Water Quality Measuring Device Documentation

EN2160 – Electronic Design Realization

Department of Electronic and Telecommunication Engineering

University of Moratuwa

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Contents

User Requirements

Water Quality Measuring Device can assess the quality of water based on several parameters such as pH value, temperature of the water, and turbidity. This device will be particularly useful in industrial settings where it can measure the quality of water discharged after factory usage.

Industrial wastewater often contains various contaminants that can be harmful to the environment and human health. Regular monitoring and assessment of water quality is therefore crucial. However, existing methods can be time-consuming, expensive, and may not provide real-time data.

Current solutions typically involve manual sampling and laboratory testing. While these methods can be accurate, they are not ideal for continuous monitoring or real-time data analysis. Some digital devices exist for this purpose, but they may not offer comprehensive data analysis or user-friendly interfaces. Meantime our device is unique because it not only measures multiple water quality parameters but also provides real-time data via a mobile application. Furthermore, it uses an AI model to analyze the data and determine the usability of the water, making it a smart solution for water quality monitoring.

The most affectable parameters of the water are following parameters. They are,

1. pH value – Define whether water is acidic or caustic.
2. Turbidity – How much amount of light can pass through water.
3. Temperature – Temperature of the water
4. Conductivity – Measures the ion contains in the water.

This device can continuously monitor the above parameters and it can predict the water is whether good to use or not, and the mobile app of the device can show the values of above parameters.

Following are the user requirements of the device.

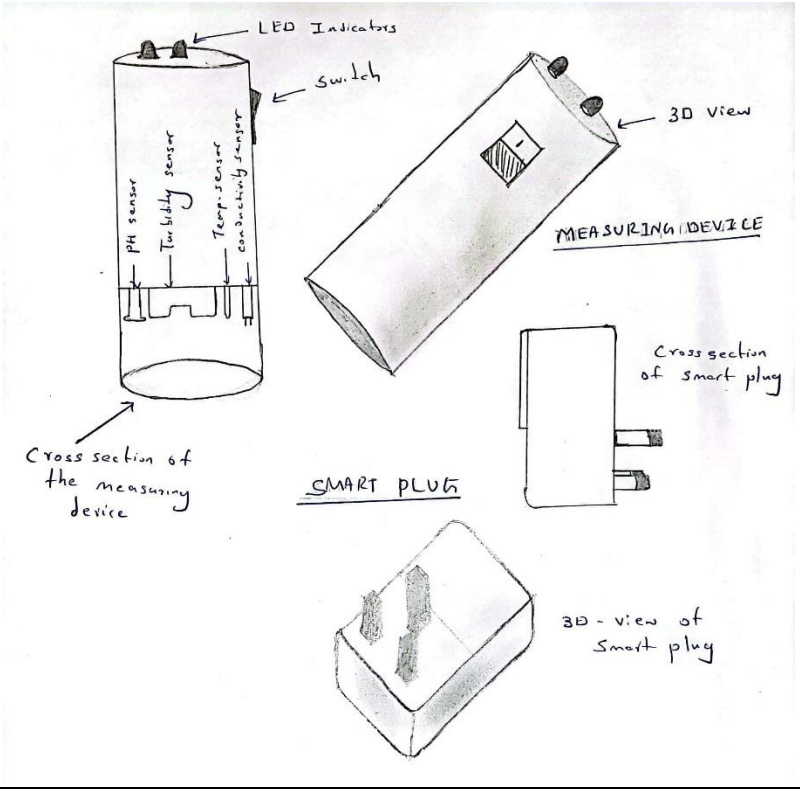
- Cost effectiveness – usually to measure the water quality in a lab, it costs lot of chemicals, and these chemicals are bit expensive and cannot use continuously due to the higher cost, but this device can measure the water quality without any cost. The only cost is the amount that need to be paid when buying the device.
- Time effective – when you put this device into the water, you can measure the value of the above parameters within a small amount of time.
- User friendly -There are no hard calibrations or tests to use this device. Only need to dip the device little bit in the water until the values are taken.
- Size and durability – This device is a water proof device and the product enclosure is a plastic enclosure with a small size.
- Real time data monitoring – Values of the above parameters can be taken real time without any tests in labs.

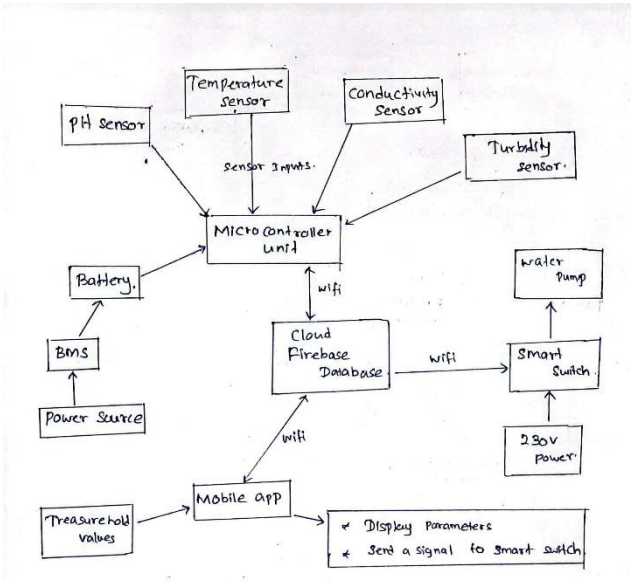
Conceptual Designs

Conceptual Design 01

- The design of this device is like a cylinder, and the main four sensors of the device are located at the bottom of the device. Bottom of the device can be drowned in the water to get values. The device is water sealed. Device is integrated with a smart plug device.

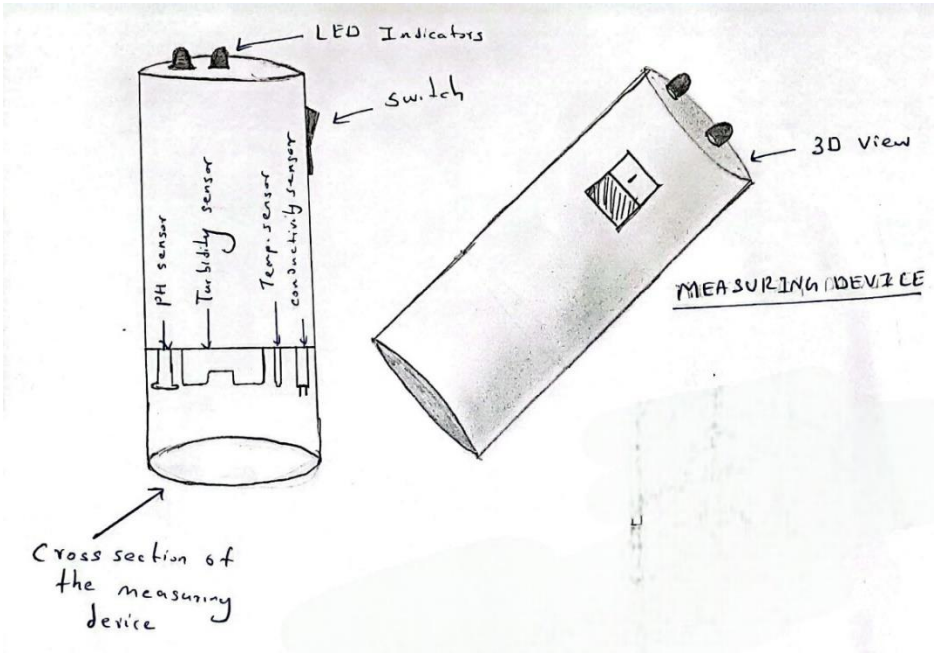
- Smart Plug – This device turns off the water supply (water pump) if the water source is not in good position to use. The data for the device to work will be transferred through cloud base data management system.

