UNIVERSITY OF CAPE TOWN

EEE3088F

PCB DESIGN ASSIGNMENT

MARCH 2022

GROUP 18

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GIT

1. Github [1]

GitLab link: https://gitlab.com/g5168/eee3088f-group-project

The Gitlab branch "/Schematics Week 5" contains all relevant material for this assignment. Past versions of the design/schematics can be found in the "/main" branch.

FAILURE MANAGEMENT

Note: All changes highlighted in red.

2. Power Subsystem Failure Management [2]

I have decided to order extra components and add traces in parallel to where the original components should be but leave it as an open circuit. In the event of trace damage or a component malfunction, I can utilize these traces in parallel. I have chosen multiple components (for each component) that could work if jlcpcb are out of stock at the time of ordering, then I can just use one of the alternatives. If there is an error in my circuit that I only detect post manufacture, I can make use of the parallel traces that I made to alter the values of components or even design a new circuit, I would just have to sever some of the other traces to make this work. Components that are large enough to re-solder, should one come off or break, have been chosen for this subsystem. Minimum component sizes of "0603" (metric) were chosen for this purpose. The failure management for this subsystem has not changed otherwise (since the last assignment), since it was approved and no modifications seem necessary.

3. Sensing Subsystem Failure Management [2]

The sensing subsystem will provide additional traces to connect to through-holes that can be used in the case of trace/component destruction. Should a component fail or be destroyed, additional components can be soldered on the through-holes of the pcb. As in the power subsystem, the traces will be connected in parallel to where the original components were set. Additional components will likely be collected from other sources that can replace the ones used in the pcb, so that component replacements can be done when/where necessary. While there are no over-voltage/power preventing mechanisms in the sensing subsystem, the module is powered directly from the discovery board which has power/voltage regulators internally.

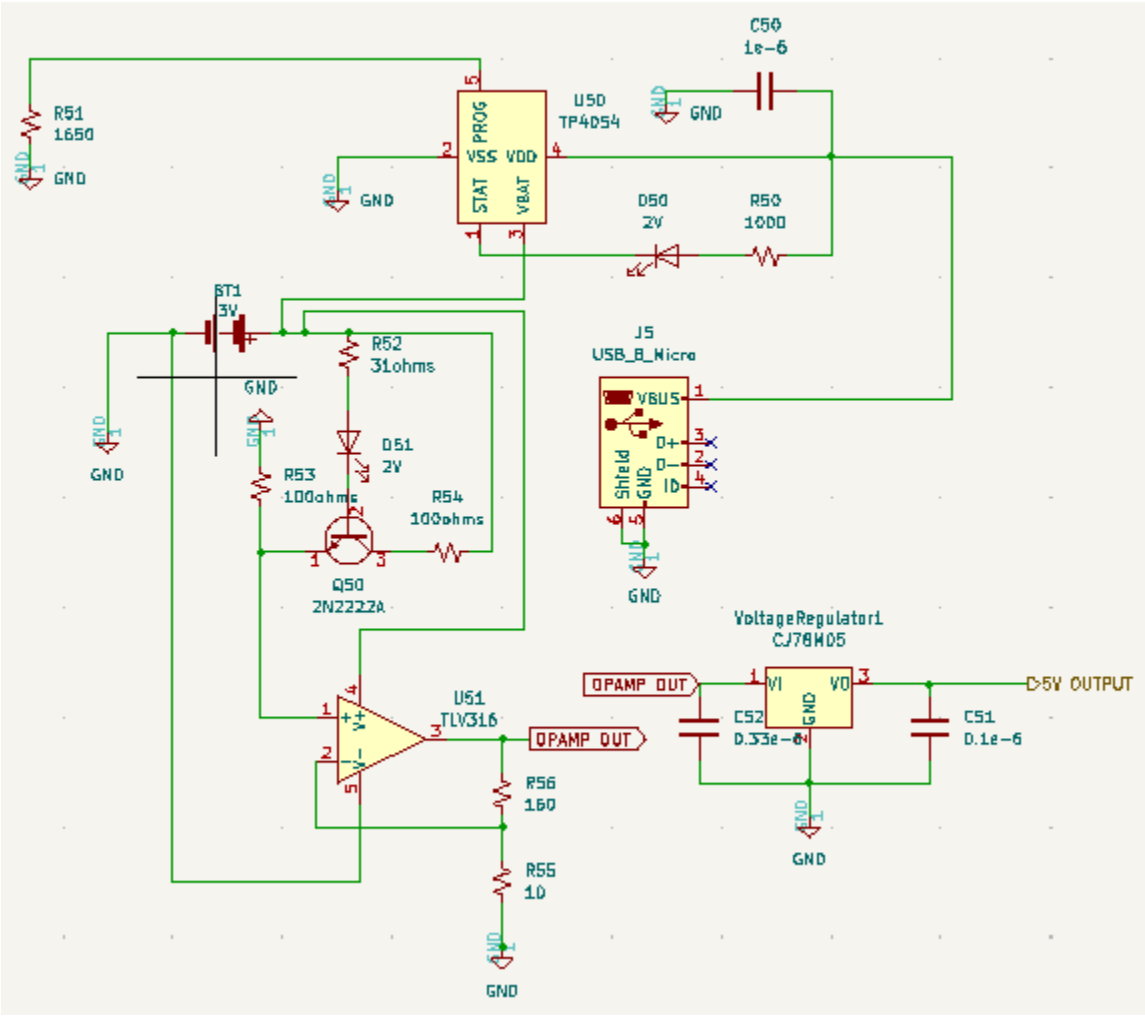
Providing that the STM is operating properly, the sensing subsystem should be safe from failure. Components that are large enough to re-solder, should one come off or break, have been chosen for this subsystem. Minimum sizes of “0603” (metric) were chosen for this purpose. The failure management for this subsystem has not changed otherwise (since the last assignment), since it was approved and no modifications seem necessary.

