Department of Electronics and Telecommunications

University of Moratuwa

Design Methodology
Soldering Station

EN2160

Engineering Design Realization

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Contents

1. Project Overview

The soldering station plays a pivotal role in both electronics manufacturing and repair sectors, offering precise temperature control essential for efficient and accurate soldering operations. Our project is dedicated to crafting an advanced soldering station that incorporates essential functionalities such as temperature control, while also introducing innovative features like sleep mode and tip change mode. Additionally, the inclusion of a hot air gun adds versatility, catering to a wide range of soldering applications.

Our focus is on engineering a soldering station that not only meets industry standards but surpasses them through technological innovation and user-centric design. By prioritizing performance optimization and energy efficiency, our solution aims to enhance the overall user experience while streamlining workflow processes. Through meticulous attention to detail and adherence to professional standards, our soldering station endeavors to set a new benchmark for excellence in the field.

Objectives and Goals:

- Develop a soldering station to meet the increasing demand for accessibility and efficiency within the electronics industry.
- Prioritize inclusivity by integrating features that cater to the diverse needs and preferences of users.
- Focus on user-friendly design, affordability, and portability to ensure accessibility for electronic enthusiasts and learners.
- Incorporate essential functionalities such as temperature control, sleep mode, tip change mode, timers and a hot air gun to facilitate various soldering tasks.
- Enhance performance, energy efficiency, and overall user experience through the application of innovative technology and user-centric design principles.

2. Review Progress

In our ongoing progress review, we've carefully assessed various types of soldering stations to understand their suitability and practicality within our project scope. Each type offers distinct benefits and considerations, guiding our decision-making process as we aim to develop an inclusive and effective solution. In this review, we examine the specifications of five soldering station types, analyzing their features, applications, and limitations. Our goal is to make informed decisions that align with professional engineering standards and prioritize user needs while advancing our project objectives.

1.1. Industrial products

1. Induction Soldering Stations:

- Utilizes induction heating technology for precise temperature control.

- Requires specialized training due to its complex operation.

- Offers consistent heating across solder joints, minimizing the risk of overheating or cold joints.

- Typically features adjustable power settings for varying soldering requirements.

- Suitable for soldering delicate components such as surface mount devices (SMDs) and integrated circuits.

- May have higher initial cost due to the complexity of the technology and specialized equipment.

- Commonly used in industries requiring high precision soldering, such as electronics manufacturing and medical device assembly.

Figure 1-Induction Soldering Stations

2. Lead-Free Soldering Stations:

- Utilizes lead-free solder alloys composed of tin, silver, and copper for reduced environmental impact.

- Requires higher soldering temperatures compared to lead-based solders.

- Produces less toxic fumes during soldering operations, improving workplace safety.

- Requires adjustment in soldering technique due to the different flow characteristics of lead-free solder.

- Compliance with environmental regulations such as RoHS (Restriction of Hazardous Substances) directives.

- Ideal for applications where lead contamination is a concern, such as consumer electronics manufacturing.

- May require additional flux application for improved wetting due to the higher melting temperatures of lead-free solder alloys.

Figure 2-Lead-Free Soldering Stations

3. Infrared Soldering Stations:

- Utilizes infrared radiation for non-contact soldering, reducing the risk of damage to sensitive components.

- Offers precise temperature control and uniform heating distribution across solder joints.

- Suitable for soldering components with heat-sensitive materials such as plastics and ceramics.

- May have higher initial cost due to specialized equipment and technology.

- Offers fast heating and cooling cycles, increasing soldering efficiency.

- Commonly used in industries requiring high-quality soldering with minimal thermal stress on components, such as aerospace and automotive electronics assembly.

Figure 3-Infrared Soldering Stations

4. Hot Air Soldering Stations:

- Utilizes heated air for soldering, allowing precise control of temperature and airflow.

- Offers versatility for various soldering applications, including SMD soldering, rework, and desoldering.

- Requires proper technique to avoid damaging components, especially when soldering small or delicate parts.

- Typically features adjustable temperature and airflow settings to accommodate different soldering requirements.

- Commonly used in electronics repair, prototyping, and small-scale production environments.

- Requires periodic calibration and maintenance to ensure consistent soldering performance.

Figure 4-Hot Air Soldering Stations

5. Ultrasonic Soldering Stations:

- Utilizes ultrasonic vibrations to create frictional heat for soldering, enabling soldering without direct contact.

- Suitable for soldering dissimilar materials with different melting points, such as metals, ceramics, and glass.

- Offers fast and efficient soldering process with minimal heat-affected zone.

- Requires specialized equipment and training for operation.

- Commonly used in applications where conventional soldering methods are impractical or ineffective, such as joining fragile or heat-sensitive materials.

- Offers potential for automation in high-volume manufacturing environments.

Figure 5-Ultrasonic Soldering Stations

2.2. Academic Projects

Open-Source Soldering Iron Station with Temperature Feedback & Control (University of California, Berkeley)	Ryan Sommer (Undergraduate Researcher)	This project aimed to create a low-cost, open-source soldering station with precise temperature control using readily available components and an Arduino microcontroller. The project focused on affordability and accessibility for educational settings
Portable Miniaturized Soldering Station (Indian Institute of Technology, Bombay)	Shashank Agarwal and Pranit Kulkarni (Graduate Students)	This project focused on developing a portable and compact soldering station suitable for field use and applications where space is limited. The station utilized a battery-powered design and incorporated safety features like automatic shut-off.

ireless and Self Calibrating Soldering Station (University of Stuttgart, Germany)	Florian Mayer (Master's Student), Martin Schneider-Tanne (Professor)	This project focused on developing a wireless soldering station with features like automatic tip temperature calibration and remote control using Bluetooth connectivity. The emphasis was on enhancing user convenience and safety.

2.3. YouTube videos related to our project

1. Different Kind of soldering stations

This video provides a general overview of different soldering stations available on the market, including industrial models. It discusses factors to consider when choosing a soldering station, such as power, temperature range, and features.

Watch the video: http://www.youtube.com/watch?v=XnUnYuRRmM4

2. Understanding Power Supply Circuit works

This video and web page provide information on transforming electrical power from one form to another, like AC to DC, or changing voltage levels. Maintaining a desired voltage or current output despite input fluctuations or load changes. Implementing safeguards against overvoltage, overcurrent, short circuits, and other anomalies

Watch the video: https://youtu.be/LNEiBP3YT2k?si=RY-UYfx0Jduun6C-

Web page: https://www.utmel.com/blog/categories/powersupply/introduction-to-6-coaCmmon-power-supply-design-circuits

3. Programming Atmega with OLED

This official tutorial guides you through setting up Atmel Studio 7, a software environment commonly used for programming Atmel microcontrollers like the Atmega. It covers creating projects, using the interface, and basic tasks like uploading code.

Watch the video: https://m.youtube.com/watch?v=8HNG8EnAjfw

4. PID -Temperature control

This video provides a clear and concise guide to building a PID controller for your soldering iron using an Arduino Nano microcontroller. It covers the essential components, circuit connections, and code required to implement a PID control loop. The presenter explains how PID control works and how it allows for precise and stable temperature regulation, allowing you to work with different materials without overheating or damaging them. He also demonstrates calibrating the controller for optimal performance, making it a valuable resource for both beginners and experienced hobbyists.

Watch the video: https://www.youtube.com/watch?v=fv6dLTEvl74

3. Plan Next Steps

In the upcoming phase of our soldering station project, we will focus on refining and integrating key elements to enhance its functionality and user experience. This phase encompasses both hardware and software aspects, ensuring that our soldering station meets the highest performance and usability standards.

3.2. Hardware Integration:

Our primary objective is to optimize the hardware components of the soldering station, particularly the temperature control system and the integration of the hot air gun feature. We will conduct thorough testing to ensure that the temperature control system maintains precise regulation of the soldering iron's temperature, preventing overheating and ensuring consistent heat output. Additionally, we will seamlessly integrate the hot air gun feature into the soldering station design, implementing necessary circuits and components to control its operation effectively.

3.3. Software Development:

In parallel with hardware integration, we will focus on software development to enhance the functionality and usability of the soldering station. Our main emphasis will be on refining the temperature control algorithm, leveraging PID principles to achieve accuracy and responsiveness in temperature regulation. Furthermore, we will integrate sound indication features into the software to provide audible alerts for key events such as temperature reach and mode changes, enhancing the user experience.

3.4. Testing and Evaluation:

Comprehensive testing and evaluation are essential to ensure the reliability and performance of the soldering station. We will conduct rigorous performance testing under various conditions to assess temperature control accuracy, heat-up time, and overall soldering performance. Additionally, we will gather feedback from potential users to identify any usability issues or areas for improvement, incorporating this feedback into iterative design updates to enhance the user experience further.

3.5. Decision Making Process:

The decision-making process will be guided by predefined evaluation criteria, including accuracy, efficiency, and robustness. We will establish an experimental setup using appropriate tools and equipment to test the soldering station's performance under realistic conditions. Analyzing experimental results and user feedback will enable us to make informed decisions regarding design modifications and feature implementation, ensuring that the soldering station meets the needs and expectations of our users effectively.

3.6. Further Steps in Project Completion:

Looking ahead, we remain committed to continuous improvement and innovation in our soldering station project. We will explore opportunities for further enhancement and iteration of the design, staying updated on industry trends and user preferences to incorporate new features and functionalities as needed. Through our focused efforts and dedication to excellence, we aim to deliver a soldering station that sets new standards for performance, reliability, and user satisfaction.

4. Identify stakeholders.

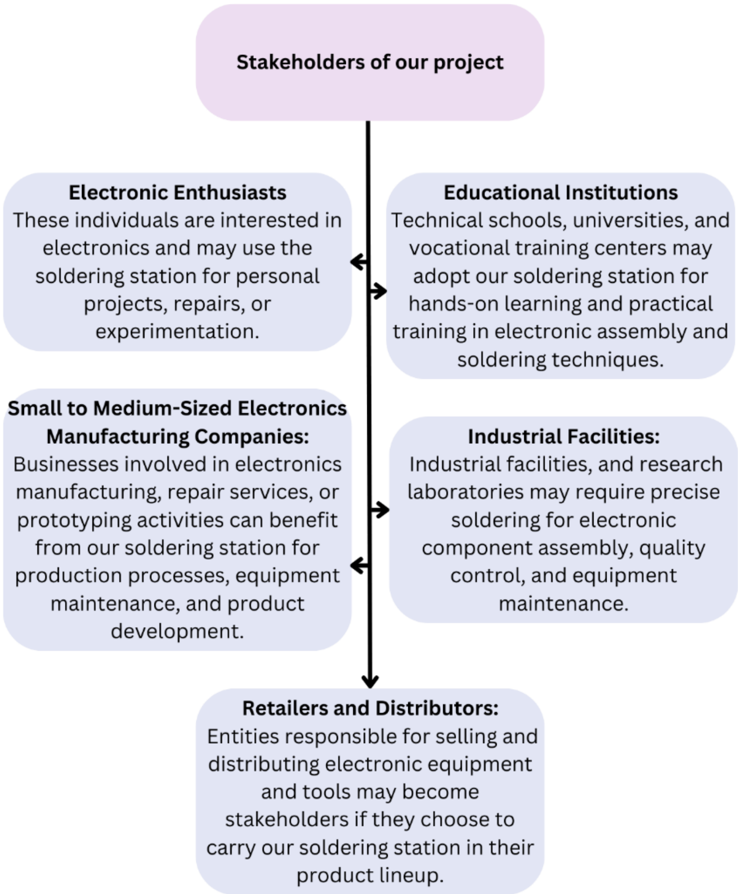


Figure 6-stakeholders

5. Stakeholder map

The stakeholder map diagram illustrates the various stakeholders engaged in a project, grouped based on their levels of interest and influence. Employing a quadrant-based methodology, stakeholders are strategically positioned to reflect their degree of involvement and impact on project results. This structured categorization aids in stakeholder management by facilitating anticipation of their requirements, ensuring comprehensive engagement with key stakeholders, and maintaining consistent communication channels with those considered most significant. By aligning strategies for engaging stakeholders with their respective levels of interest and influence, project stakeholders can be efficiently managed to enhance project outcomes.

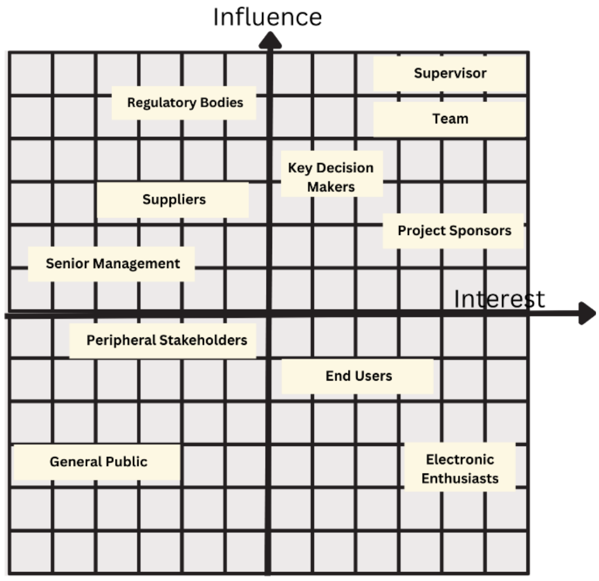


Figure 7-Stakeholder map

6. Observe Users

Observing users is a crucial aspect of understanding the needs, behaviors, and preferences of individuals interacting with products, services, or systems. By carefully watching how users engage with a particular offering, researchers, designers, and product developers can gain valuable insights into usability issues, pain points, and opportunities for improvement.

6.2. Identified Users

Soldering Professionals:

These individuals rely on soldering as part of their daily work, whether in electronics manufacturing, device repairs, jewelry-making, stained-glass work, or circuit board assembly. They need reliable and versatile soldering equipment to meet the demands of their profession.