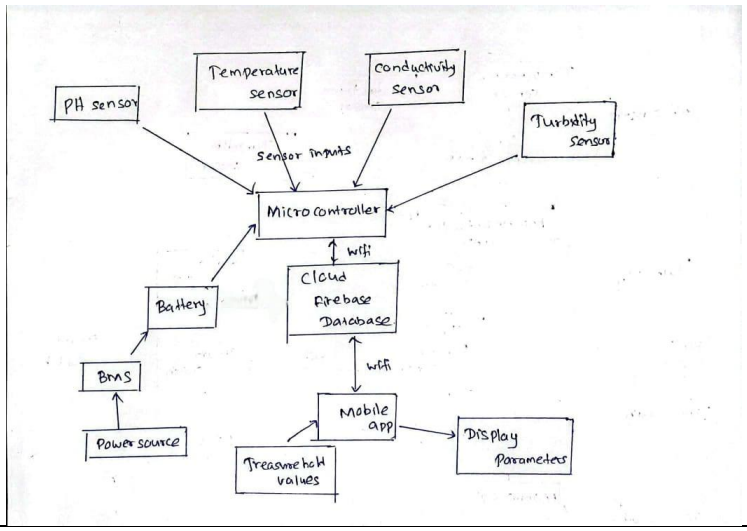
Enclosure Design


Functional Block Diagram


Conceptual Design 02

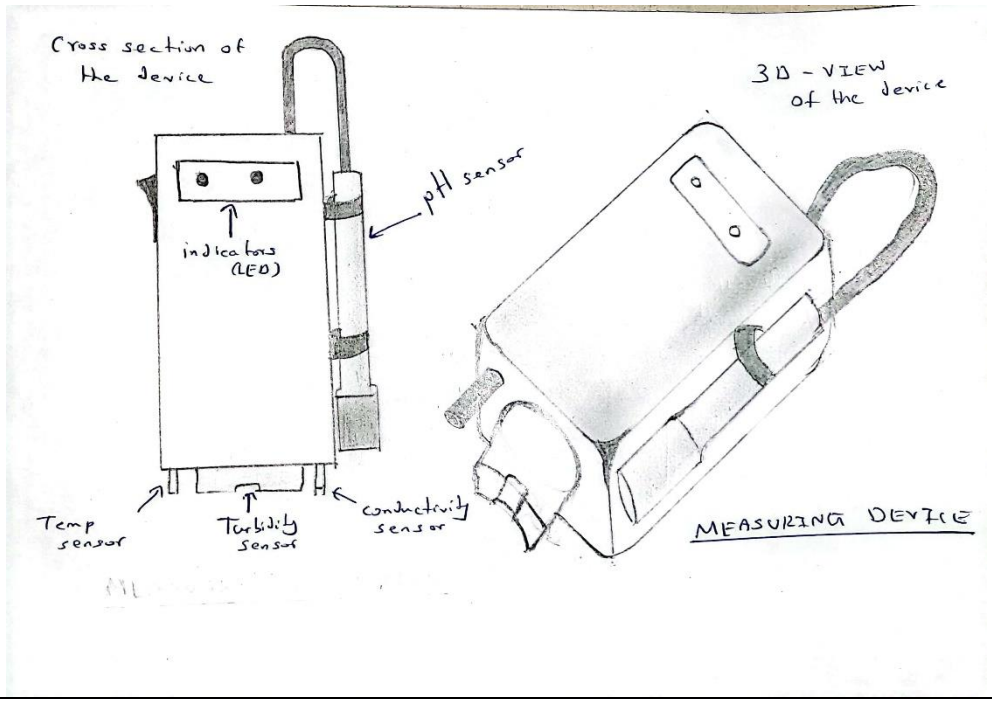
- The design of this device is like a cylinder, and the main four sensors of the device are located at the bottom of the device. Bottom of the device can be drowned in the water to get values. The device is water sealed.

Enclosure Design


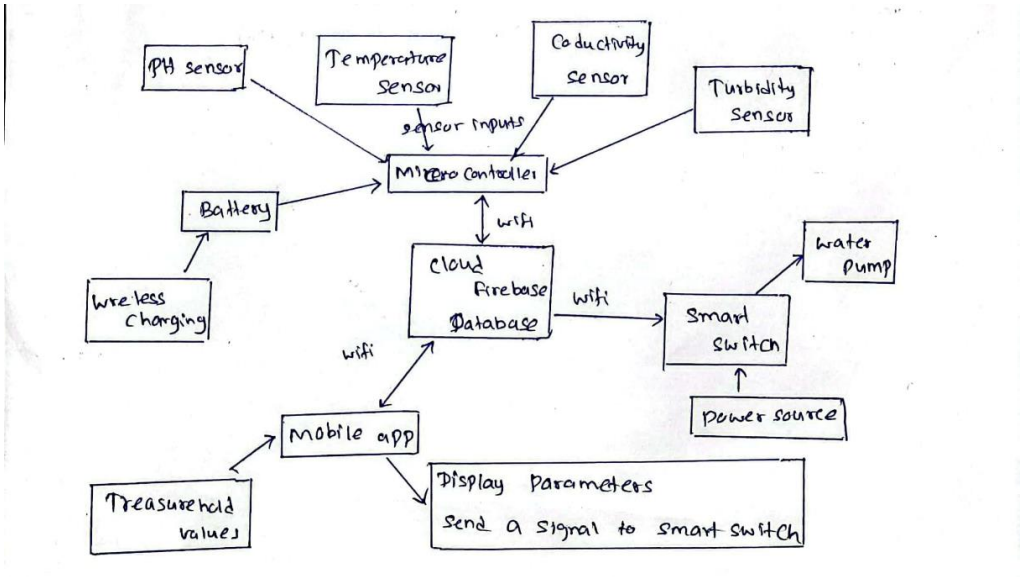
Functional Block Diagram


Conceptual Design 03

- The device enclosure is like a box type and the pH sensor is attached separately to the device. Other three sensors are integrated with the enclosure design. Device can be drowned in the water to measure values. Device is rechargeable and wireless charging is used.

Enclosure Design


Functional Block Diagram



These are the three conceptual designs we have designed, and following are the evaluation of the these conceptual designs.

Evaluation of the Conceptual Designs

		Conceptual design 1	Conceptual design 2	Conceptual design 3
Newly added features		LED indicators to show the water quality status. Smart switch for cutoff power supply Mobile Application	Direct power charging LED indicators to show the water quality status. Mobile Application	Wireless Charging pH Probe can be accessible separately. Mobile Application
Removed features		Wireless charging pH Probe can be accessible separately.	Wireless charging Smart Switch pH Probe can be accessible separately.	Smart Switch Direct Power Charging
Enclosure design criteria comparison	Functionality	9	8	7
	Aesthetics	8	8	7
	Heat dissipation	6	6	6
	Assembly and serviceability	8	8	9
	Ergonomics	8	8	7
	Simplicity	8	8	7
	Durability	8	8	7
Functional block design criteria comparison	Functionality	8	9	7
	User experience	9	8	8
	Manufacturing feasibility	7	7	7
	Cost	7	8	7
	Performance	8	7	7

	Future proo1ng	8	7	8
	Power	8	8	8
Total		110	108	102

Design Selection

According to above evaluation criteria first conceptual design has chosen to develop.

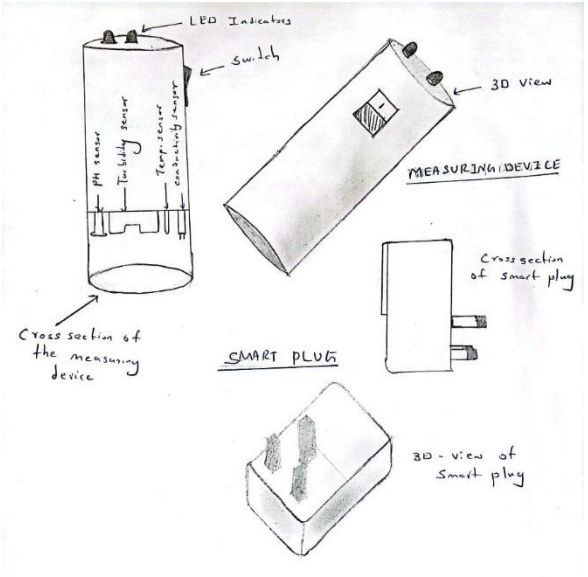
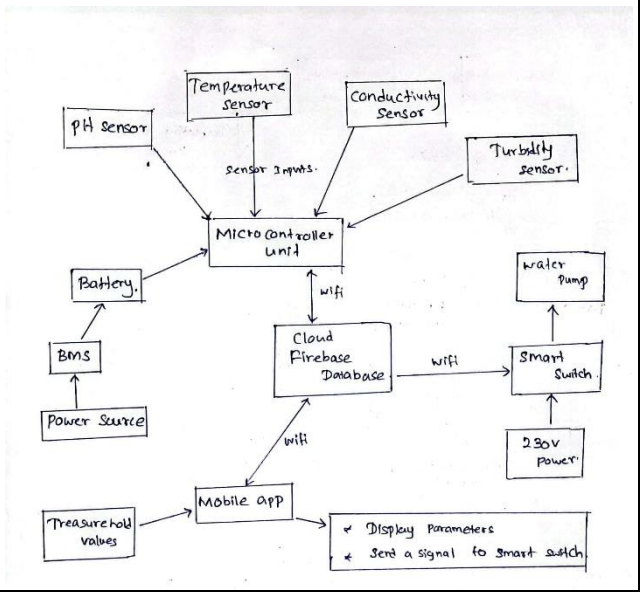
Features of the design

All the main four sensors of the device are integrated within the device and there are two indicators to show the usability of the water according to the values taken by the sensors.