4. Microcontroller interfacing Failure Management [2]

A diode is used to prevent surging to the USB mount from any external source the USB is connected to. Further, alternative EEPROM and FTDI chips have been considered and researched to ensure that in the event that the original component choices are unavailable at the time of PCB assembly, the schematics and gerbers can be updated for manufacturing. In the event that the AT24C256C-SSHL-T EEPROM is not available, there are M24C02-WMN6TP chips available which have the same amount of storage space and are also cheaper and will fit into the budget. In the case that the CH340C FTDI chip is unavailable, it is likely that the CH340G will be available. However, this chip would also require the addition of a clock as it has no integrated clock. There is also a decoupling capacitor to the input of the FTDI pin to ensure a stable DC supply. The microcontroller subsystem will provide additional traces to connect to through-holes that can be used in the case of trace/component destruction. Should a component fail or be destroyed, additional components can be soldered on the through-holes of the PCB. As in the other subsystems, the traces will be connected in parallel to where the original components were set. Components that are large enough to re-solder have been chosen for this subsystem. Minimum component sizes of “0603” (metric) were chosen for this purpose. If any components fail, replacements can be soldered onto the pcb easily. The code that will be uploaded onto the microcontroller will be stored on GitLab/GitHub in case the code is wiped from the microcontroller’s memory. Every time that the code for the STM is manipulated critically, it will be committed via Git. This ensures the security of code in the case of system failure.