Students and Beginners:

Those who are new to soldering often start with basic projects or educational exercises. Soldering stations with user-friendly features and safety mechanisms are essential for beginners to learn and practice soldering techniques effectively.

Small Business Owners:

Owners of small businesses or workshops specializing in electronics repair, prototyping, or custom manufacturing rely on soldering equipment to carry out their operations efficiently. They need soldering stations that offer consistent performance and durability to meet their business needs.

Professional Engineers and Designers:

Engineers, designers, and professionals working in industries such as aerospace, automotive, telecommunications, and consumer electronics require soldering equipment for research, development, prototyping, and product design purposes. They often need precise temperature control and advanced features to meet the demands of their projects.

6.3. Compilation of Needs and User Requirements for the Soldering Station Project:

In developing our soldering station project, we meticulously compiled a comprehensive list of needs and user requirements to guide the design and development phases. Here's how we approached this crucial step:

- Stakeholder Engagement: We engaged with various stakeholders to understand their perspectives and requirements, gaining valuable insights into the diverse needs of our target audience.
- Observation and Feedback: Through direct observation and feedback sessions, we identified user preferences, pain points, and areas for improvement, ensuring our design addressed real-world needs.
- Needs Compilation: We compiled a comprehensive list of needs spanning essential functionalities, performance requirements, usability considerations, safety features, and compatibility specifications.
- User Requirement Identification: From the compiled list, we identified specific user requirements that directly addressed the needs and preferences of our target users, prioritizing them based on significance and impact.
- User-Centric Approach: Maintaining a user-centric approach, each requirement was carefully evaluated to ensure alignment with user needs, feasibility, and relevance.
- Iterative Refinement: The compilation process was iterative, involving continuous refinement and validation based on feedback from stakeholders and user representatives.

6.4. Identified Needs and User Requirements:

Precise Temperature Control:

Incorporate a temperature control system that allows users to adjust temperatures accurately for various soldering tasks and materials. This ensures optimal soldering results and prevents thermal damage to components.

Energy Efficiency:

Implement energy-saving features such as sleep mode to minimize power consumption during idle periods. This not only reduces operating costs but also promotes environmental sustainability.

Ease of Use:

Design intuitive controls and ergonomic features to enhance user comfort and streamline soldering tasks. By making the soldering station easy to operate, we reduce training requirements and improve overall user satisfaction.

Versatility:

Ensure compatibility with different soldering applications and techniques, including support for various soldering iron tips and additional tools like hot air guns. This enhances the versatility of the soldering station and expands its range of applications.

Reliability:

Use durable materials and robust components to ensure the soldering station's longevity and performance under demanding conditions. This instills confidence in users and minimizes downtime due to equipment failure.

Safety:

Include safety mechanisms such as overheat protection and insulated handles to prevent electrical hazards and promote a safe working environment. Safety is paramount, and our aim is to provide users with peace of mind while using our product.

Compatibility:

Ensure compatibility with standard power supplies and accessories to facilitate integration into existing workstations and workflows. By offering compatibility with common industry standards, we make it easy for users to incorporate our product into their existing setup.

7. Simulate Ideas

7.2. Simulating main power supply

The power circuit plays a pivotal role in our project, delivering a stable and reliable 24V DC output essential for the optimal functioning of our device. Its careful design and implementation are crucial to ensure adequate current supply and minimize heat dissipation.

The primary objective of this project was to devise a power supply circuit capable of transforming the standard 230V AC grid supply into a stable 24V DC output, with a mor than 80W power. However, the initial iteration of the power supply circuit, despite being designed and simulated, encountered notable challenges pertaining to insufficient current handling and notable heat dissipation. Furthermore, finding suitable components.

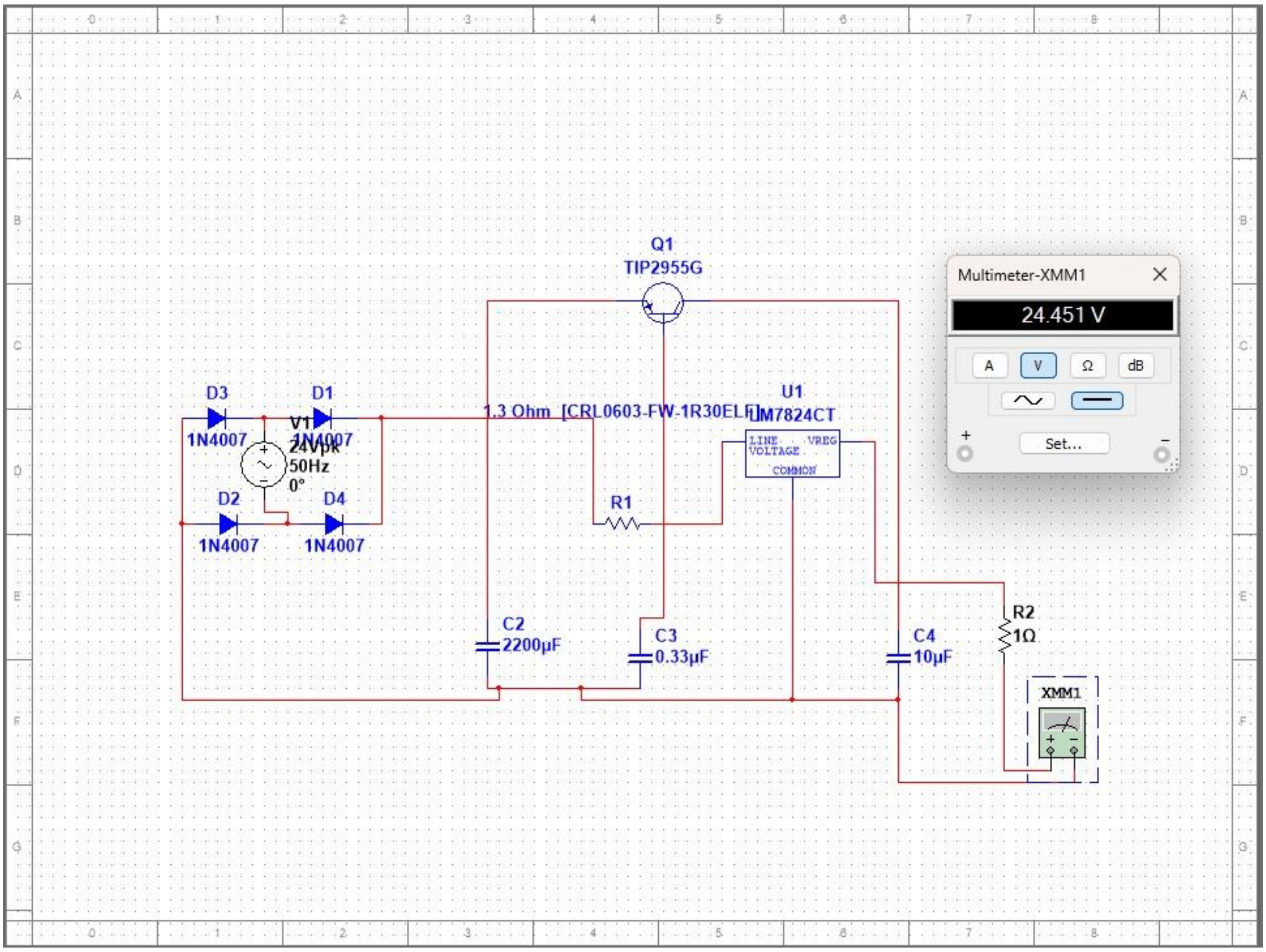


Figure 8-Simulating power supply circuit

Following a thorough assessment of the shortcomings associated with the initial design, a revised power supply circuit was conceptualized. This revised iteration incorporated a center tap transformer in conjunction with a 2-diode full-wave rectifier. Nonetheless, this design exhibited certain drawbacks, including delayed stabilization and voltage drops. We validated it using a simulation and a dot board implementation.

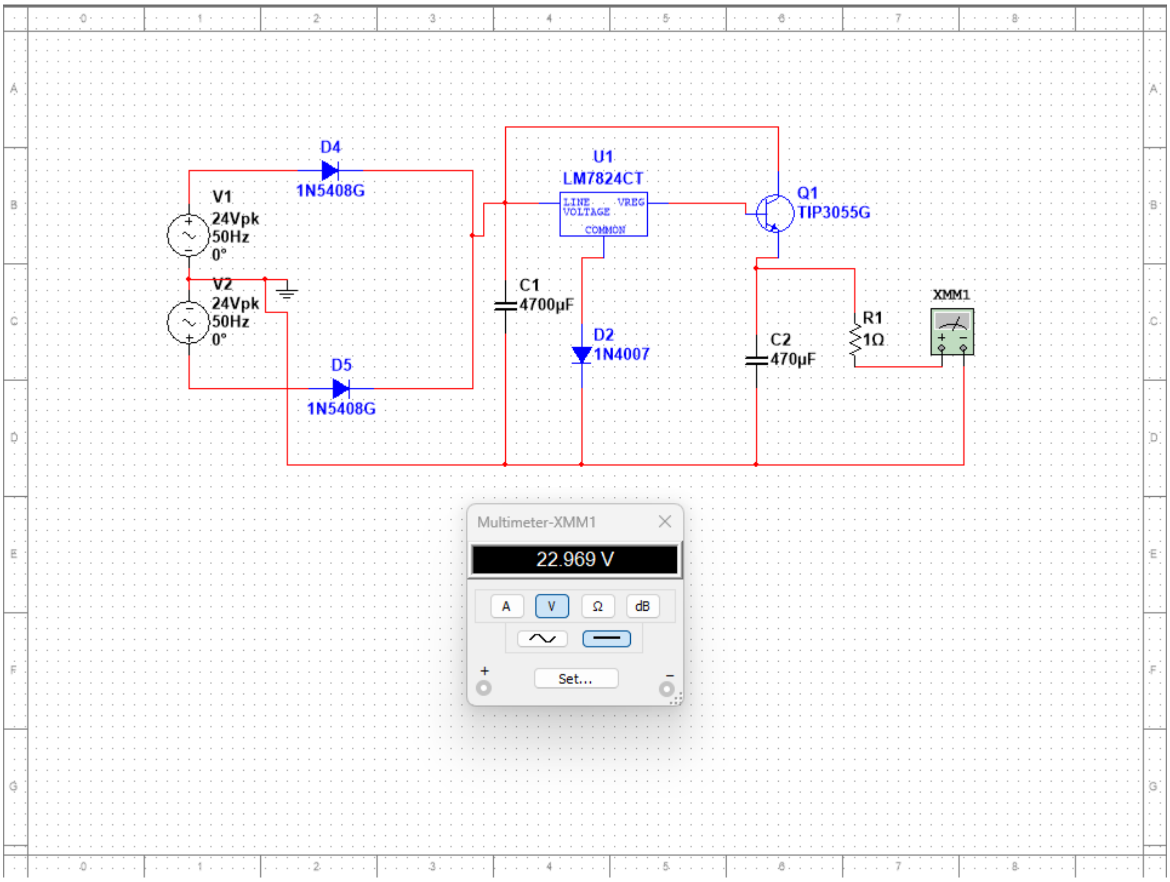


Figure 9-Simulating power supply circuit

To mitigate these challenges, further refinement of the circuit design was pursued. Notably, the 2-diode rectifier was replaced with a bridge rectifier, and a non-center tap transformer was employed. This refinement not only reduced power dissipation but also enhanced the stability of the output voltage while minimizing voltage drops. Then we extend this circuit to get 5V as well.

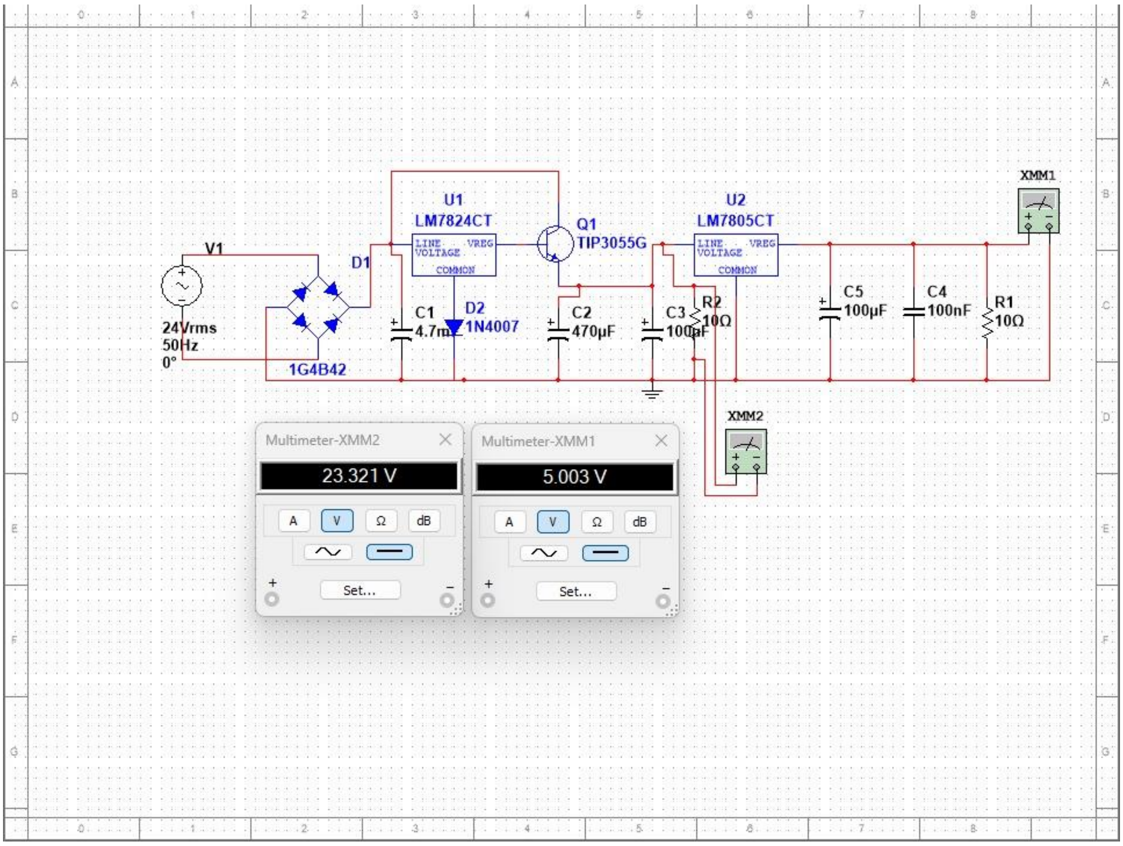


Figure 10-Simulating finalize power supply circuit

Simulation of the refined circuit showcased its capability to effectively fulfill the project requirements. Additionally, the subsequent dot board implementations validated the feasibility of the design in real-world applications.