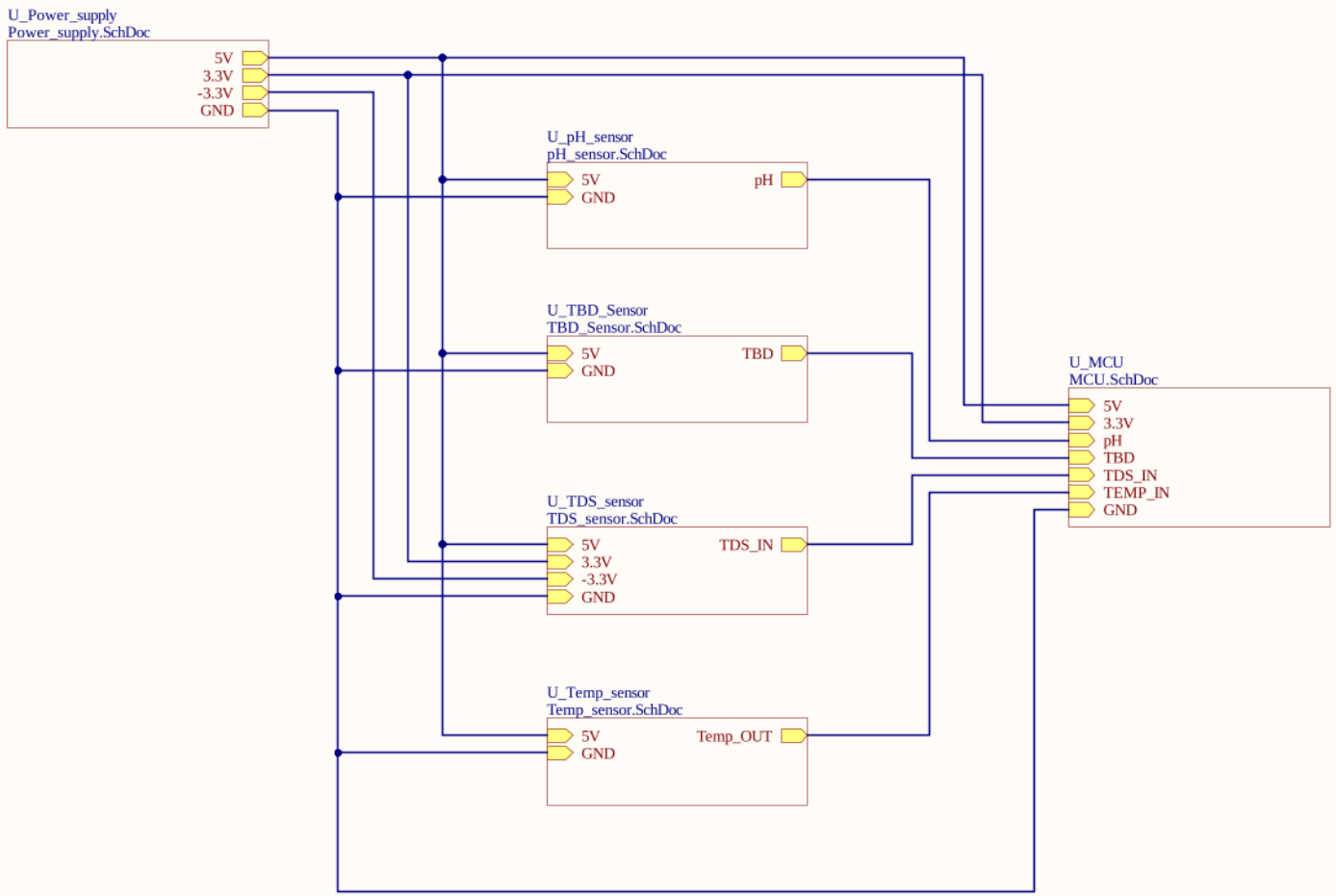
User can observe the real time values through a mobile application and the mobile application can predict whether the water is usable or not.

Enclosure type of the device is cylindrical.

There is a smart plug device is integrated to the design and the smart plug work as the switch to the water pump. If the quality of the device is not in a good condition, then smart plug can automatically turn off the water pump.

Enclosure Design	Functional Block Diagram
	

PCB Schematic Design



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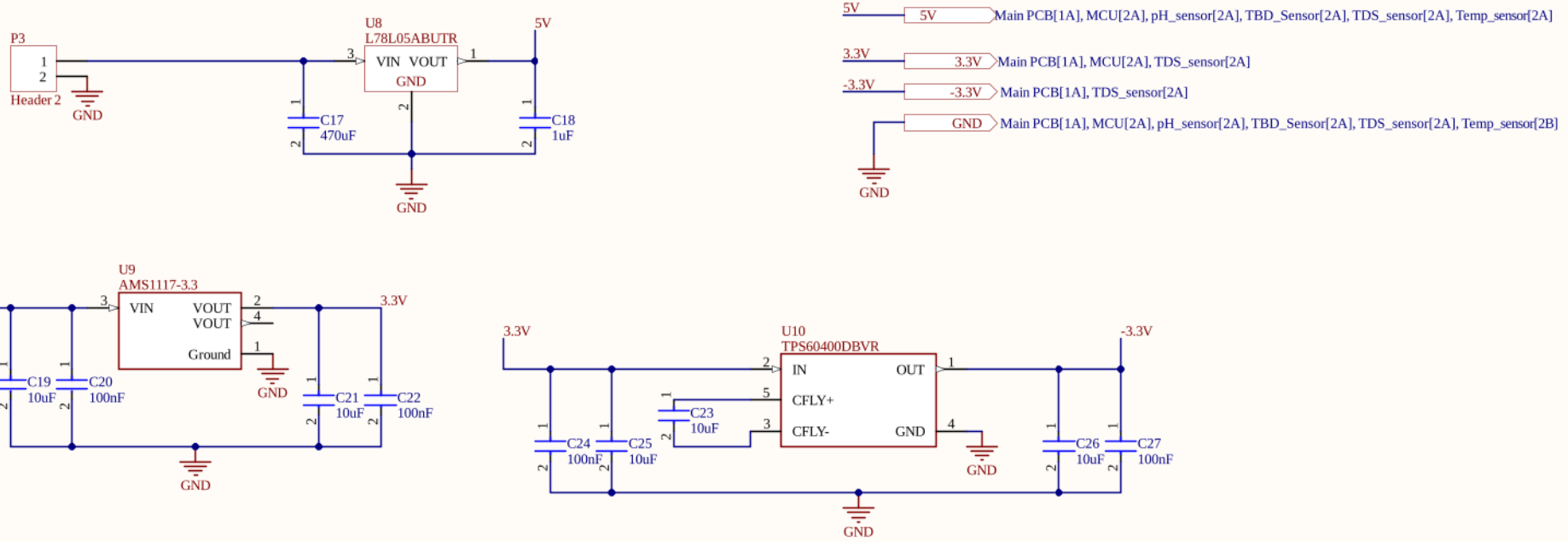

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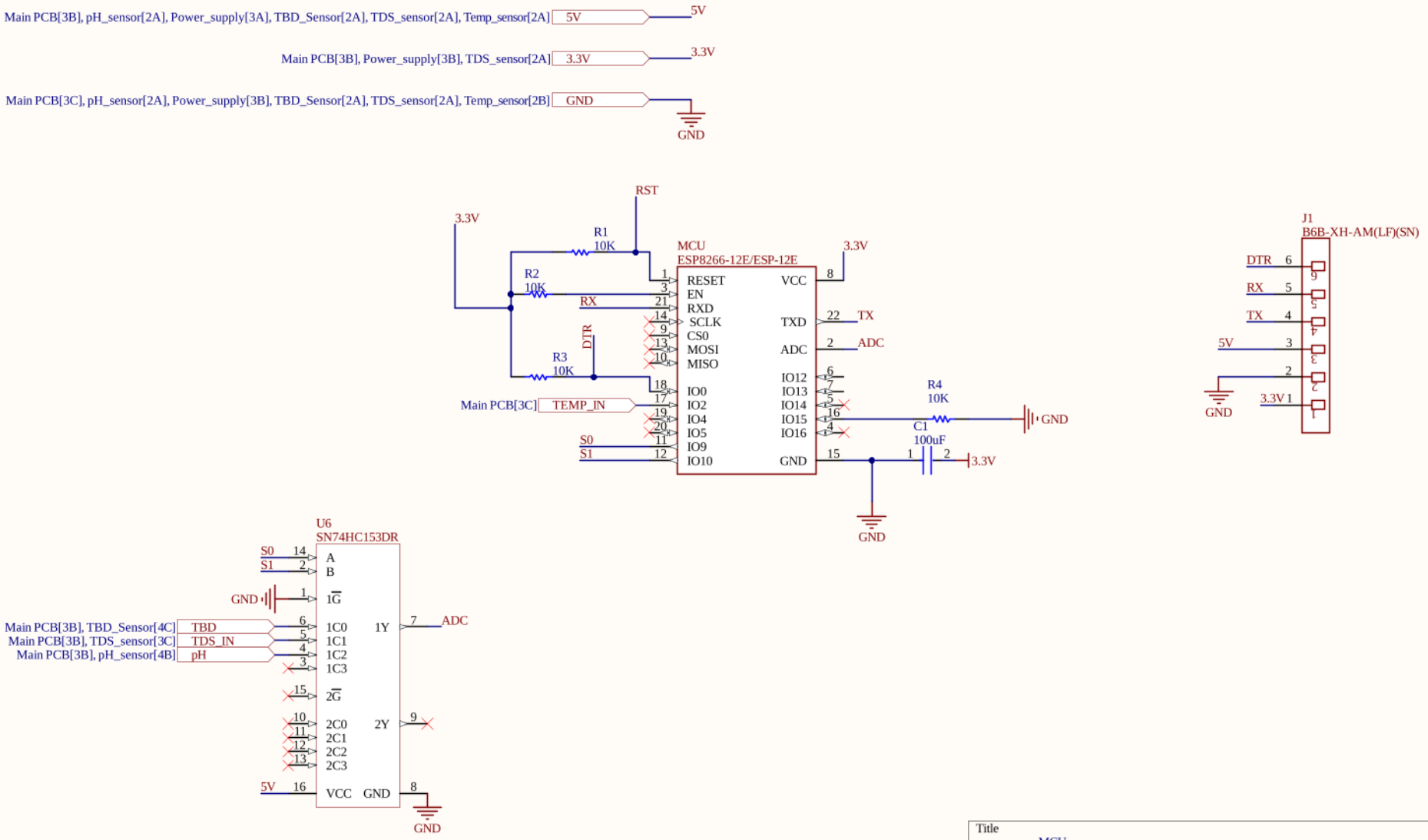