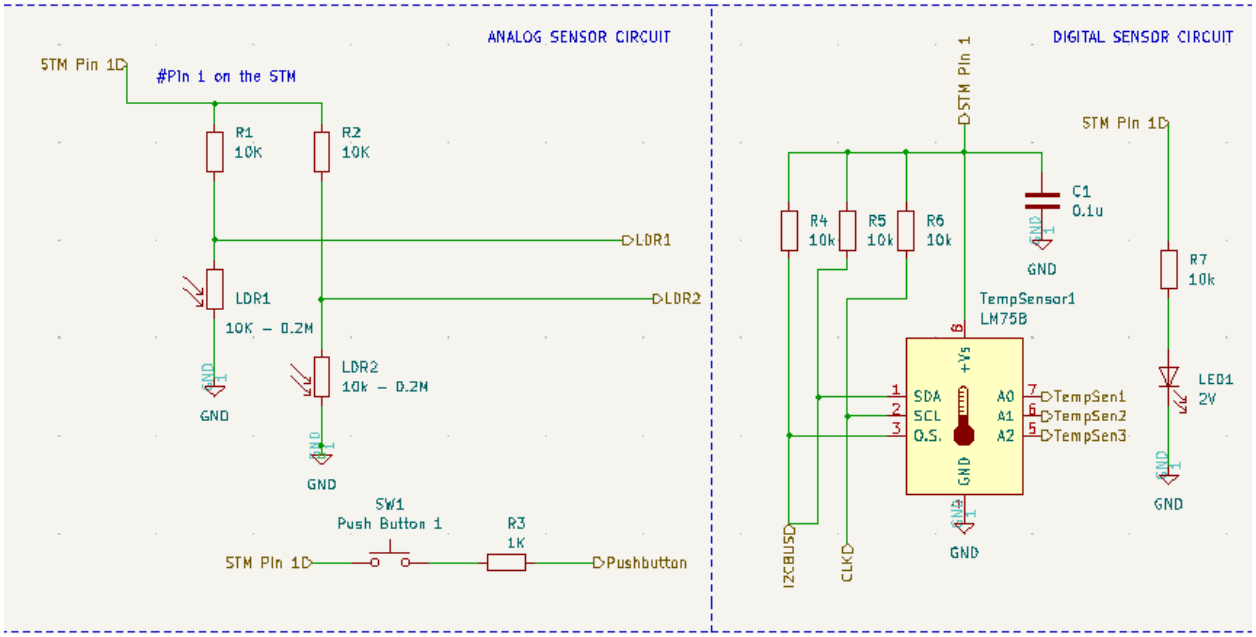
SCHEMATICS

5. Power Subsystem Schematic [2]



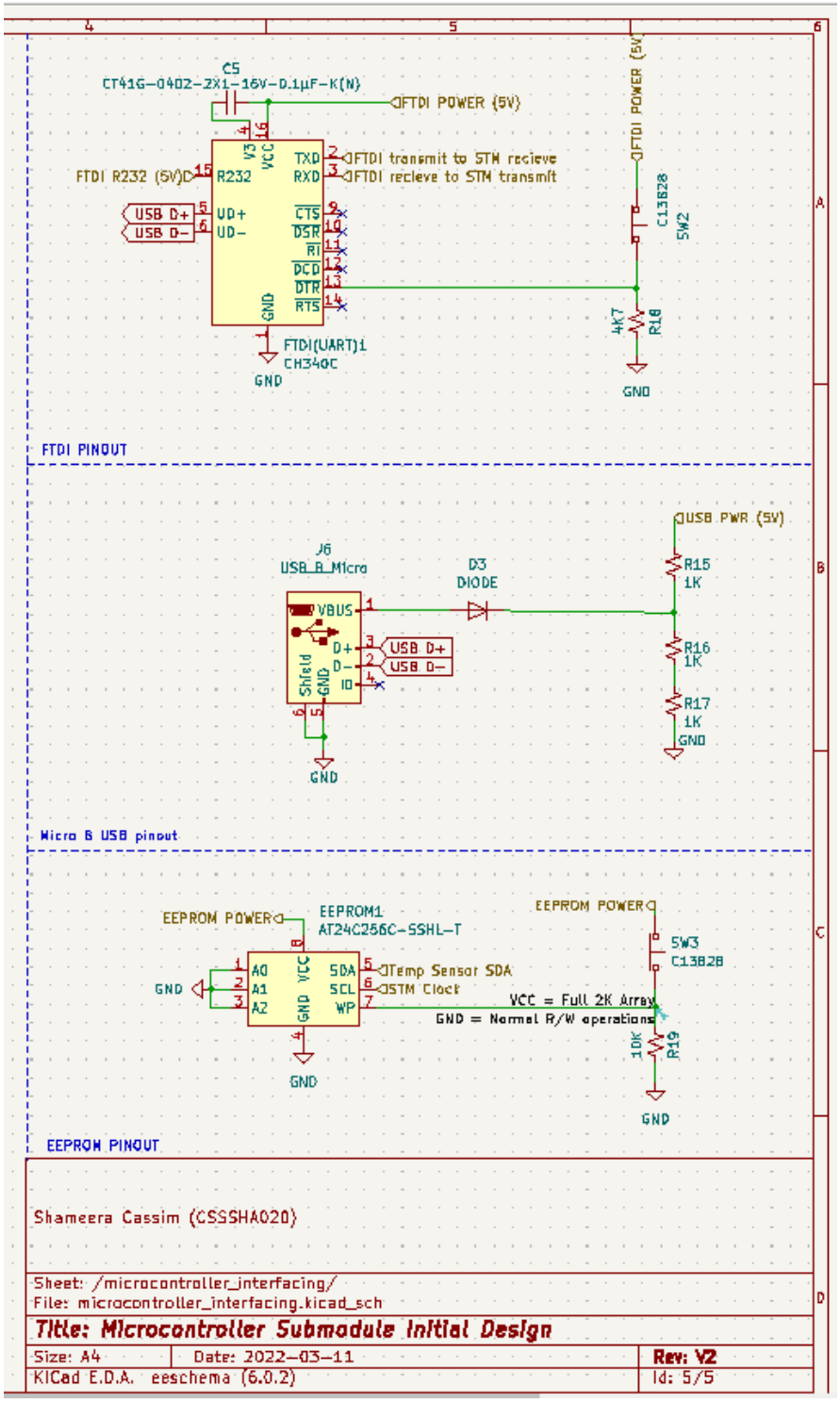
No changes were made from last week's schematic, as it was approved and no inefficiencies/problems were discovered.