The refined power supply circuit offers several advantages over its initial counterpart, including heightened efficiency, diminished heat dissipation, and a more condensed PCB layout. Furthermore, the utilization of readily available components bolsters the project's scalability and feasibility for mass production.

7.3. Simulating thermocouple feedback system

As part of our project development process, we conducted a simulation to optimize the thermocouple feedback system for our soldering iron. We designed an inverting amplifier circuit to amplify the signal from the thermocouple before feeding it into the microcontroller for temperature regulation feedback. Through careful selection of resistor values and meticulous calculations, we fine-tuned the amplifier circuit to achieve the desired gain while maintaining stability and minimizing noise. Simulating the circuit before proceeding to PCB design validated our design choices, ensuring that the amplifier provided the necessary gain without introducing distortion or unwanted effects. This simulation phase allowed us to confidently proceed with PCB design, knowing that the feedback system would support precise temperature control in our soldering station, ultimately enhancing the soldering experience for users and delivering superior results.

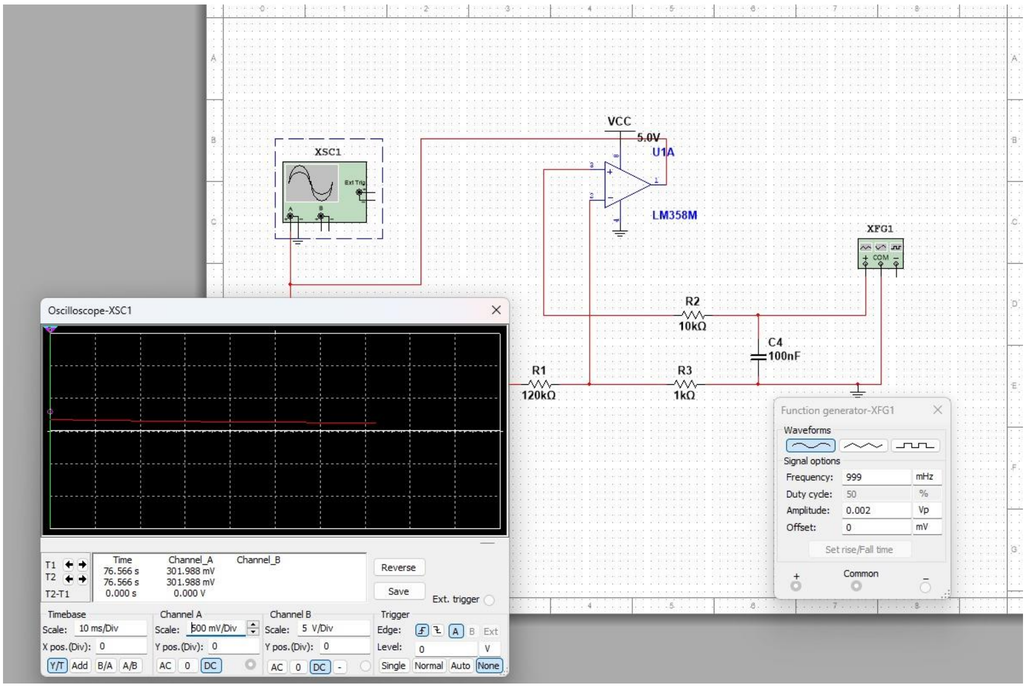


Figure 11-Simulating thermocouple feedback system

8. Conceptual Design and Functional block diagrams

8.2. Conceptual design 1

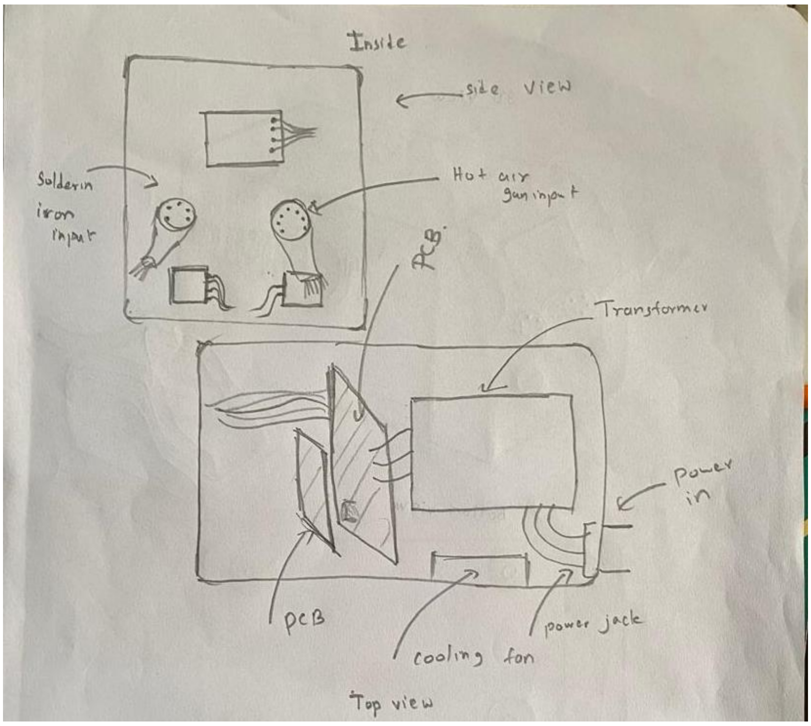


Figure 12-inside

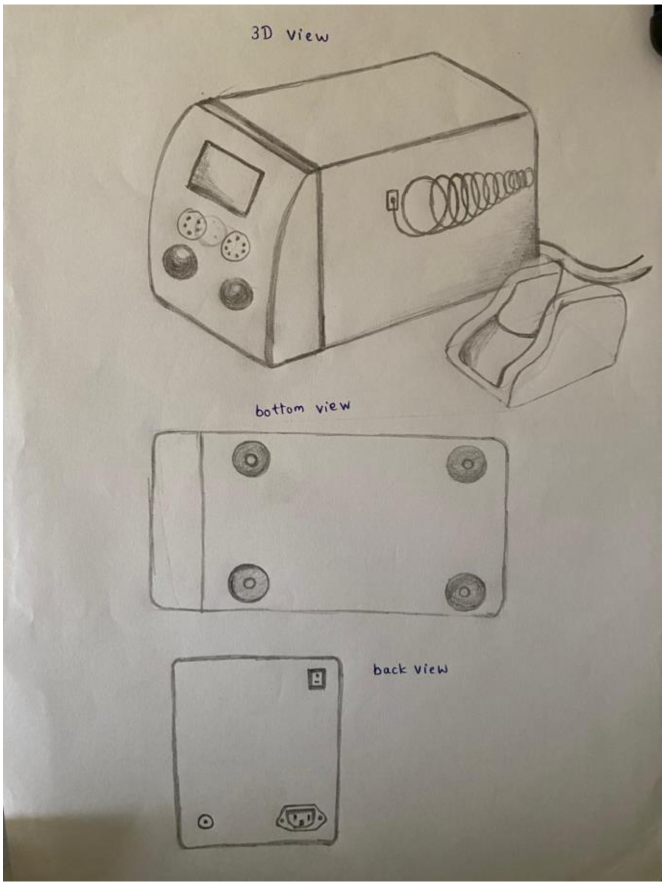


Figure 13-outside

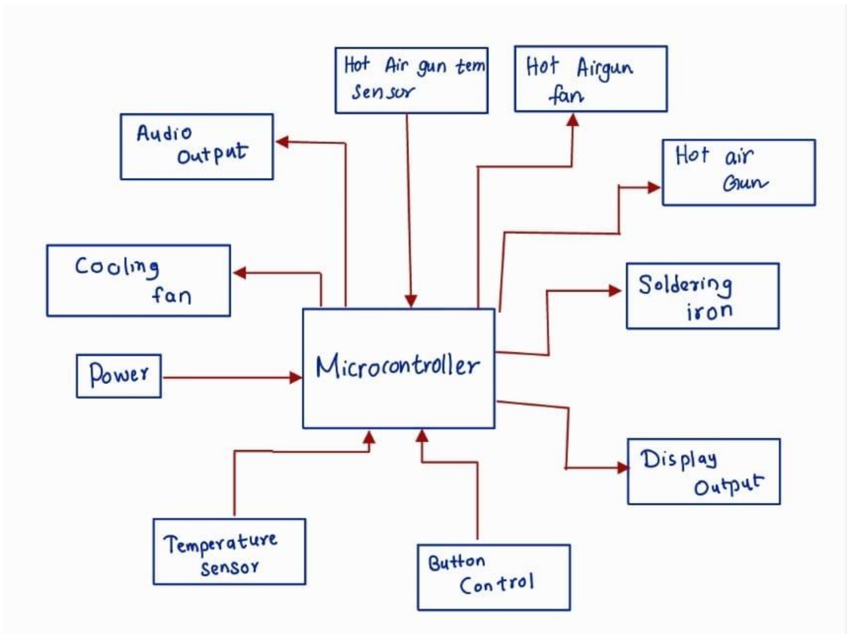


Figure 14-Functional block diagram conceptual design 1

This design includes a hot air gun option compared with the other two. To control the hot air gun and the fan, an AC circuit needs to be included. In the DC circuit PCB, a fan controller circuit for the hot air gun needs to be incorporated. Since the hot air gun requires AC power, users can only use a 230V AC power supply. Therefore, this design includes a transformer, making it heavier compared to the other two designs. Additionally, to indicate some modes, there is a sound indication, which also changes the PCB slightly compared to others. Software-wise, we include sleep mode, tip change mode and also use PID for temperature controlling. In sleep mode, when the soldering iron is not in use, it will automatically turn off. This mode helps to reduce power consumption.