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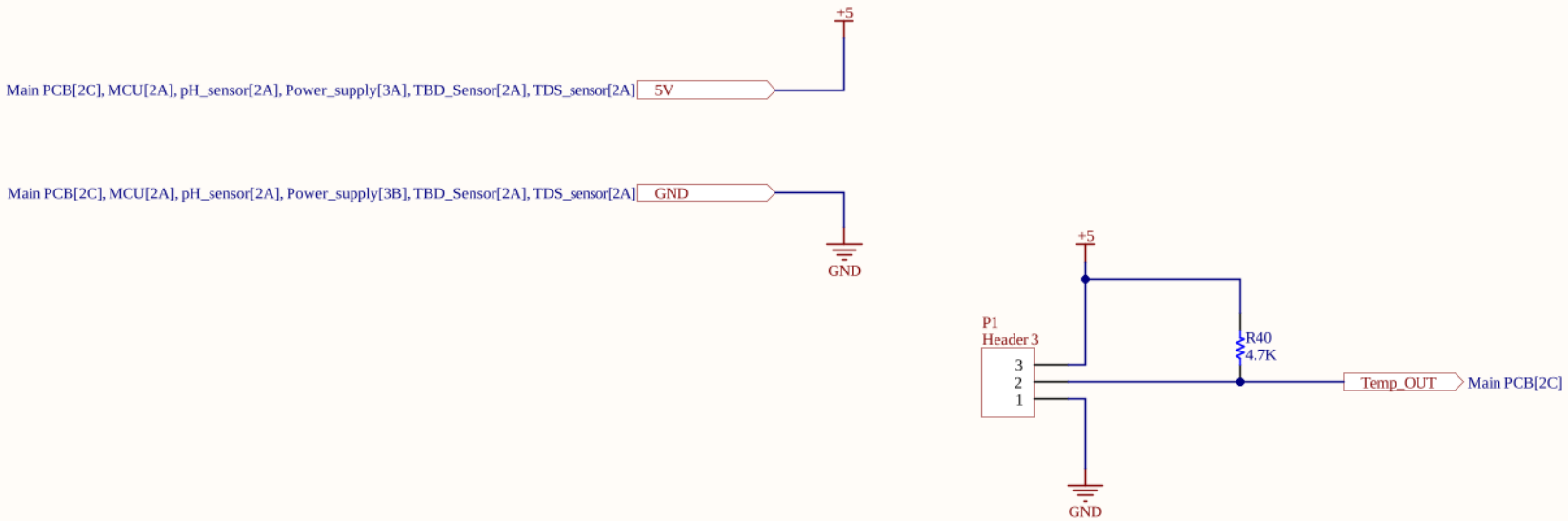

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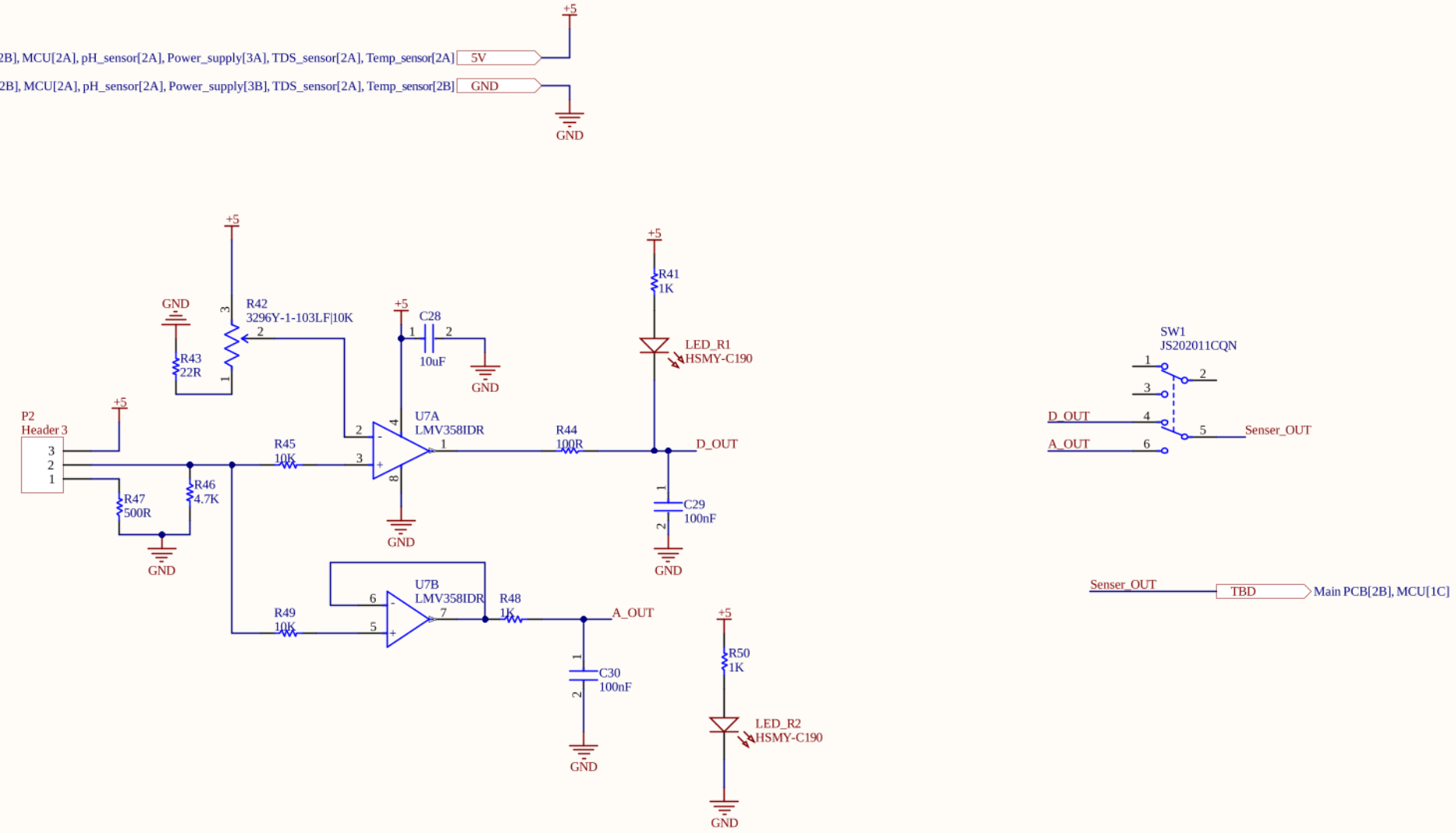