6. Sensing Subsystem Schematics [2]



This schematic was changed by removing 2 LDRs and the corresponding resistors. The price of hand-soldering 4 LDRs made the BOM exceed the project budget, so only 2 LDRs were used. Jlcpcb had no non-hand-soldered photoresistors available to replace the photoresistors chosen. These adjustments mean that the peripheral system will be able to rotate in only two directions, rather than being multi-directional.

7. Microcontroller interfacing Schematic [2]

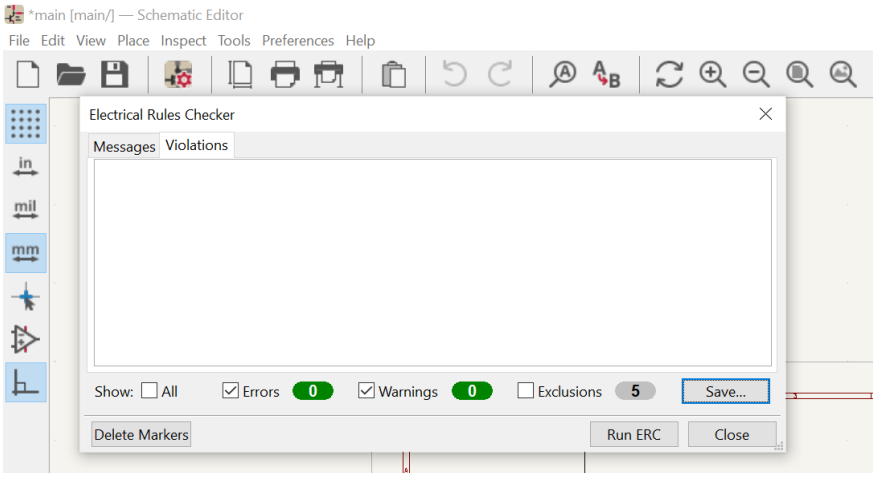


No changes were made from last week's schematic, as it was approved and no inefficiencies/problems were discovered.

ERROR CHECKING

8. Updated ERCs [2]

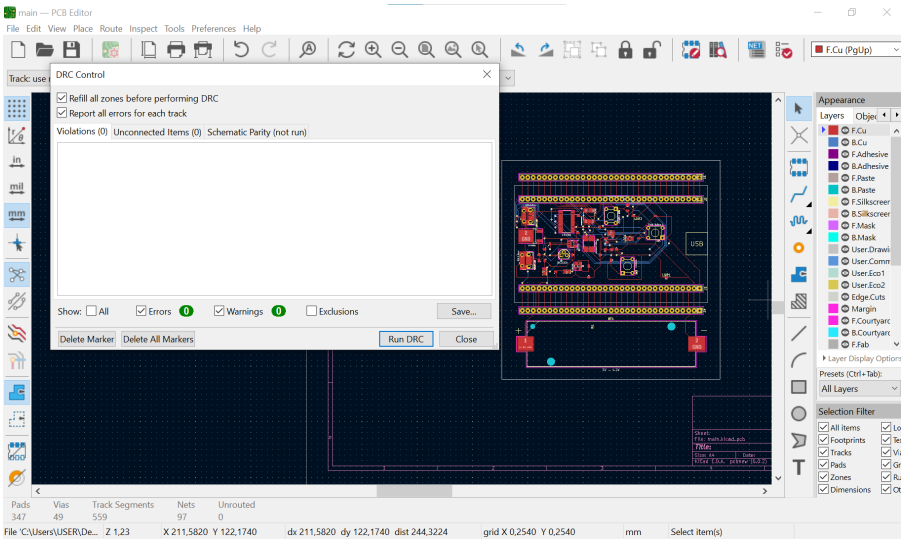
The built-in KiCad Error Report Checking function is being used for this assignment. This ERC alone is necessary to validate the schematics and circuitry.



Five warnings and errors were excluded as they had no impact on the actual workings of the circuit.