8.3. Conceptual design 2

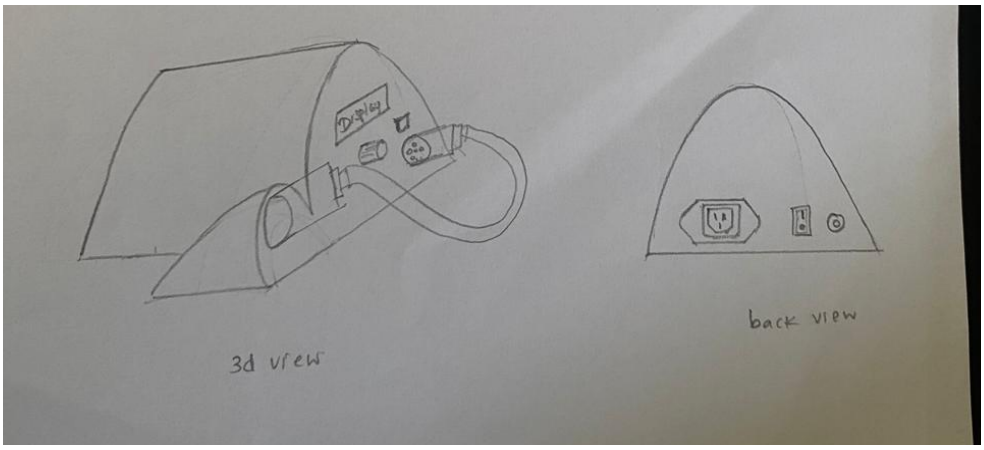


Figure 15-Outside

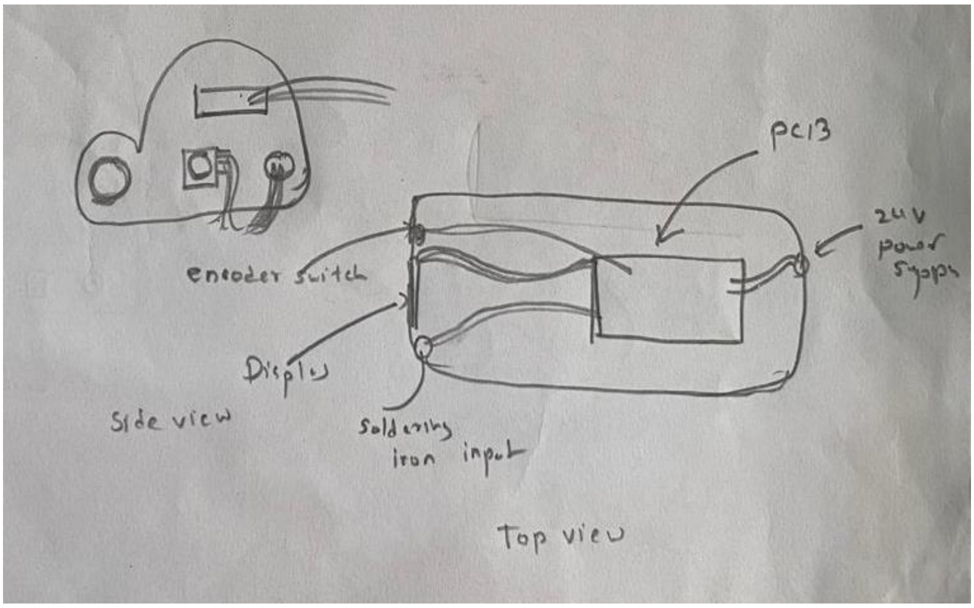


Figure 16-Inside

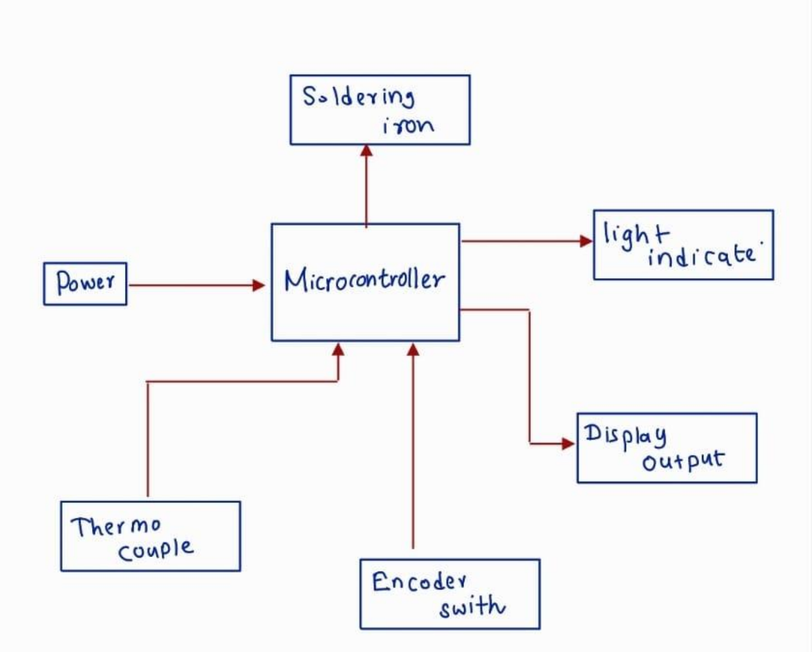


Figure 17-Functional block diagram conceptual design 2

In this design, we have opted to create a lightweight option. The main heavy component, the transformer, has been removed, allowing users to utilize a 24V DC power supply, making it easier to carry anywhere. Additionally, power consumption will be significantly lower compared to the other two devices. In this design, there is an additional component on the PCB for amplifying the output of the thermocouple used to measure temperature, setting it apart from the other two designs. Furthermore, compared to the other two designs, this one includes a tip change mode, allowing users to change the tip according to their requirements.

8.4. Conceptual design 3

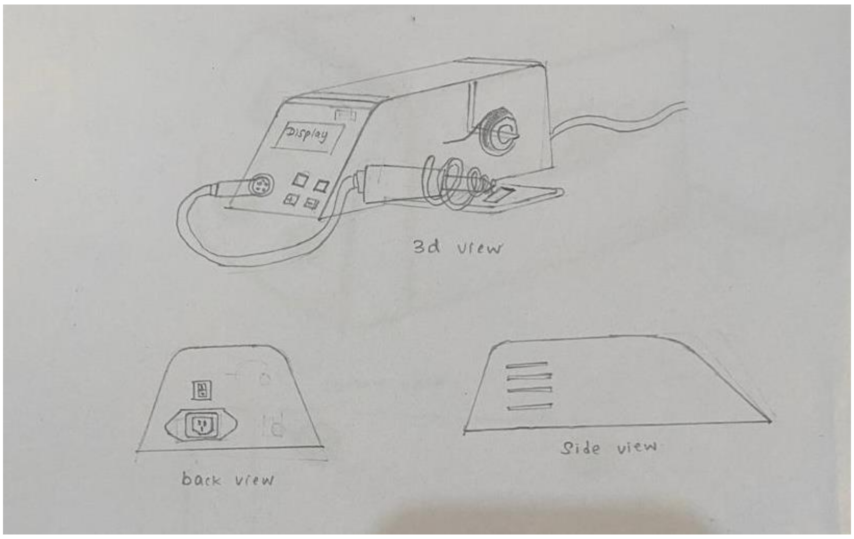


Figure 18-Outside

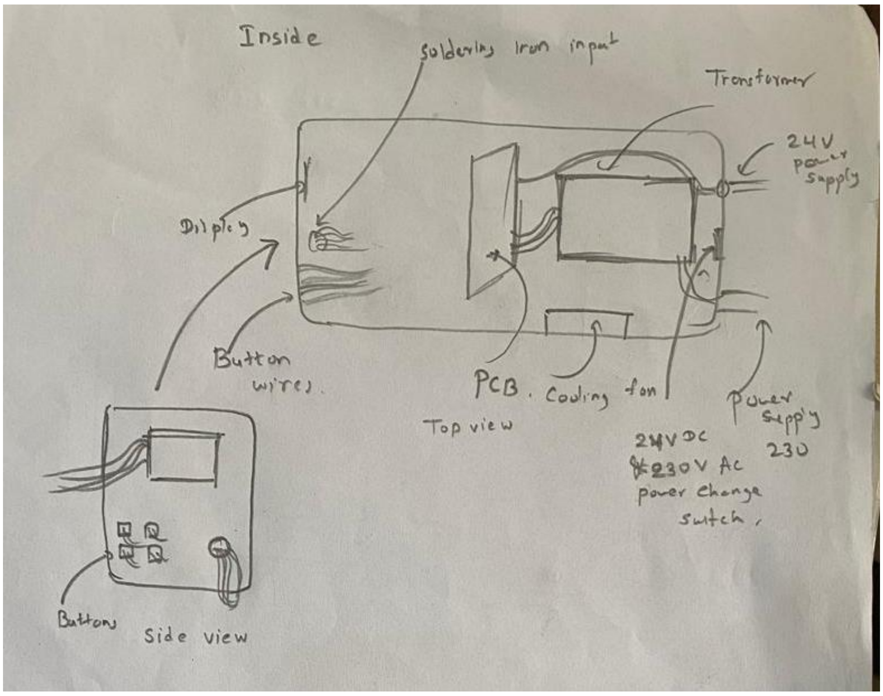


Figure 19-Inside

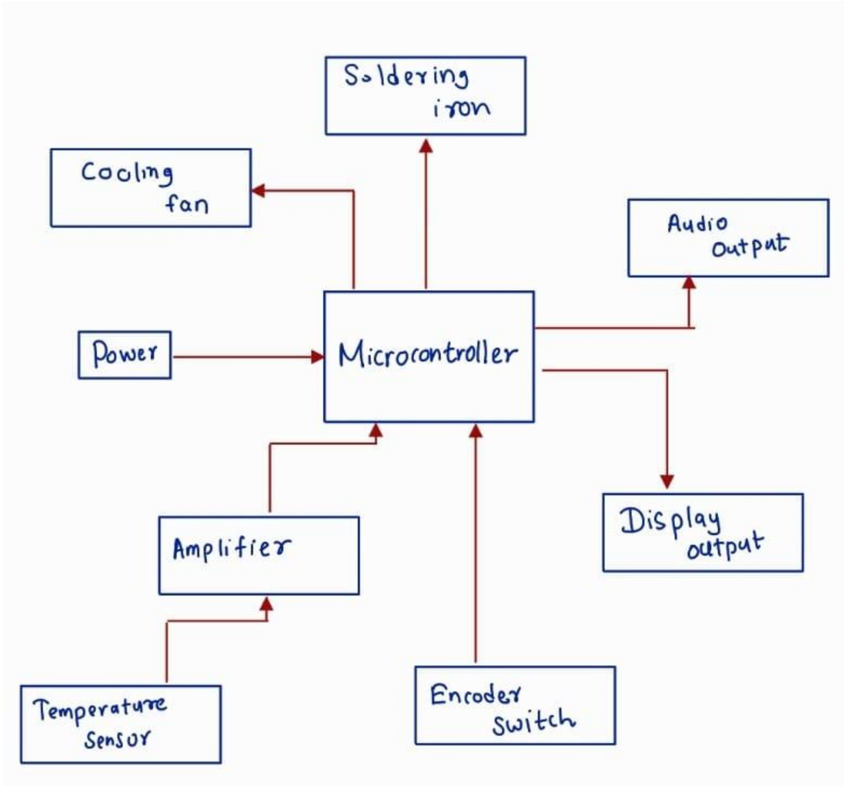


Figure 20-Functional block diagram conceptual design 3

One of the main differences with this design is that users can switch between both 230V AC and 24V DC power supplies. However, users should not expect rapid heating with the 24V DC power supply. Additionally, this design includes a timer mode where users can set a specific time, and the soldering station will automatically turn off accordingly. To control the soldering iron, the temperature sensor output needs to be increased, requiring the PCB to include an amplifying circuit.

8.5. Complete Comparison

	Conceptual design 1	Conceptual design 2	Conceptual design 3
Newly added features	User friendly sleep mode Hot air gun Sound indication Rapid heating PID for control temperature Tip change mode Sleep mode Temperature sensor	Tip change mode Light indication Portability (light weight) Working with direct 24V DC supply Thermocouple	Timer mode Sound indication Rapid heating (with 230V) User can choose between DC or AC (230V) power supply.
Removed features	Light weight 24V power supply Thermocouple	230V direct power supply Rapid heating Sound indication Hot air gun Timer mode Temperature sensor	PID for control temperature Smooth encoder controller Hot air gun

8.6. Evaluation of the designs

Enclosure design criteria comparison	Functionality	9	5	9
	Heat Dissipation	7	3	7
	Assembly and Serviceability	9	2	7
	Durability	8	5	8
	Simplicity	9	4	8
	Accessibility	8	8	8
	Safety Features	7	7	7
	Compatibility	8	7	9
	Ergonomics	7	9	7
	Aesthetics	7	8	7
Functional block design criteria comparison	Functionality	9	6	7
	Performance	9	6	9
	User Experience	8	9	8
	Power Efficiency	5	9	7
	Cost	9	7	8
	Scalability	7	4	7
	Manufacturing Feasibility	9	7	9
Total		135	106	132

8.7. Evaluation Criteria

Enclosure Design Criteria:

1. Functionality: Assessing how effectively the design supports essential functions.
2. Heat Dissipation: Gauging the efficiency of managing generated heat.
3. Assembly and Serviceability: Examining the ease of assembly and disassembly.
4. Durability: Assessing the resilience to impacts and environmental factors.
5. Simplicity: Considering the level of complexity in the design.
6. Accessibility: Easy access to controls and components.
7. Safety Features: Include insulation and burn protection.
8. Compatibility: Integrate seamlessly with soldering accessories.
9. Ergonomics: Analyzing the design's fit in the user's hand and ease of interaction.
10. Aesthetics: Evaluating the visual appeal and attractiveness to users.

Functional block diagram Criteria:

1. Functionality: Evaluate circuit design's alignment with functional requirements and goals.
2. Performance: Evaluate signal quality, resolution, and bandwidth achieved.
3. User Experience: Assess the system's ease of use and user-friendliness.
4. Power Efficiency: Measure the device's effectiveness in managing power consumption for optimal efficiency and longevity.
5. Manufacturing Feasibility: Examine the practicality of mass-producing the design.
6. Cost: Analyze the design's cost-effectiveness relative to its functionality.
7. Scalability: Determine the design's adaptability to future upgrades or modifications.

8.8. Design Selection

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

Key Features:

Temperature Control: Our soldering station employs a sophisticated temperature control system, utilizing a high-precision temperature sensor and PID (Proportional-Integral-Derivative) algorithm to regulate the soldering iron's temperature with unparalleled accuracy. This ensures consistent heat output, preventing overheating and ensuring optimal soldering results.

Sleep Mode: To conserve energy and extend the lifespan of the soldering iron, our station incorporates an intelligent sleep mode feature. When the iron remains inactive for a predetermined period, the station automatically enters sleep mode, powering off the iron to minimize power consumption. This not only reduces electricity usage but also enhances safety by preventing overheating during idle periods.

Tip Change Mode: Enhancing usability and versatility, our soldering station features a convenient tip change mode that facilitates effortless tip replacement. Users can quickly and easily swap soldering iron tips to accommodate different soldering tasks or maintain tip cleanliness, ensuring optimal soldering performance at all times.

Dual Functionality with Hot Air Gun: In addition to soldering iron functionality, our station integrates a powerful hot air gun, expanding its capabilities for a wide range of soldering applications. The hot air gun enables precise heating and desoldering of components, making it ideal for surface mount technology (SMT) soldering, rework, and repair tasks.

User-Friendly Interface: Our soldering station is designed with user convenience in mind, featuring intuitive controls and a user-friendly interface for seamless operation. The station's clear display provides real-time feedback on temperature settings and operating status, ensuring effortless control and monitoring of soldering parameters.

Sound Indication: To enhance user experience and provide intuitive feedback, our soldering station incorporates sound indication features. Audible alerts notify users of key events such as reaching the desired temperature, activating sleep mode, or completing tip changes, enhancing usability and operational efficiency.

Rapid Heating: With advanced heating elements and rapid heat-up capabilities, our soldering station ensures quick and efficient temperature stabilization, minimizing downtime and enabling rapid soldering operations.

9. Design Prototype

In the concept and design prototype phase, we initially implemented the power circuit using a dot board and validated its functionality, recognizing its critical role in the product's performance.