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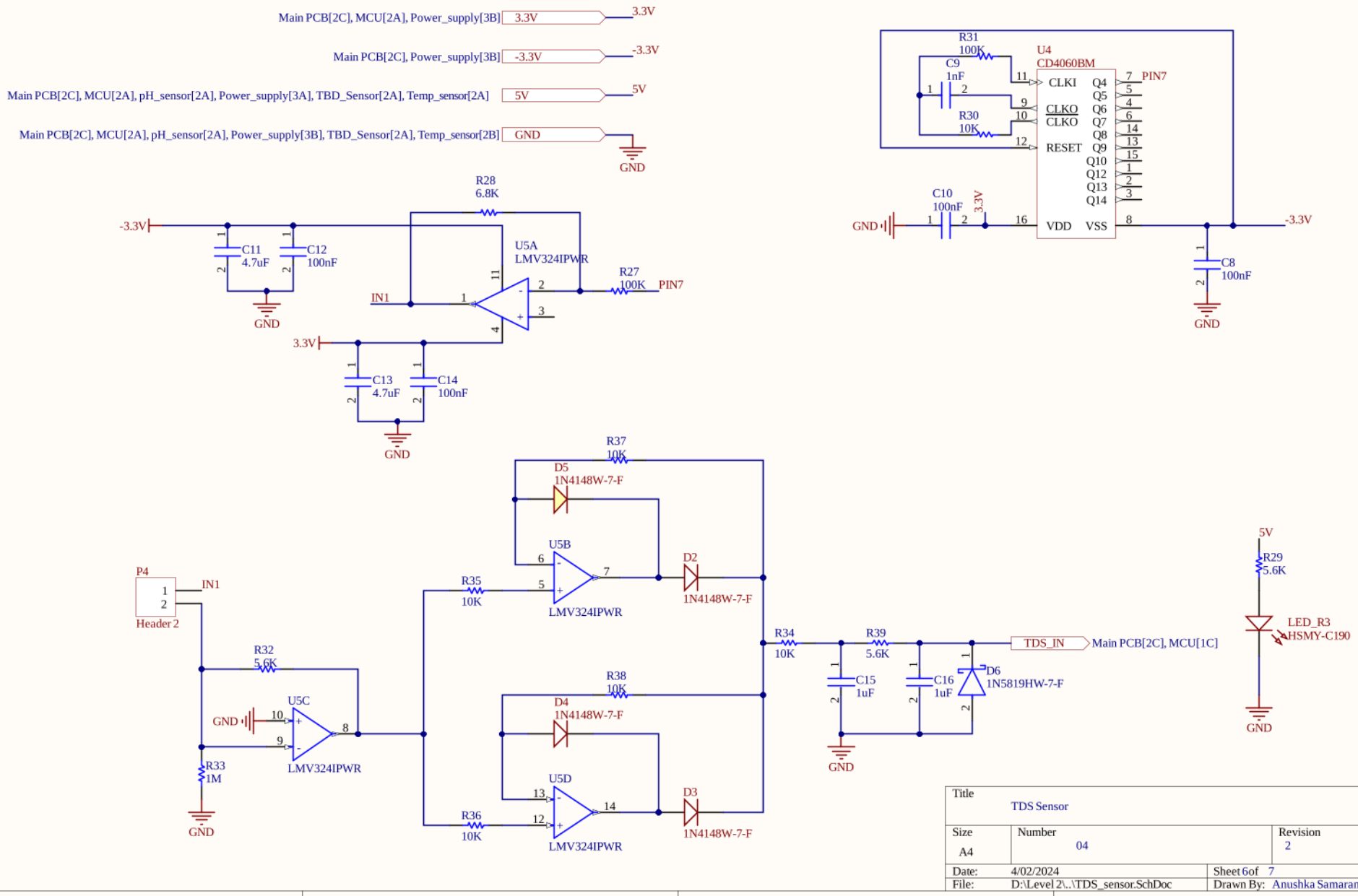
Main PCB[2C], MCU[2A], Power_supply[3B] 3.3V
3.3V
Main PCB[2C], Power_supply[3B] -3.3V
-3.3V
Main PCB[2C], MCU[2A], pH_sensor[2A], Power_supply[3A], TBD_Sensor[2A], Temp_sensor[2A] 5V
5V
Main PCB[2C], MCU[2A], pH_sensor[2A], Power_supply[3B], TBD_Sensor[2A], Temp_sensor[2B] GND
GND
R31
100K
C9
1nF
R30
10K
U4
CD4060BM
CLKI
CLKO
CLKO
RESET
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q12
Q13
Q14
PIN7
C10
100nF
3.3V
VDD
VSS
-3.3V
C8
100nF
R28
6.8K
-3.3V
C11
4.7uF
C12
100nF
U5A
LMV324IPWR
IN1
R27
100K
PIN7
3.3V
C13
4.7uF
C14
100nF
R37
10K
D5
1N4148W-7-F
U5B
LMV324IPWR
D2
1N4148W-7-F
R35
10K
P4
Header 2
IN1
R32
5.6K
U5C
LMV324IPWR
R33
1M
R38
10K
D4
1N4148W-7-F
U5D
LMV324IPWR
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1N4148W-7-F
R36
10K
R34
10K
R39
5.6K
TDS_IN
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C16
1uF
D6
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R29
5.6K
LED_R3
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A4
Number
04
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4/02/2024
Sheet 6 of 7
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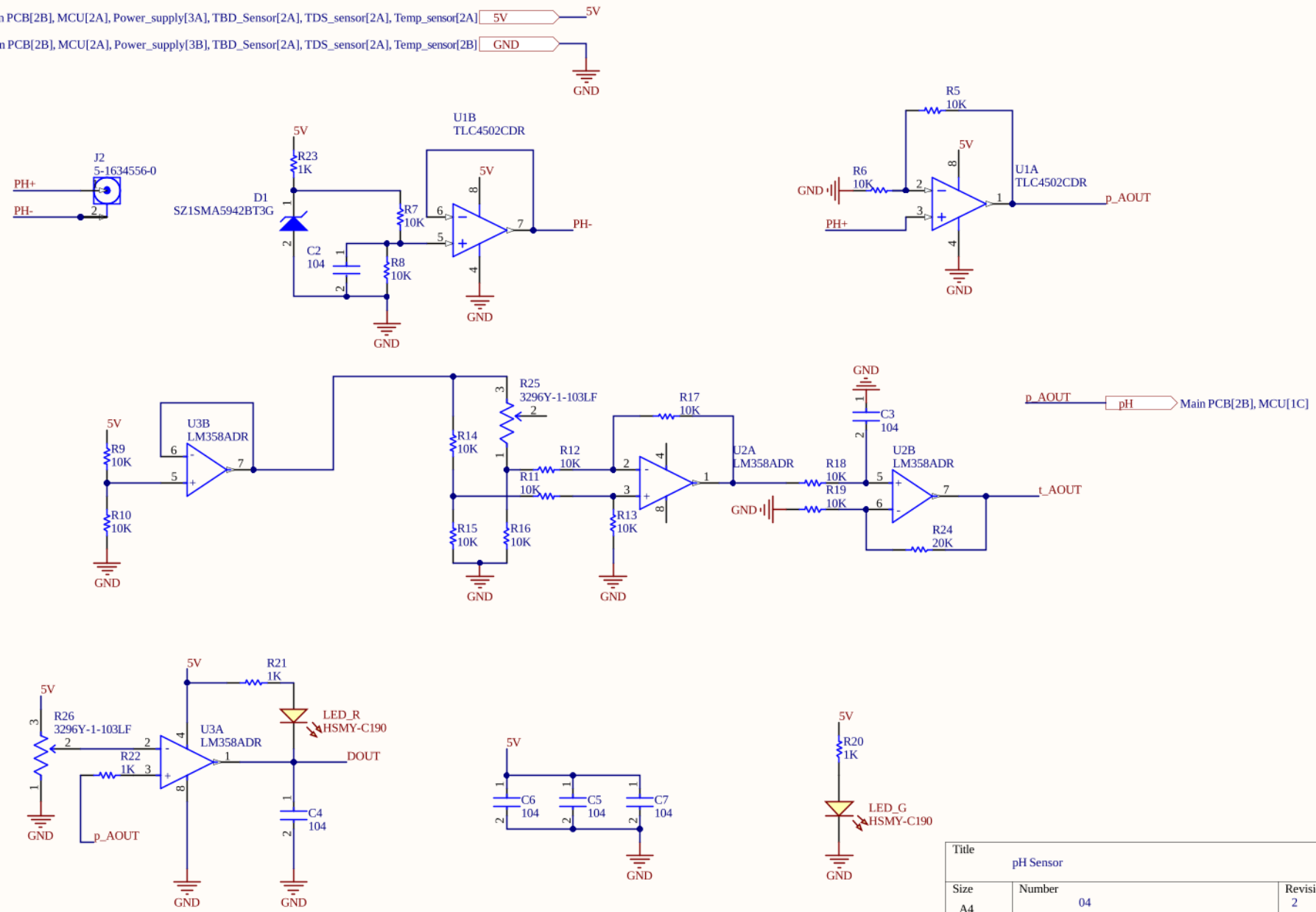
Anushka Samaranayake