9. DRCs [2]

The built-in KiCad Design Report Checking function is being used for this assignment. This DRC alone is necessary to validate the schematics and circuitry.



There were no errors or exclusions needed for the DRC.

BILL OF MATERIALS

10. Updated BOM [5]

Link to Git documentation folder:
https://gitlab.com/g5168/eee3088f-group-project/-/tree/main/Week%205%20Documentation

Both the BOM generated on KiCad and the one that was compiled on Excel are included here. Below is a complete budget for our HAT including assembly costs:

Unit	Description	Multiplier	Cost per unit ($)	Total Cost ($)
SENSOR				
LM75BD	Temperature Sensor	1	0,5734	0,5734
BL-HUE35A-AV-TRE	Red LED	1	0,0234	0,0234
RCT02300RFLF	300Ω Resistor	1	0,0028	0,0028
CT41G-0402-2X1-16V-0.1µF-K(N)	0.1uF Capacitor	1	0,0034	0,0034
RCT0310KJLF	10KΩ Resistor	7	0,0016	0,0112
GL48516	Photoresistor	4	0,0527	0,2108
C13828	Push Button	1	0,0382	0,0382
POWER				
	Resistor	7	0,0007	0,0049
	microusb in	1	0,3	0,3
BL-HUE35A-TRE	LED	2	0,1305	0,261
TP4054	Charger IC	1	0,2523	0,2523
2n2222A	NPN transistor	1	0,1736	0,1736

78L05FS	Voltage regulator	1	0,21	0,21
Tlv316	op amp	1	1,2	1,2
N/A	Capacitors	3	0,001	0,003
MICROCONTROLLER				
C404969	Surface Mount Micro-B SMD USB Connector	1	0,048	0,048
CH340C	FTDI USB-to-UART chip	1	0,7311	0,7311
M24128-BRMN6TP	EEPROM	1	0,2052	0,2052
STM32F051	Microcontroller chip & discovery kit	1	0	0
USB to microB cable	USB to microB cable	1	0	0
COMPONENT COST PER BOARD				**4,2523**
TOTAL COMPONENT COSTS (5 BOARDS)				**21,2615**

ASSEMBLY COSTS

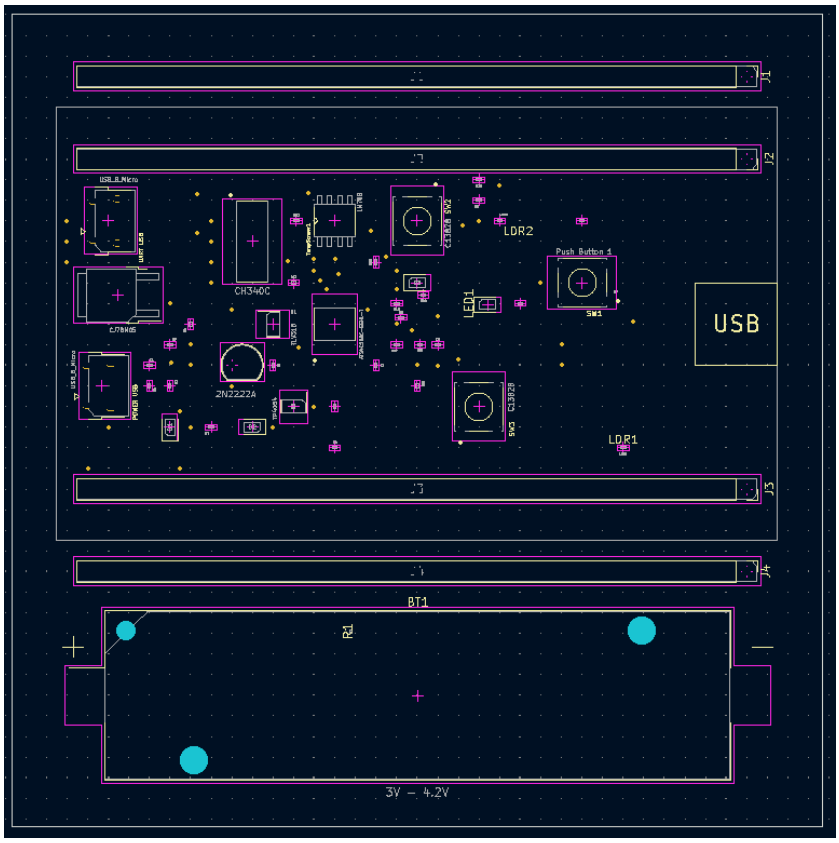
Item	Multiplier	Unit Cost ($)	Cost ($)
SMT components	36	0,0017	0,0612
Hand soldered components	3	1,5	4,5
Extended parts [once off fee]	14	3	42