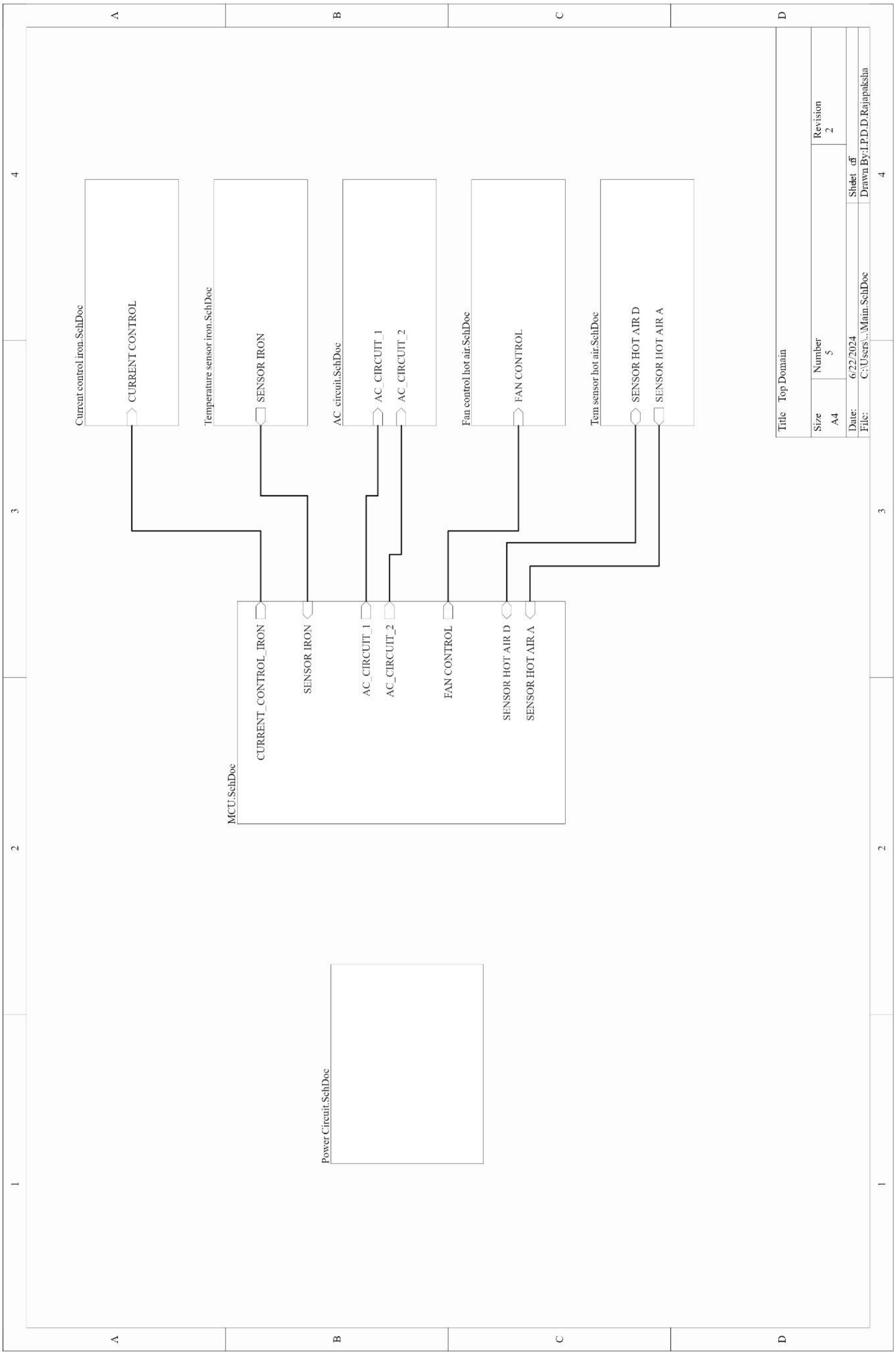
Following successful simulation, we focused on seamlessly integrating the circuit into the larger project framework. This involved designing a compact and efficient layout, considering factors like space constraints, thermal management, and signal integrity.

Careful planning ensured the smooth integration of the circuit into the project prototype. Subsequent testing and validation confirmed its reliable operation within the overall project context, providing a solid basis for further development and refinement.

10. Schematic Design

The soldering station project leverages a hierarchical design approach for the DC PCB and a straightforward layout for the AC PCB. The hierarchical structure of the DC PCB schematic effectively organizes the circuit into distinct, manageable modules, which include the temperature control system, power supply circuitry, and sensor interfaces. This modular representation enhances both comprehension and troubleshooting. Meanwhile, the AC PCB schematic emphasizes simplicity and clarity, particularly in its depiction of the zero-crossing detector and opto-isolated triac triggering circuit. Both schematics are meticulously designed to ensure clear component connections, thereby guaranteeing proper signal flow and functionality. This foundational work is crucial as we advance to the subsequent stages of PCB design.

Once the schematic designs are finalized, the next step involves translating them into physical PCB layouts. This includes routing traces, placing components, defining drill hole locations, and generating the final PCB design files for manufacturing.


Current control iron.SchDoc
CURRENT CONTROL
Temperature sensor iron.SchDoc
SENSOR IRON
AC circuit.SchDoc
AC_CIRCUIT_1
AC_CIRCUIT_2
Fan control hot air.SchDoc
FAN CONTROL
Tem sensor hot air.SchDoc
SENSOR HOT AIR D
SENSOR HOT AIR A
MCU.SchDoc
CURRENT_CONTROL_IRON
SENSOR IRON
AC_CIRCUIT_1
AC_CIRCUIT_2
FAN CONTROL
SENSOR HOT AIR D
SENSOR HOT AIR A
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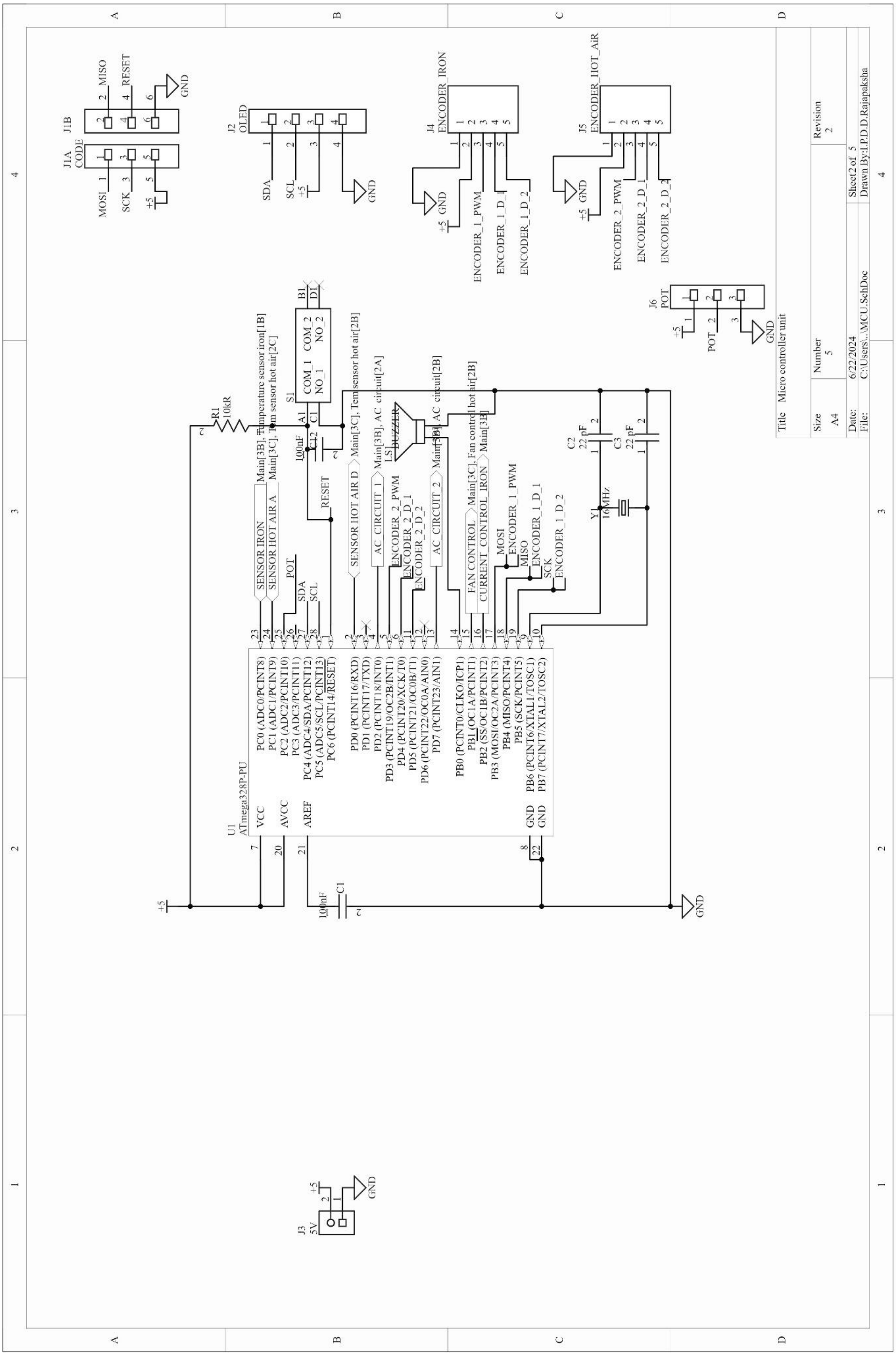
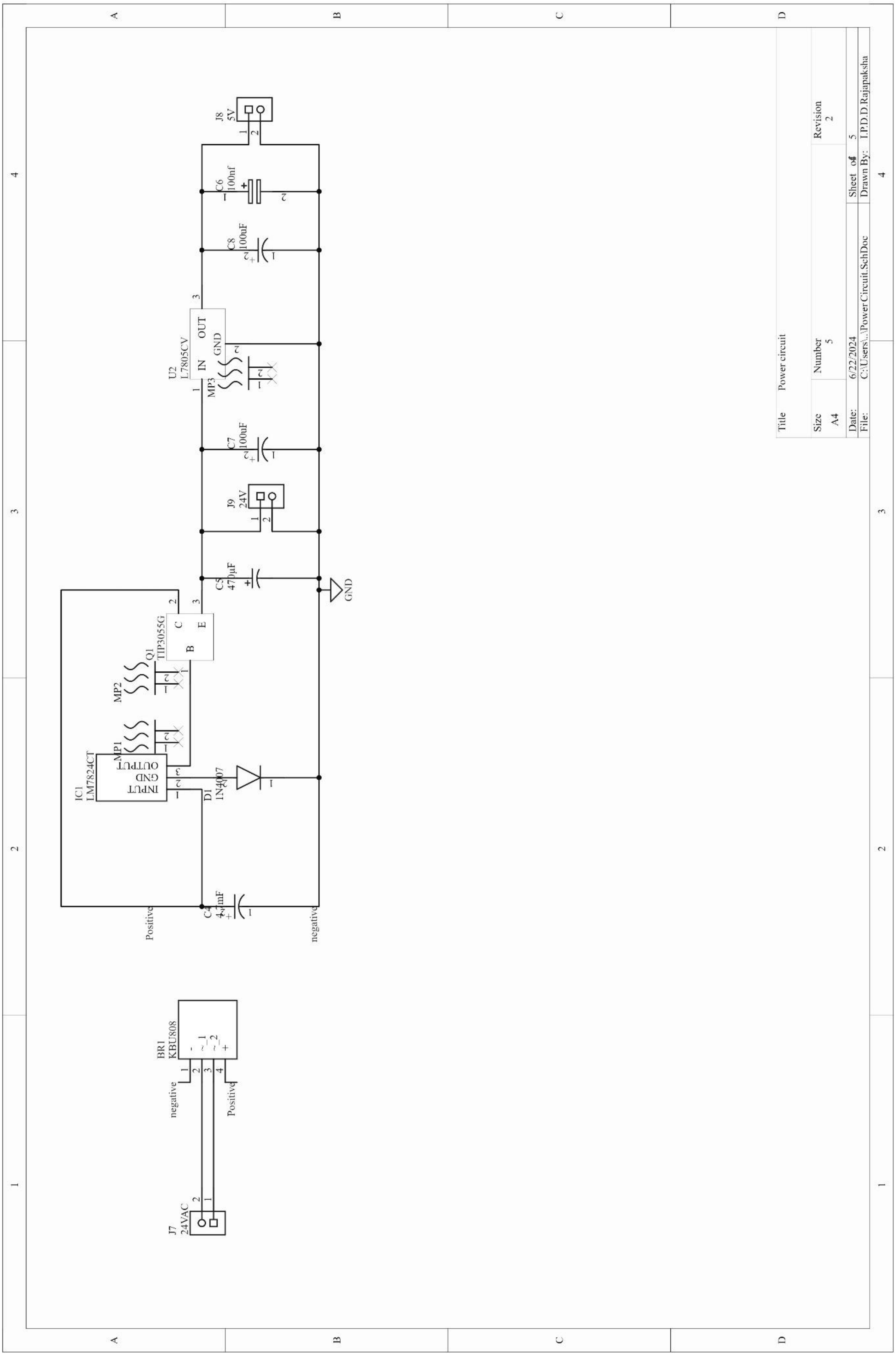
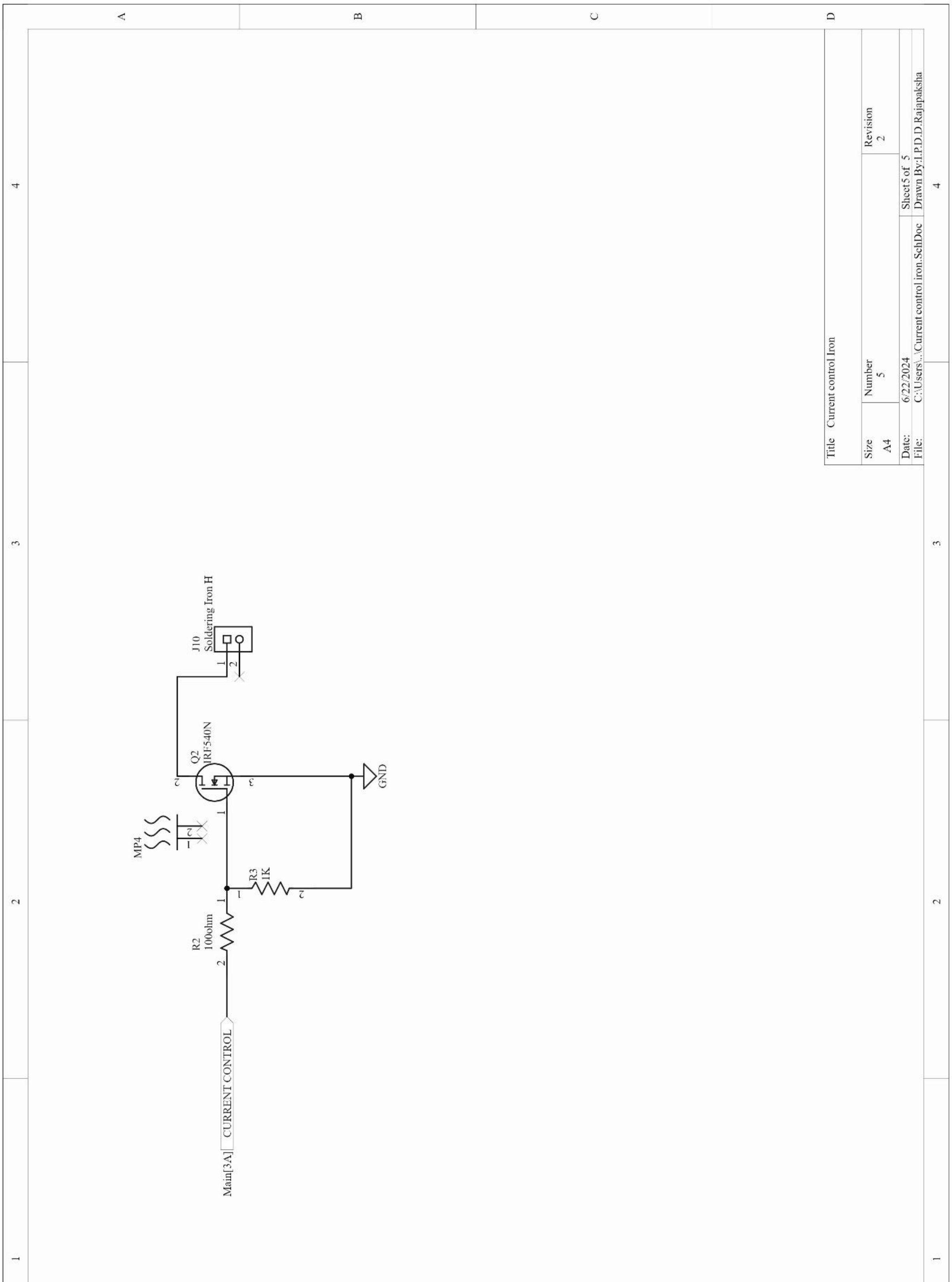
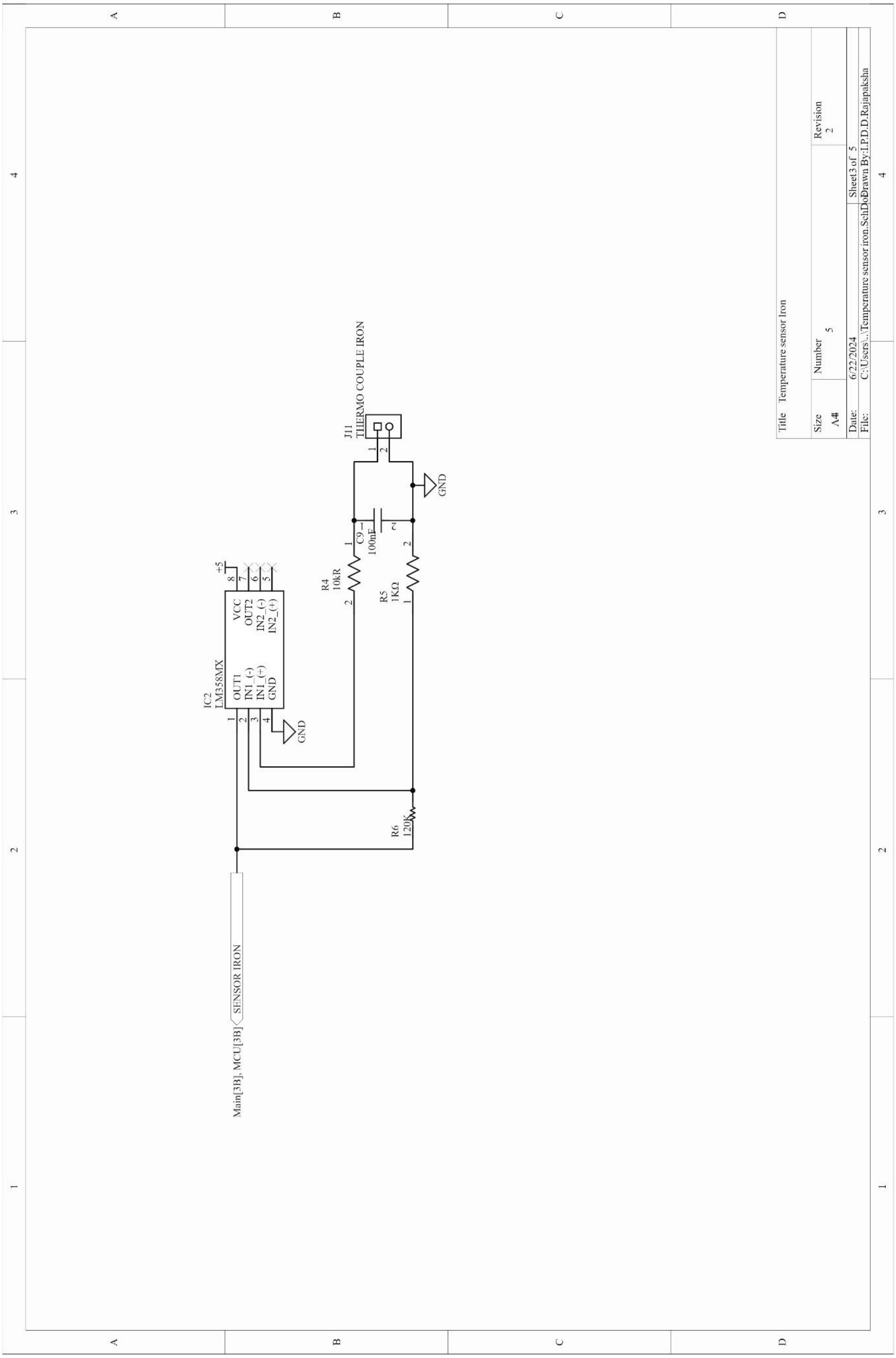
4