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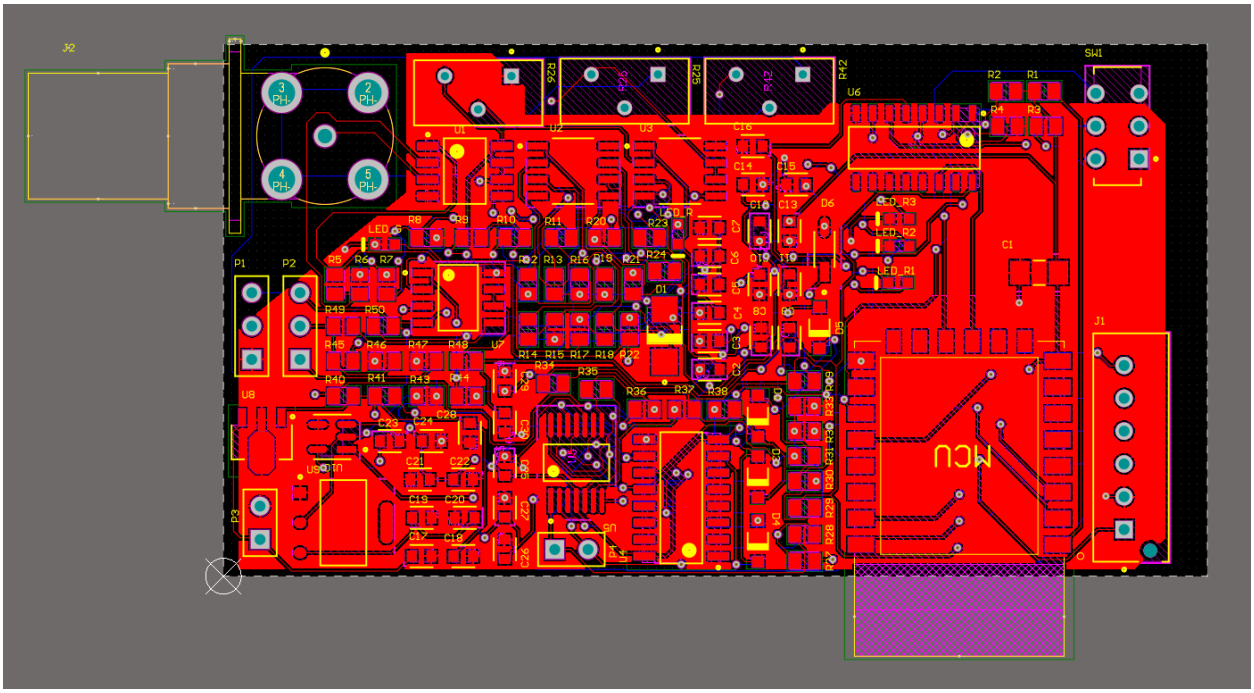
PCB Design (Routing and component placement)



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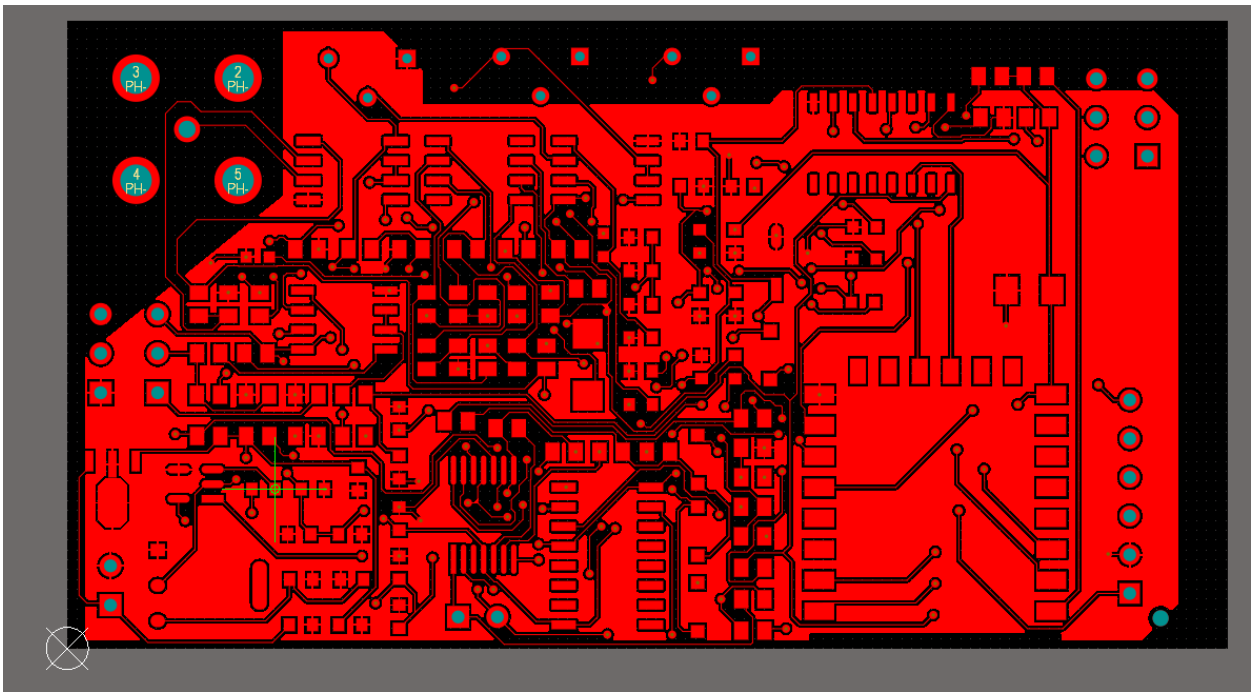