ASSEMBLY COST PER BOARD	**9,31224**
TOTAL ASSEMBLY COST (5 BOARDS)	**46,5612**

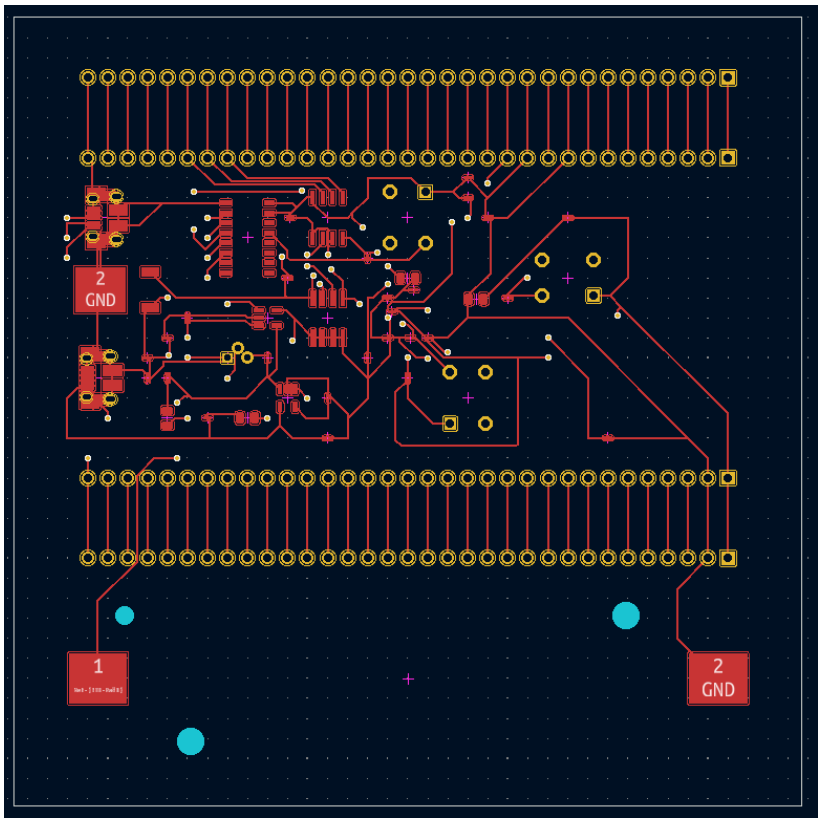
TOTAL COST PER BOARD	**13,56454**
TOTAL COST (5 BOARDS)	**67,8227**

PCB DESIGN

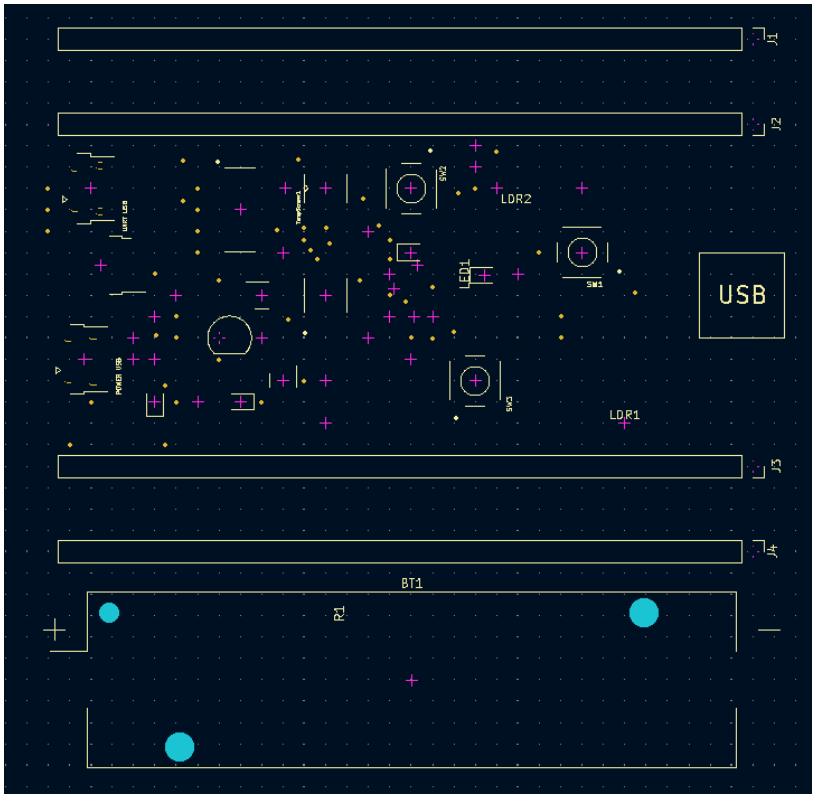
11. PCB [15]