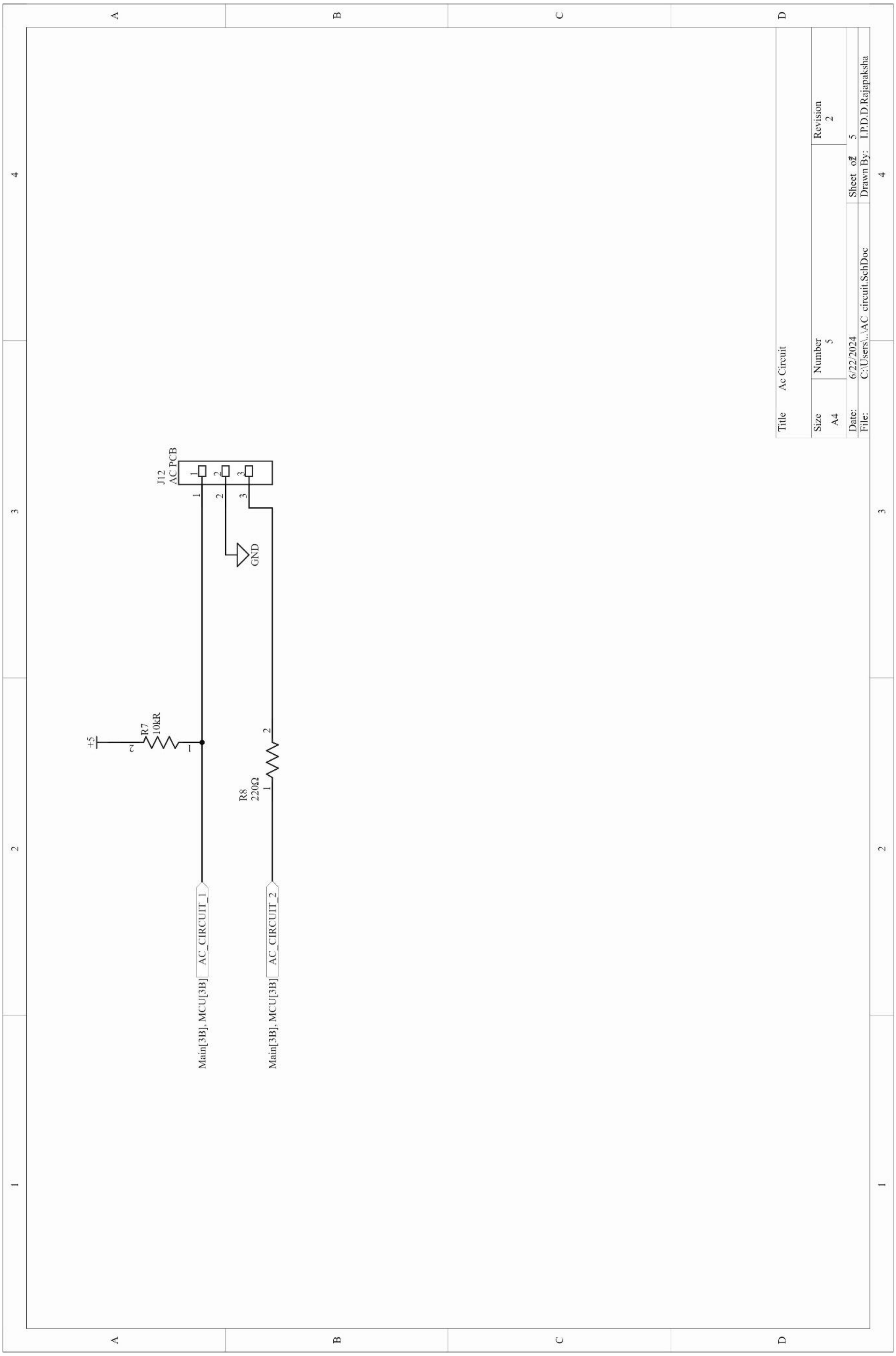

Title Micro controller unit
Size A4
Number 5
Revision 2
Date: 6/22/2024
File: C:\Users\..\MCU.SchDoc
Sheet 2 of 5
Drawn By: I.P.D.D.Rajapaksha
U1
ATmega328P-PU
VCC
AVCC
AREF
GND
PC0 (ADC0/PCINT8)
PC1 (ADC1/PCINT9)
PC2 (ADC2/PCINT10)
PC3 (ADC3/PCINT11)
PC4 (ADC4/SDA/PCINT12)
PC5 (ADC5/SCL/PCINT13)
PC6 (PCINT14/RESET)
PD0 (PCINT16/RXD)
PD1 (PCINT17/TXD)
PD2 (PCINT18/INT0)
PD3 (PCINT19/OC2B/INT1)
PD4 (PCINT20/XCK/T0)
PD5 (PCINT21/OC0B/T1)
PD6 (PCINT22/OC0A/AIN0)
PD7 (PCINT23/AIN1)
PB0 (PCINT0/CLKO/ICP1)
PB1 (OC1A/PCINT1)
PB2 (SS/OC1B/PCINT2)
PB3 (MOSI/OC2A/PCINT3)
PB4 (MISO/PCINT4)
PB5 (SCK/PCINT5)
PB6 (PCINT6/XTAL1/TOSC1)
PB7 (PCINT7/XTAL2/TOSC2)
SENSOR IRON
SENSOR HOT AIR A
SENSOR HOT AIR D
AC CIRCUIT 1
AC CIRCUIT 2
FAN CONTROL
CURRENT CONTROL IRON
ENCODER_1_PWM
ENCODER_1_D_1
ENCODER_1_D_2
ENCODER_2_PWM
ENCODER_2_D_1
ENCODER_2_D_2
MOSI
MISO
SCK
RESET
SDA
SCL
POT
R1 10kR
C1 100nF
C12 100nF
C2 22 pF
C3 22 pF
Y1 16MHz
BUZZER
S1
COM_1 COM_2
NO_1 NO_2
J1A CODE
J1B
J2 OLED
J4 ENCODER_IRON
J5 ENCODER_HOT_AiR
J6 POT
J3 5V
+5
GND