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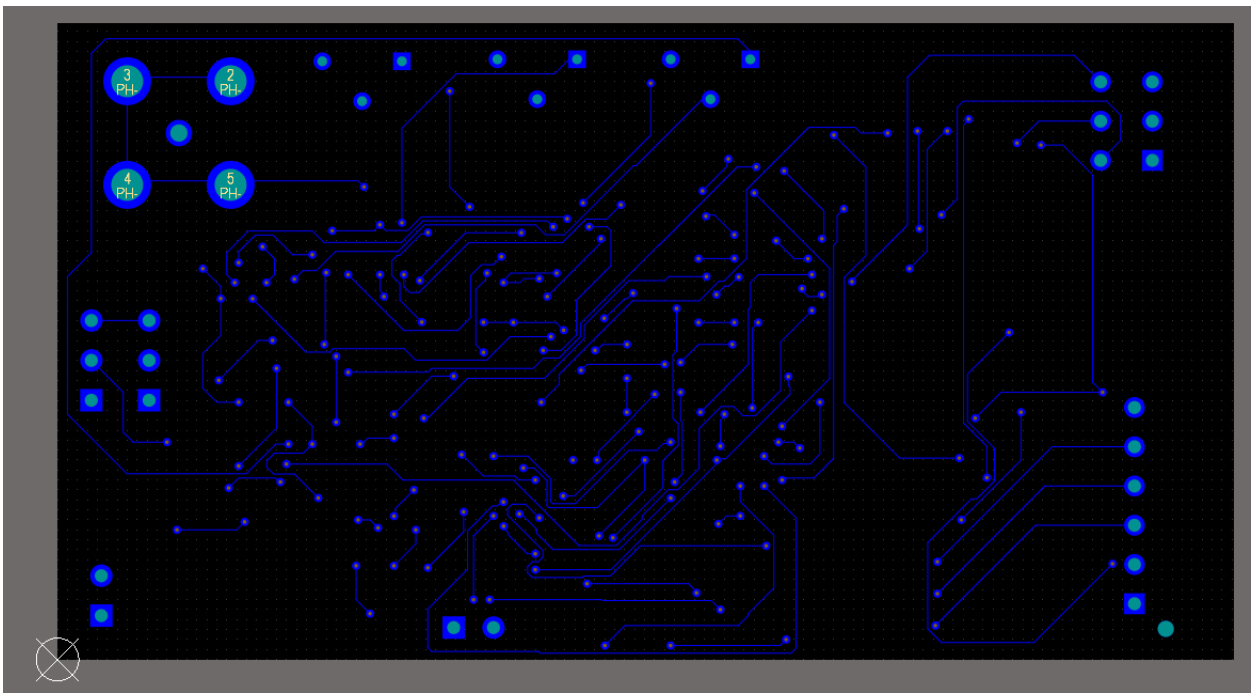
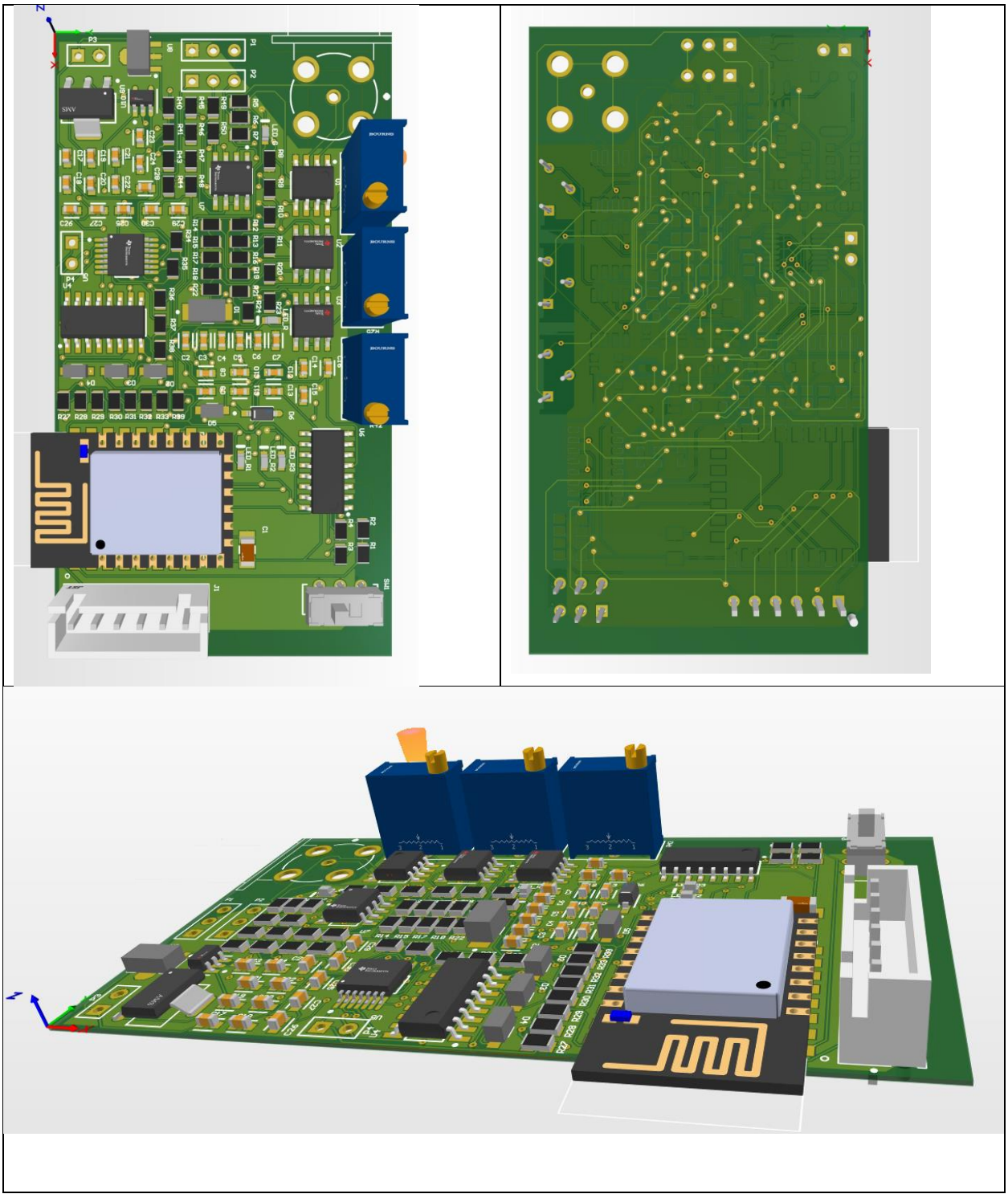
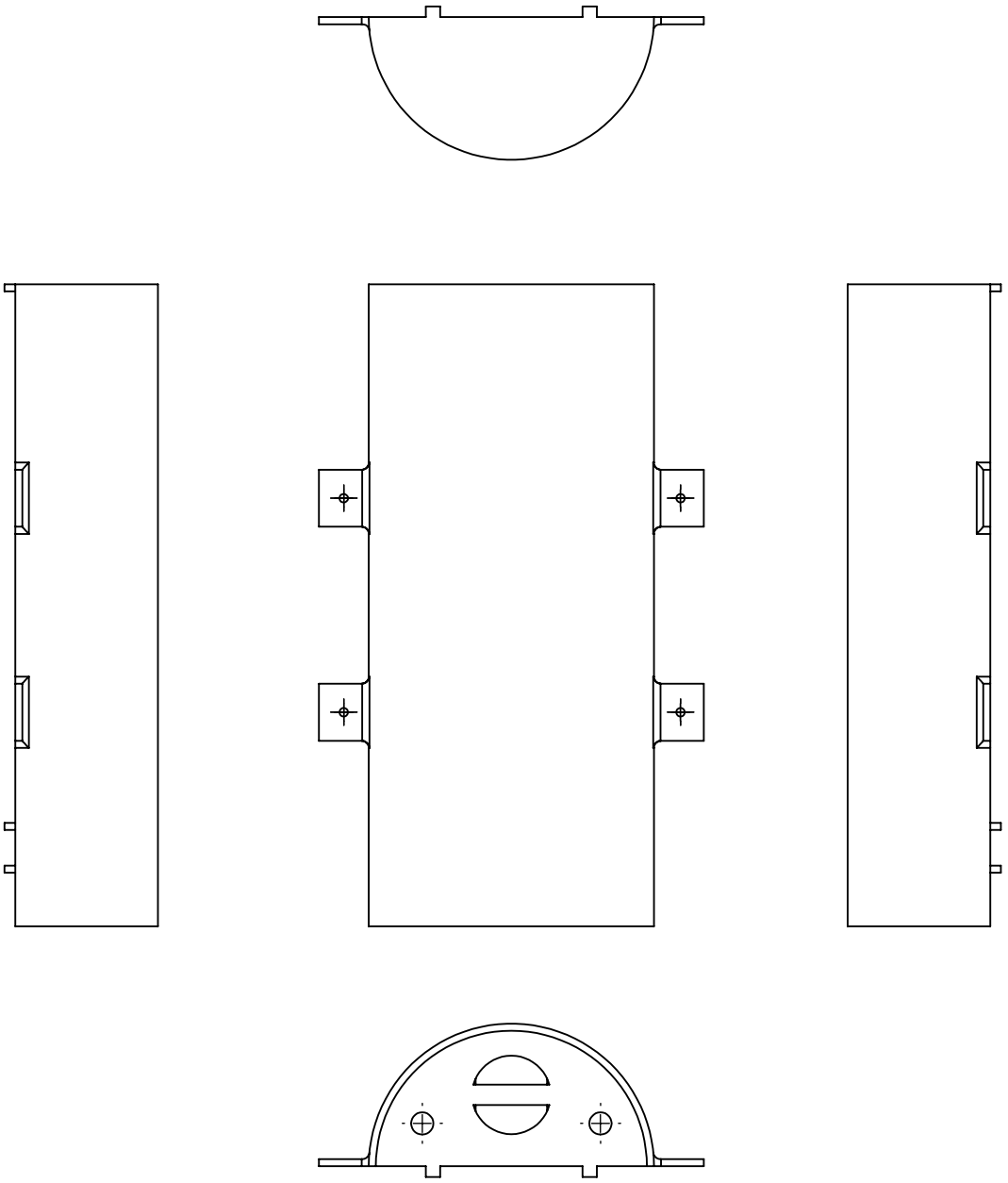


3D View



Enclosure Design



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DRAWN	Prabath Wijethilaka					Enclosure Part 1_1	
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO. Enclosure Part 1_1	A4
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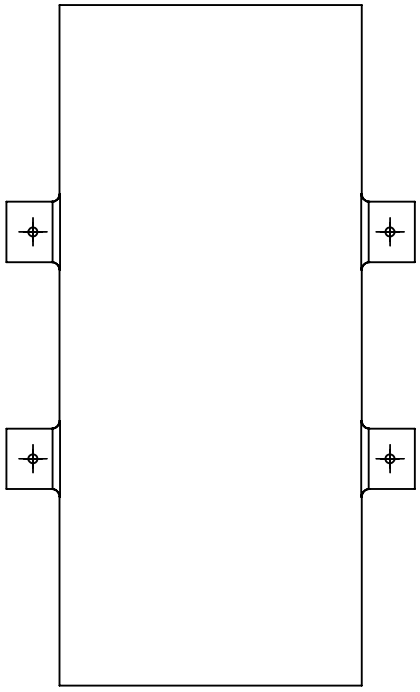