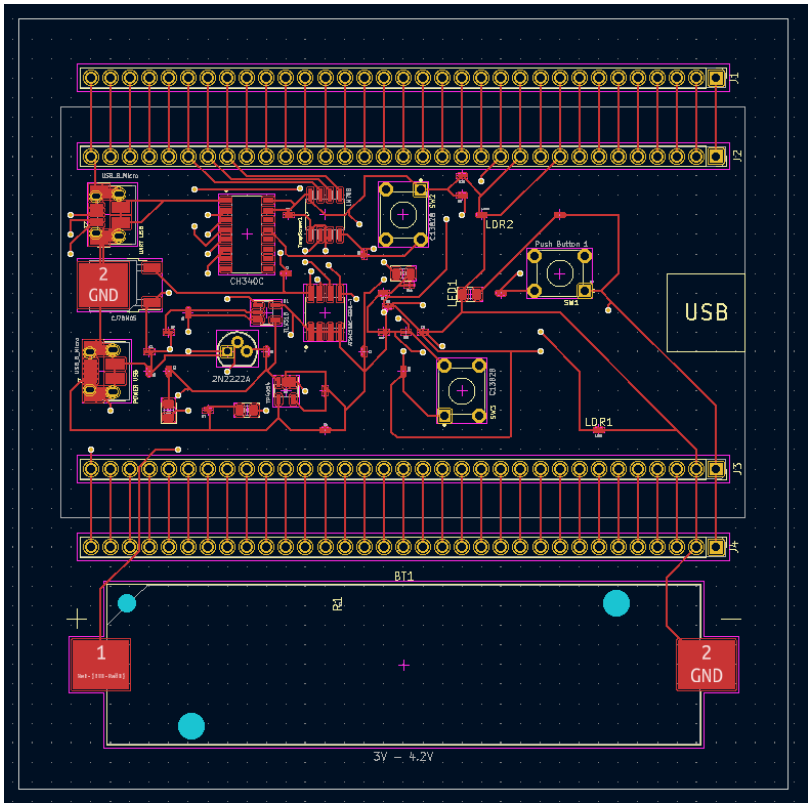
Edgecuts, Front: Courtyard, Fab & Silkscreen