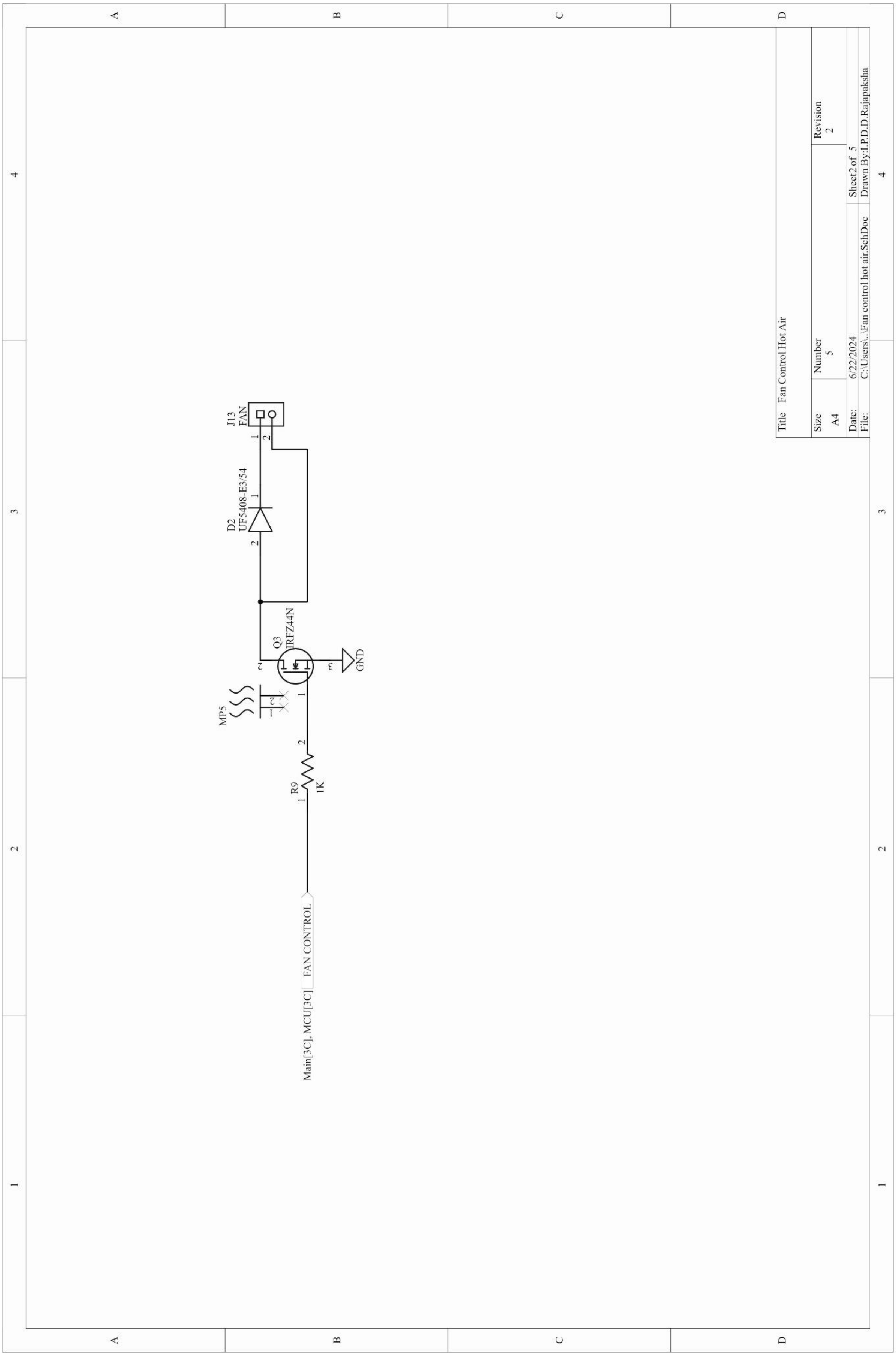

J8
5V
C6
100nf
C8
100uF
U2
L7805CV
IN
OUT
GND
MP3
C7
100uF
J9
24V
C5
470μF
GND
Q1
TIP3055G
C
B
E
MP2
MP1
IC1
LM7824CT
INPUT
GND
OUTPUT
D1
1N4007
C4
Positive
negative
BR1
KBU808
J7
24VAC
Title
Power circuit
Size
A4
Number
5
Revision
2
Date:
6/22/2024
File:
C:\Users\..\PowerCircuit.SchDoc
Sheet of 5
Drawn By:
I.P.D.D.Rajapaksha

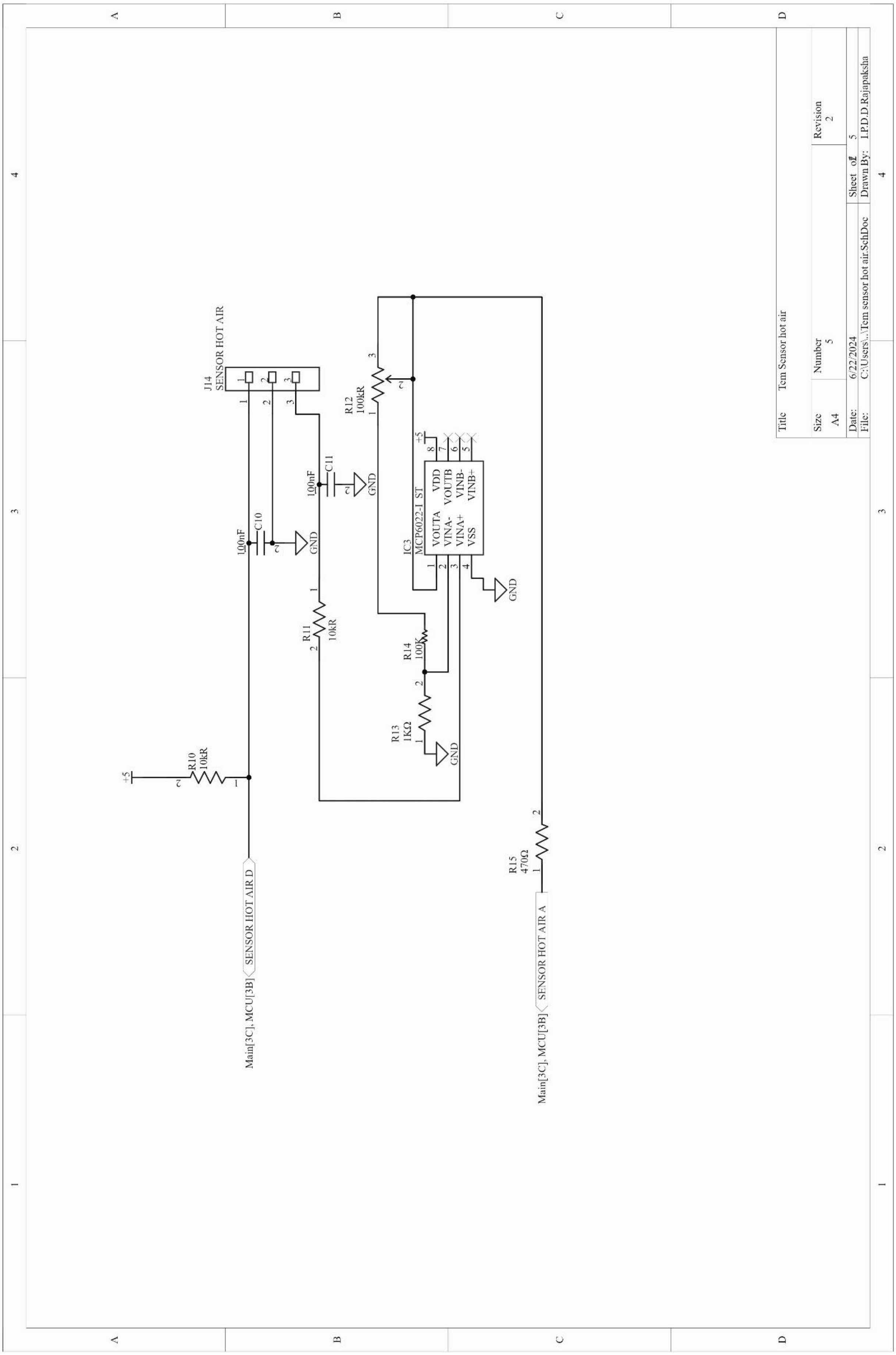


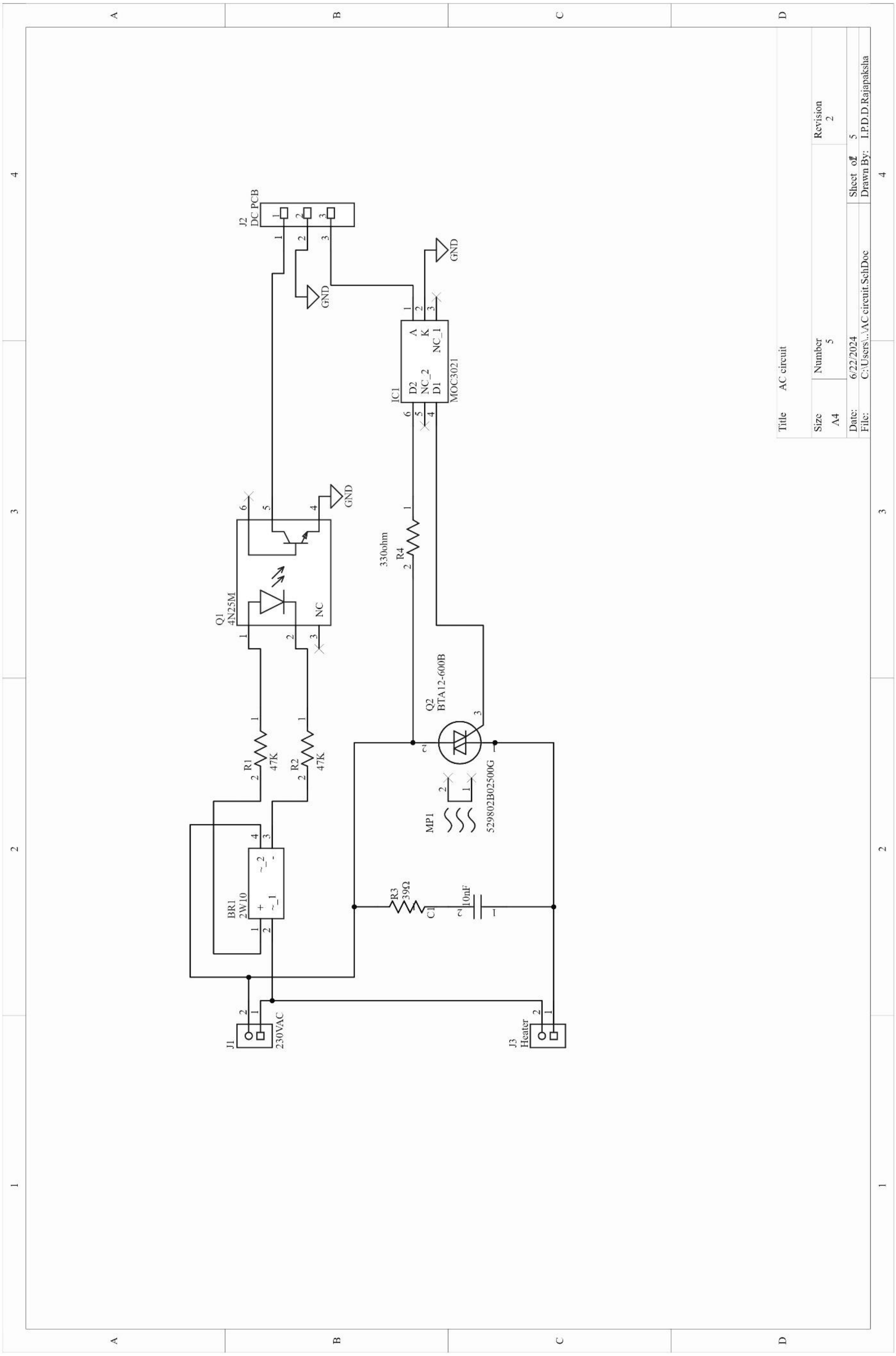
J10
Soldering Iron H
Q2
IRF540N
GND
MP4
R3
1K
R2
100ohm
Main[3A]
CURRENT CONTROL
Title Current control Iron
Size
A4
Number
5
Revision
2
Date: 6/22/2024
Sheet 5 of 5
File: C:\Users\..\Current control iron.SchDoc
Drawn By: I.P.D.D.Rajapaksha


Title Temperature sensor Iron
Size A4
Number 5
Revision 2
Date: 6/22/2024
Sheet3 of 5
File: C:\Users\..\Temperature sensor iron.SchDoc
Drawn By:I.P.D.D.Rajapaksha
J11
THERMO COUPLE IRON
GND
C9
100nF
R4
10kR
R5
1KΩ
R6
120K
IC2
LM358MX
OUT1
IN1_(-)
IN1_(+)
GND
VCC
OUT2
IN2_(-)
IN2_(+)
+5
SENSOR IRON
Main[3B], MCU[3B]


J12
AC PCB
GND
R7
10kR
+5
R8
220Ω
AC_CIRCUIT_1
Main[3B], MCU[3B]
AC_CIRCUIT_2
Main[3B], MCU[3B]
Title Ac Circuit
Size A4
Number 5
Revision 2
Date: 6/22/2024
Sheet of 5
File: C:\Users\..\AC circuit.SchDoc
Drawn By: I.P.D.D.Rajapaksha


J13
FAN
D2
UF5408-E3/54
Q3
IRFZ44N
GND
MP5
R9
1K
Main[3C], MCU[3C]
FAN CONTROL
Title Fan Control Hot Air
Size
A4
Number
5
Revision
2
Date: 6/22/2024
Sheet 2 of 5
File: C:\Users\..\Fan control hot air.SchDoc
Drawn By:I.P.D.D.Rajapaksha


SENSOR HOT AIR
J14
R12
100kR
C11
100nF
GND
C10
100nF
MCP6022-I ST
IC3
VOUTA
VINA-
VINA+
VSS
VDD
VOUTB
VINB-
VINB+
+5
R11
10kR
R14
100K
R13
1KΩ
R10
10kR
R15
470Ω
SENSOR HOT AIR D
Main[3C], MCU[3B]
SENSOR HOT AIR A
Main[3C], MCU[3B]
Title
Tem Sensor hot air
Size
A4
Number
5
Revision
2
Date:
6/22/2024
Sheet of 5
File:
C:\Users\..\Tem sensor hot air.SchDoc
Drawn By:
I.P.D.D.Rajapaksha


J2
DC PCB
GND
IC1
MOC3021
Q1
4N25M
NC
R4
330ohm
Q2
BTA12-600B
MP1
529802B02500G
R1
47K
R2
47K
BR1
2W10
R3
39Ω
C1
10nF
J1
230VAC
J3
Heater
Title AC circuit
Size A4
Number 5
Revision 2
Date: 6/22/2024
File: C:\Users\..\AC circuit.SchDoc
Sheet of 5
Drawn By: I.P.D.D.Rajapaksha

11. PCB Design

In conclusion, the routing strategy for the PCB design of the soldering station project ensures reliable current flow and minimizes signal interference. For paths handling up to 3A of current, a trace width of 2.5mm is utilized to provide ample capacity, preventing overheating and voltage drops. This choice exceeds the typical doubling rule for trace widths, emphasizing an extra margin of safety. For routes carrying lower currents, a trace width of 0.38mm is employed, surpassing the minimum requirement for signal integrity and durability. By carefully selecting trace widths based on current requirements and signal characteristics, the design aims to optimize the performance and reliability of the soldering station PCB.

