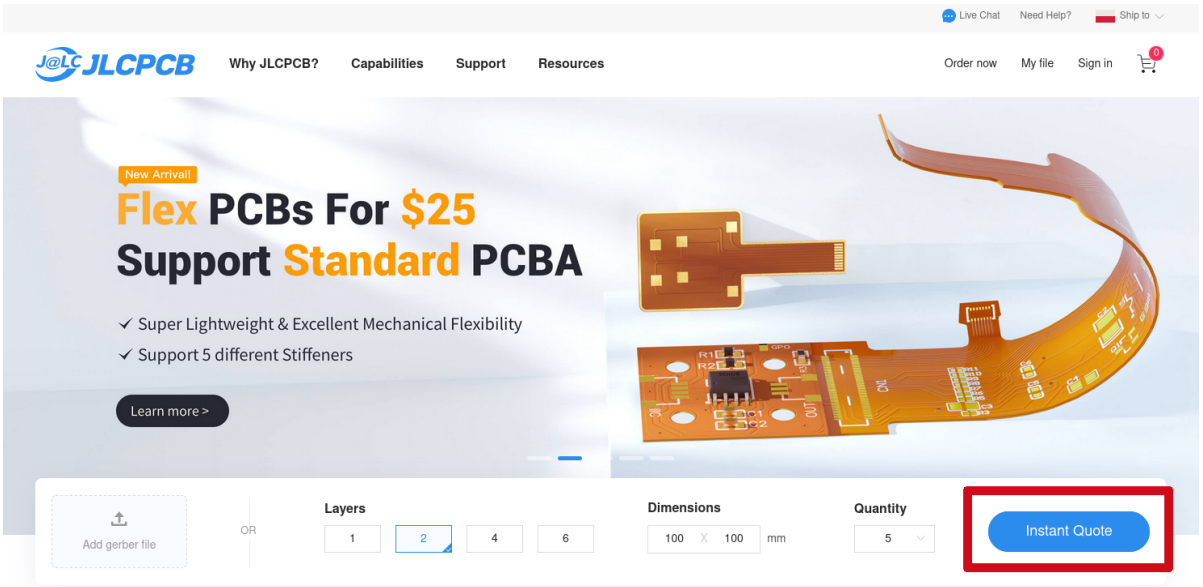
3D Model


SWPS
Designed by:
Julia
Wałowska


U13
U21
U17
U14
U25
U24
U2
+24V
CAN_L
CAN_H
GND
D1
JP1
D6
FB7
FB6
FB5
FB4
FB3
FB2
FB1
C14
C15
C16
C12
C13
C11
C10
C8
L1
R6
R5
R4
R3
R8
R9
R7
R10
U1
U3
C4
C6
C2
C9
SW1
R1
R2
OK
ERROR 1
ERROR 2
ERROR 3
D3
D4
D2
D5
Lataj nisko
i zwalniaj
na zakrętach