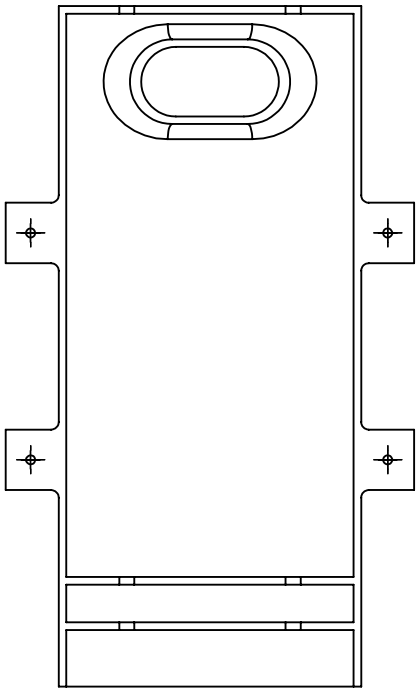

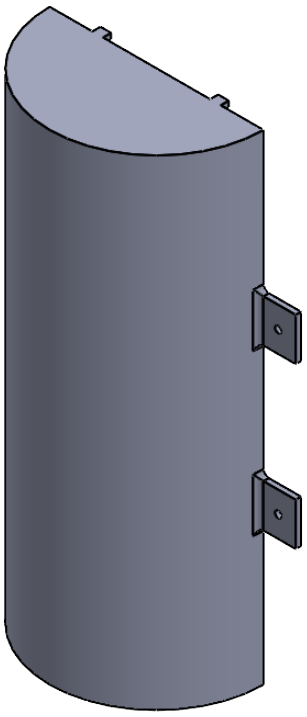

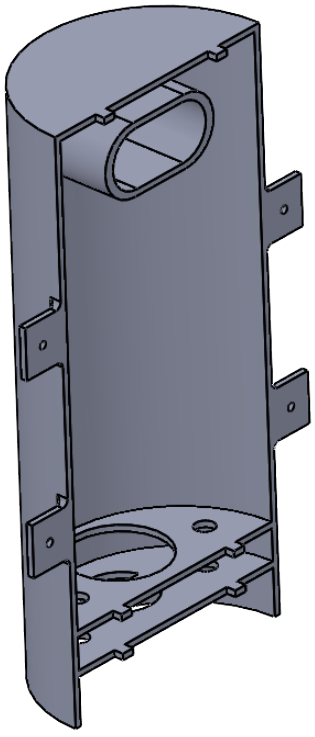

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APPV'D							
MFG							
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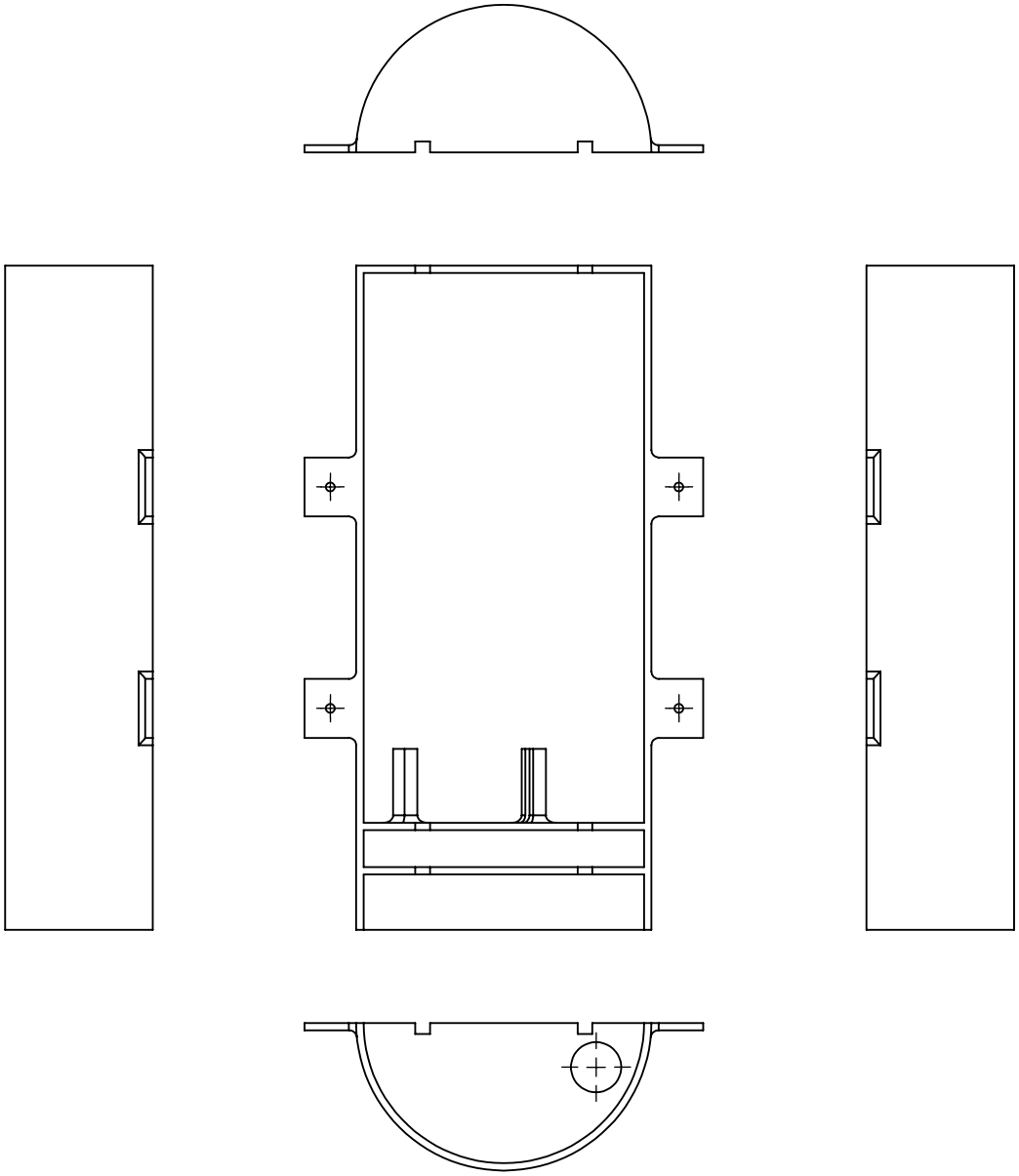

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APPV'D							
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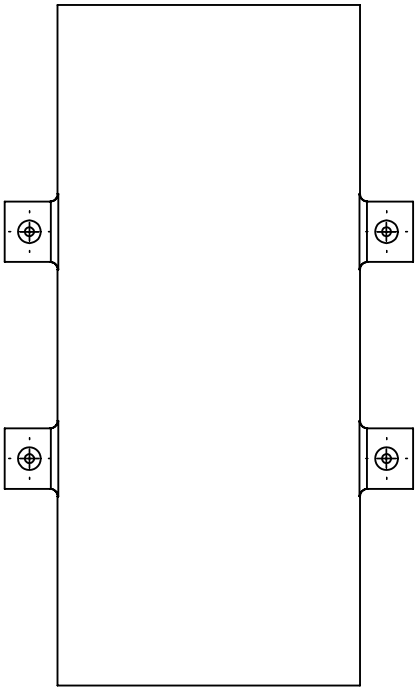

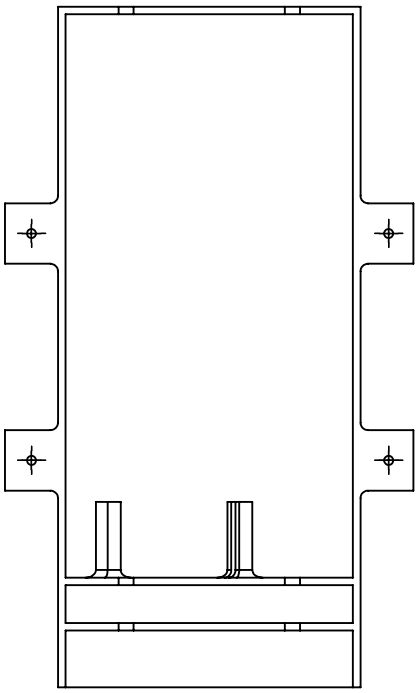

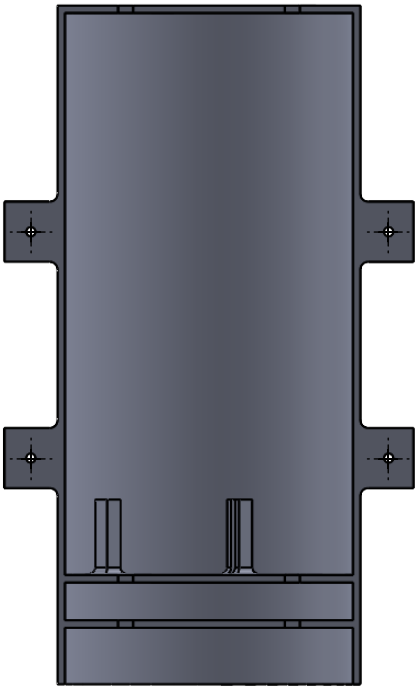

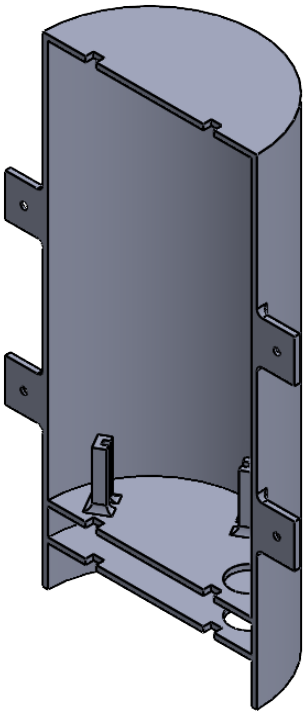

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	NAME	SIGNATURE	DATE
DRAWN	Prabath Wijethilaka		
CHK'D			
APPV'D			
MFG			
Q.A			

TITLE:

Enclosure Part 2_2

MATERIAL:

DWG NO.

Enclousure Part 2_2

A4

WEIGHT:

SCALE:1:2

SHEET 1 OF 1

Assembly design