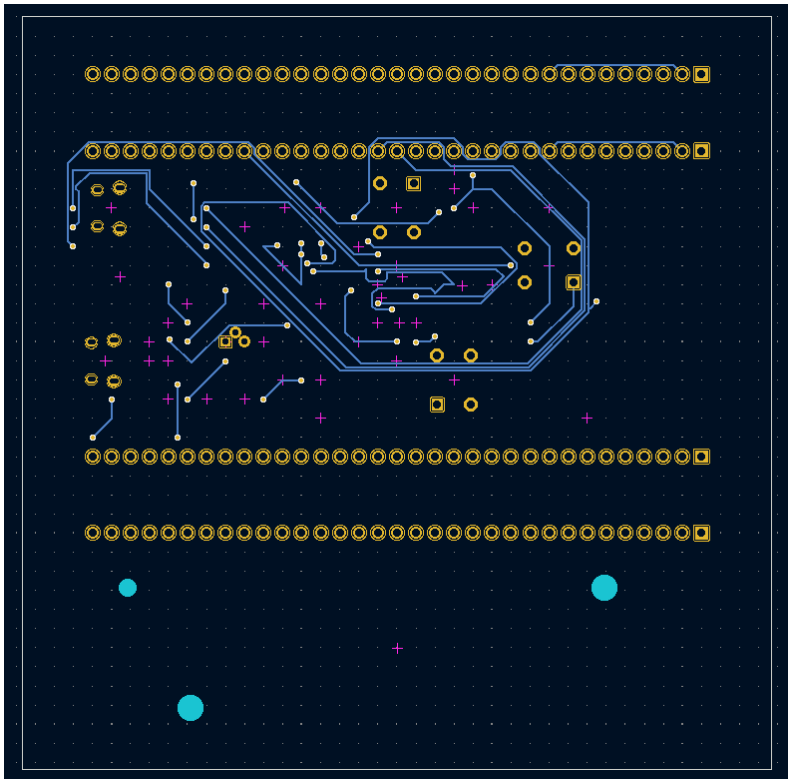
Front copper



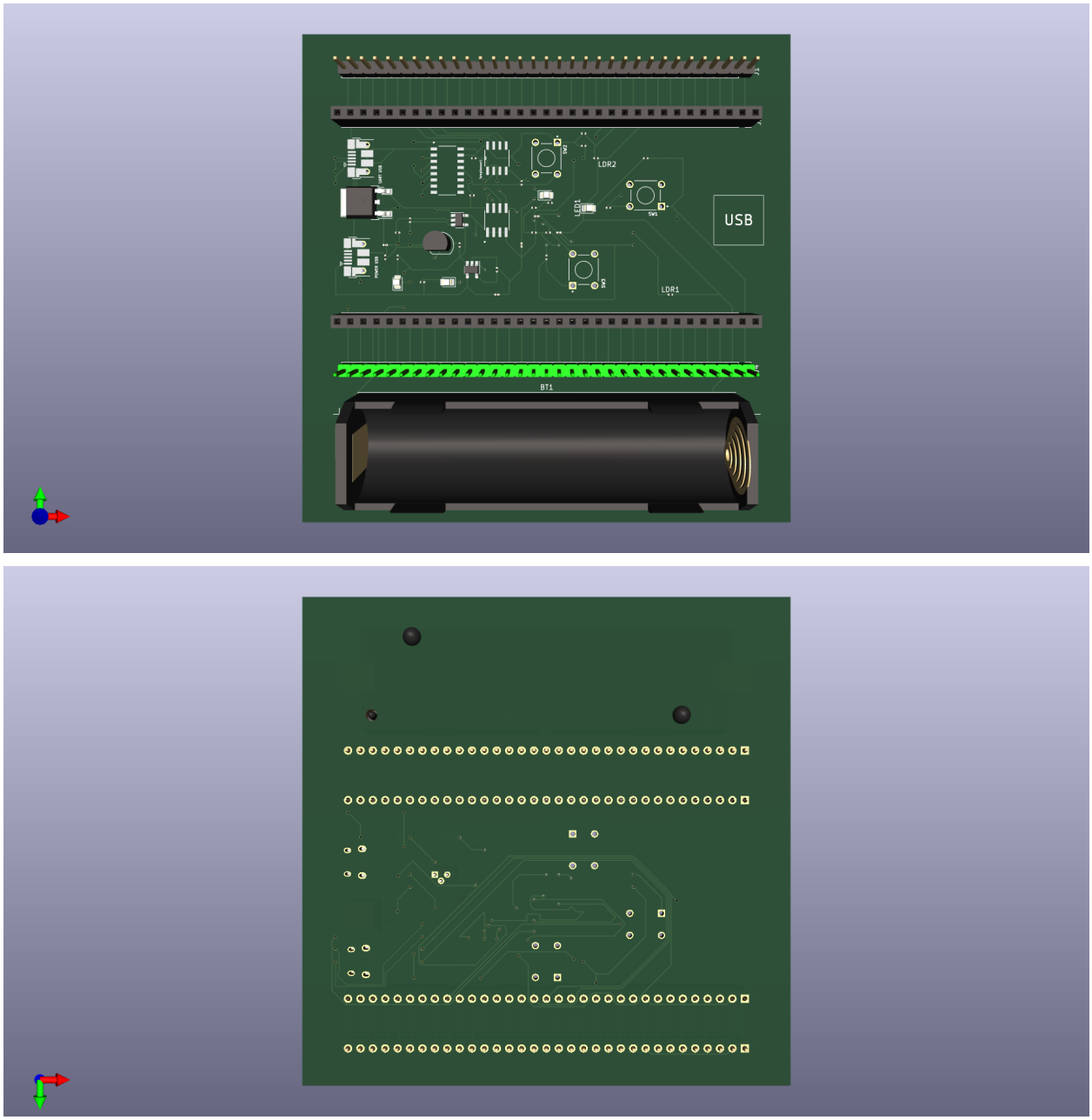
Front Silkscreen



All front layers



All back layers



3-D View of the PCB (front, back)

Gitrepo link for gerber files:
https://gitlab.com/g5168/eee3088f-group-project/-/tree/main/Gerbers%20Week%205