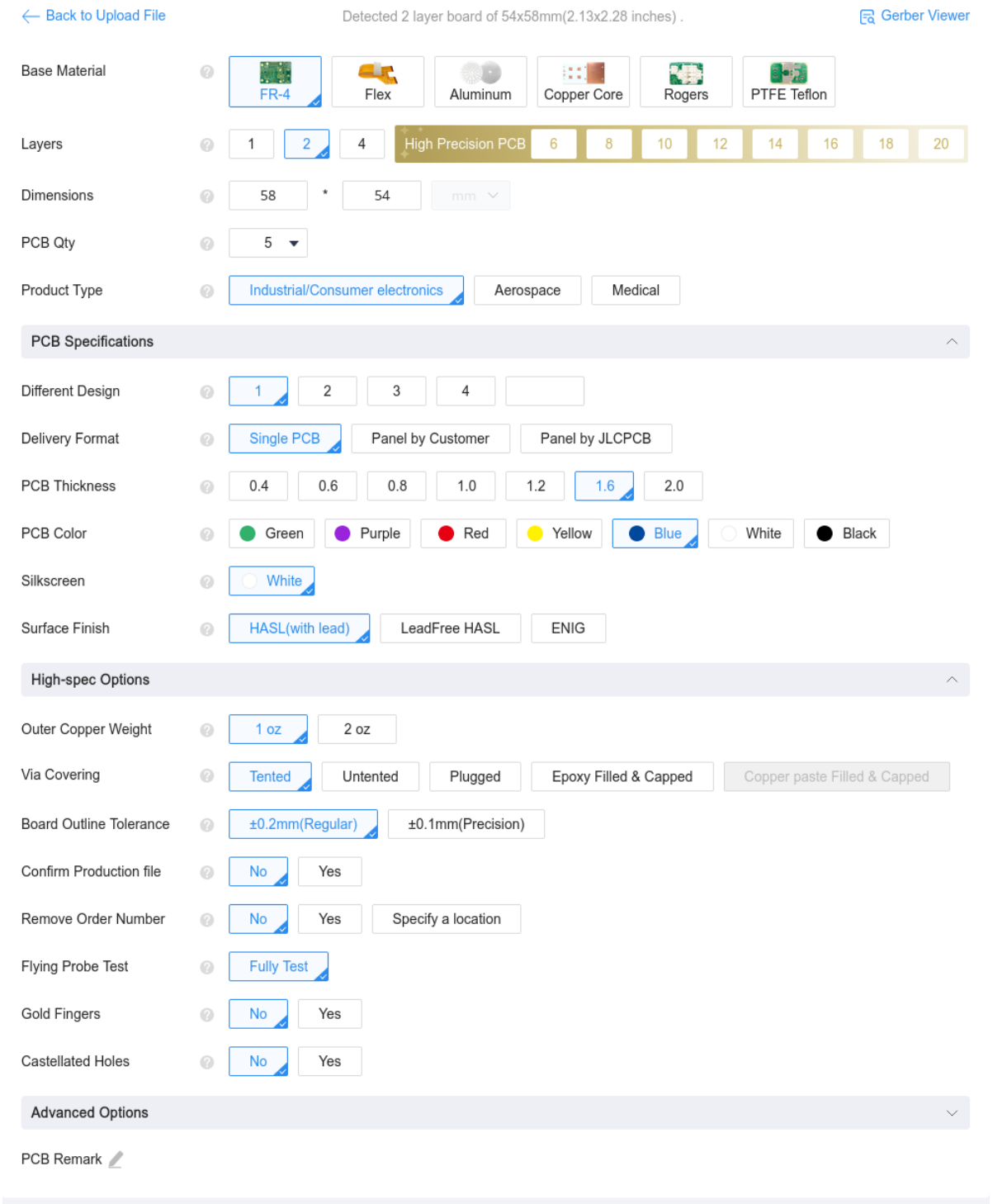
Ordering PCB on JLCPCB

Now that we've got the PCB design, it's time to order. For that, you just have to go to jlcpcb.com, and
click on the "Instant Quote" button

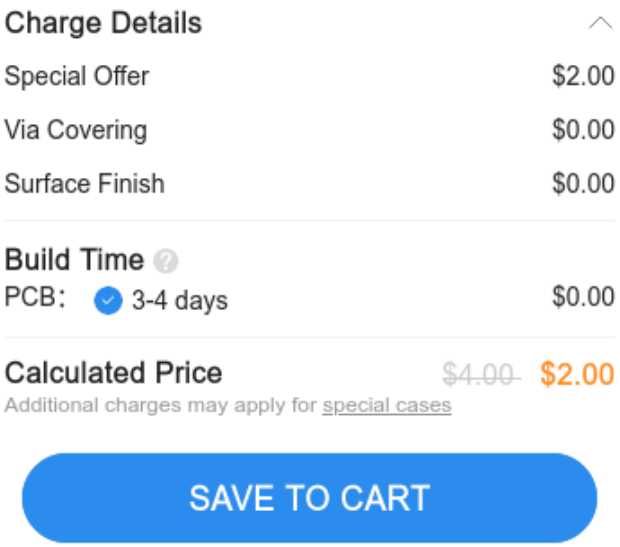


You don't have to worry about the settings here, because you can adjust everything in the new
appeared tab.
JLCPCB is also a sponsor of this whole project (not only this PCB, but all the PCBs in the car!). JLCPCB
(Shenzhen JLC Electronics Co., Ltd.), is the largest PCB prototype enterprise in China and a high-tech
manufacturer specializing in quick PCB prototype and small-batch PCB production. You can order a
minimum of 5 PCBs for just $2 (2 layers), just enough to have a few test/spare ones. To get the PCB manufactured, upload zipped Gerber files as you can see below.

Then, you have multiple options to adjust from the number of layers to your PCB color. Every option
here is very clearly marked and described (when you hover over the question mark).



After making sure your PCB looks good – by clicking Gerber viewer, you can now place the order at a
reasonable price. In case of this project, there is 2$ for 5, 2-layers PCB and it's only 3-4 days build
time(the time is extended due to the chosen color). To place the order, click on the "SAVE TO CART"
button. Fast and cheap, right?



The quality is always really satisfying so I sincerely recommend JLCPCB.