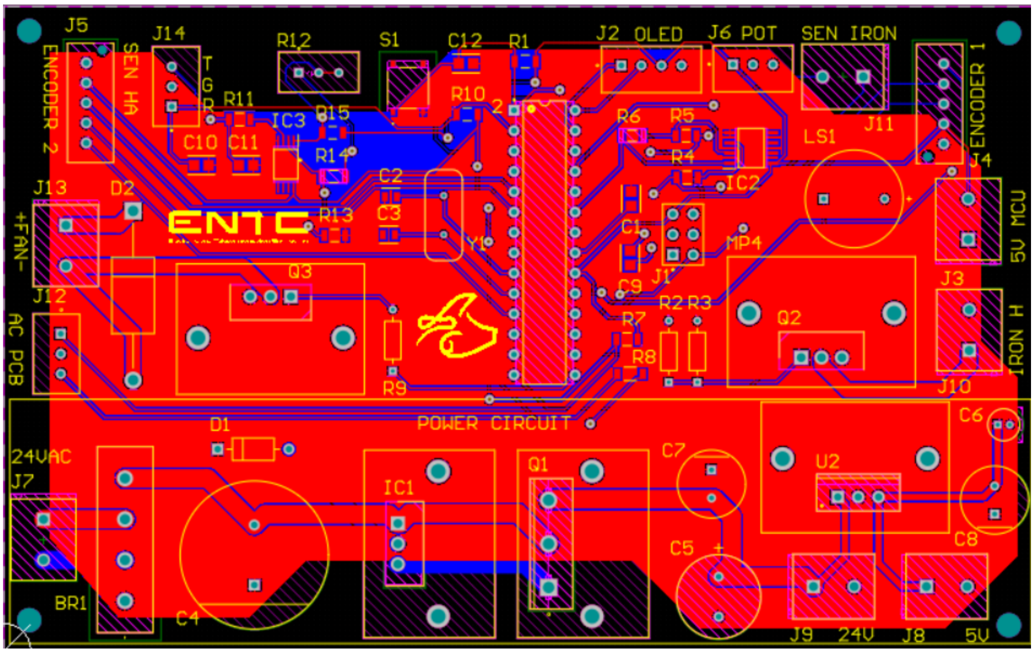


Figure 21-Top layer –DC PCB

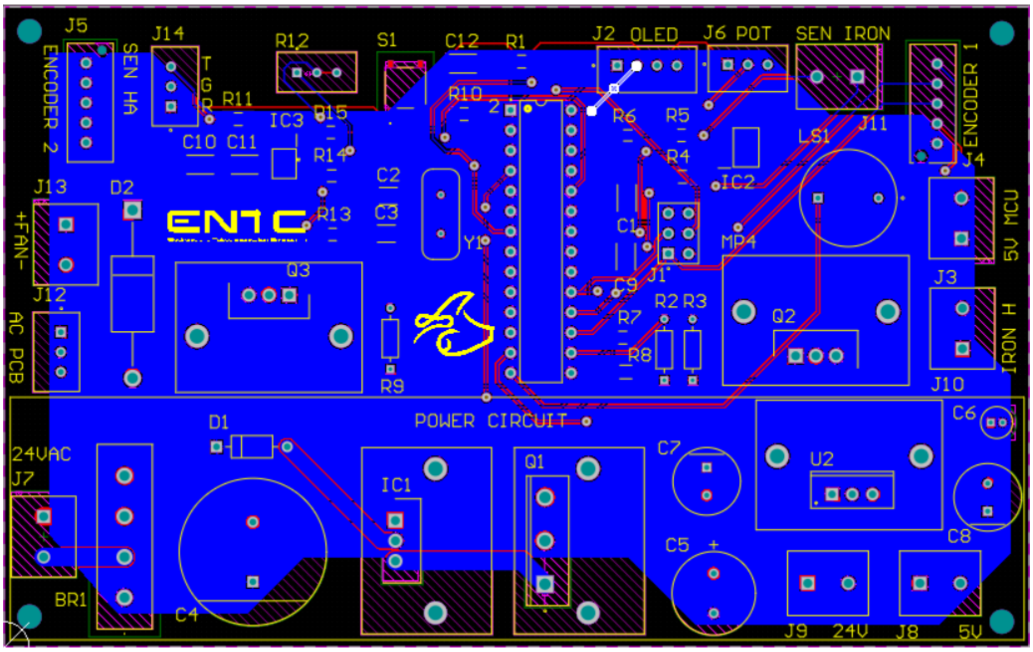


Figure 22-Bottom layer – DC PCB

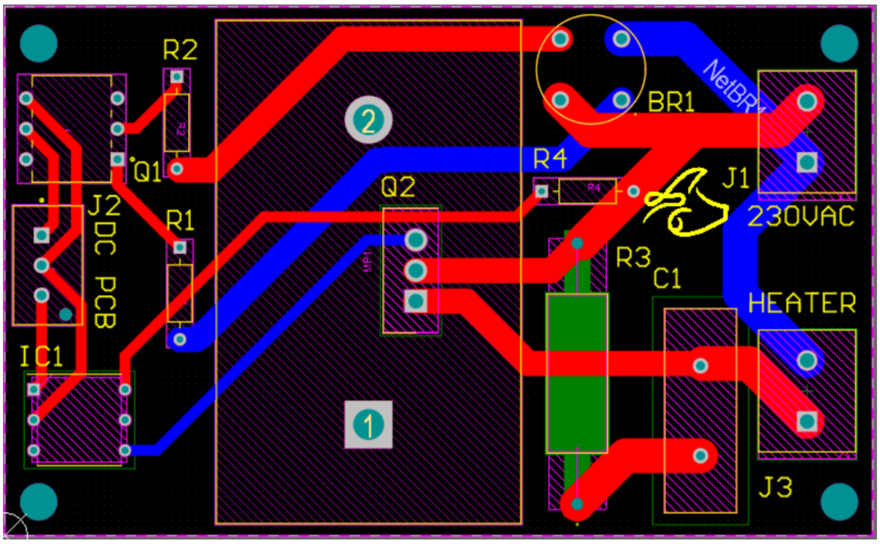


Figure 23-Top Layer – AC PCB

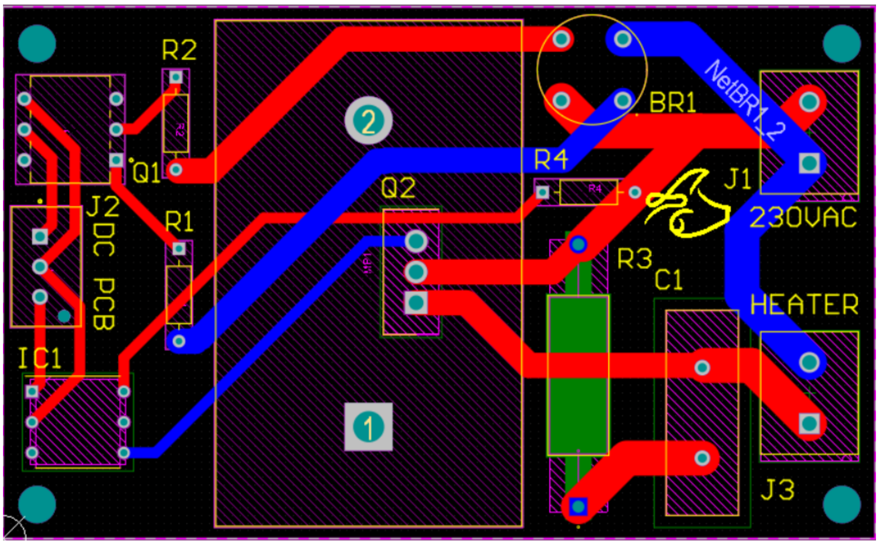


Figure 24-Bottom Layer – AC PCB

12. Solid works Design

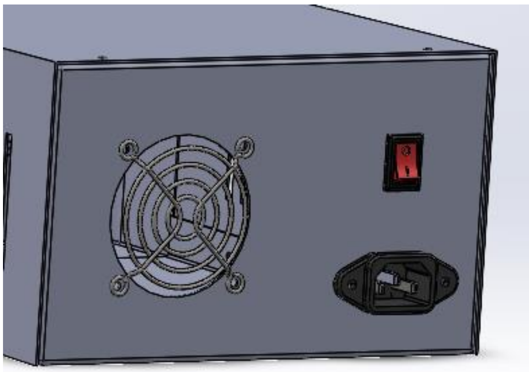


Figure 25-Back view

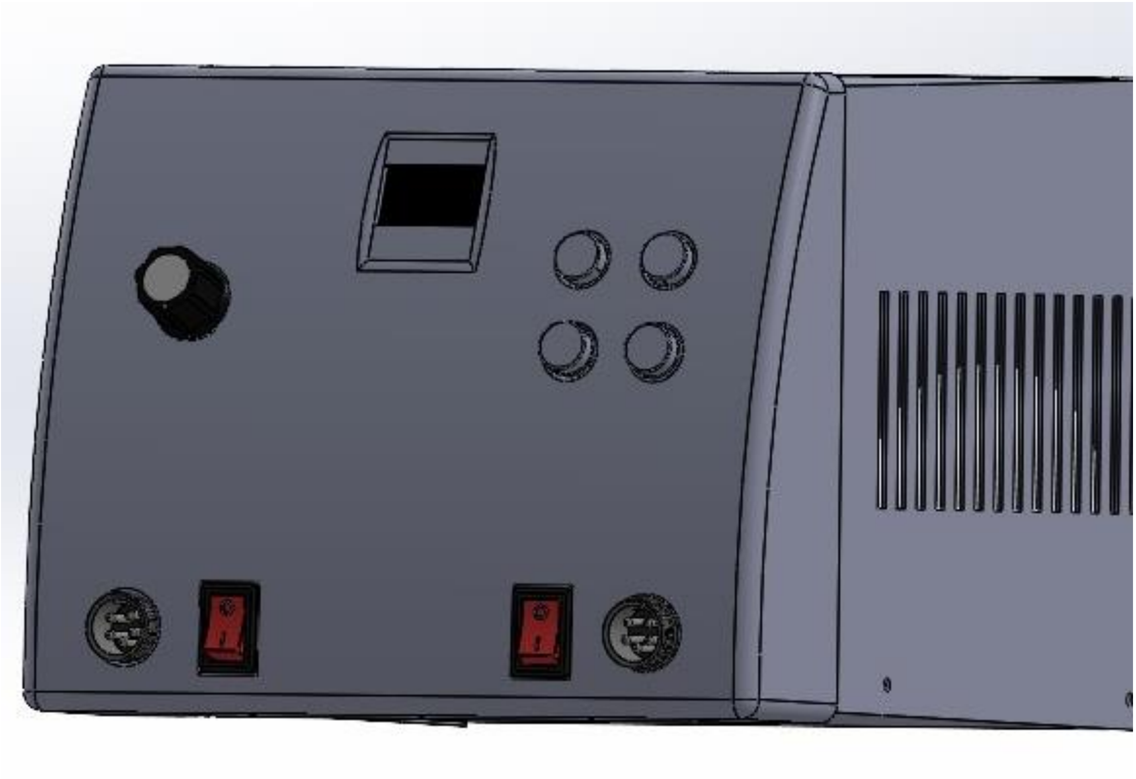


Figure 26 – final side view

Figure 27 - final front view

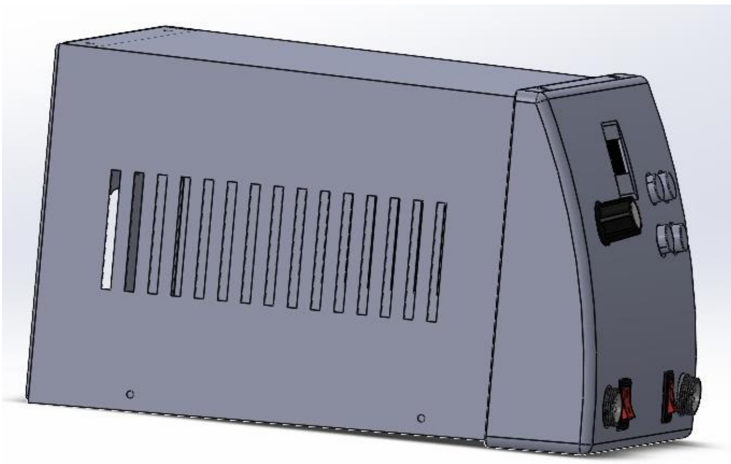


Figure 28-final side view

Figure 29- Final design

Figure 30- Back view

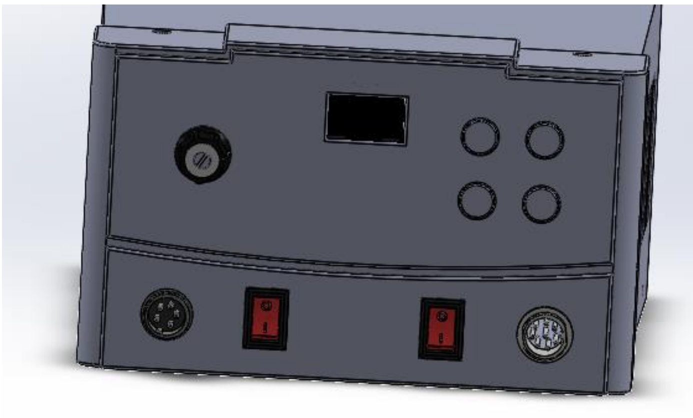


Figure 31- Front face

Figure 32-Full design

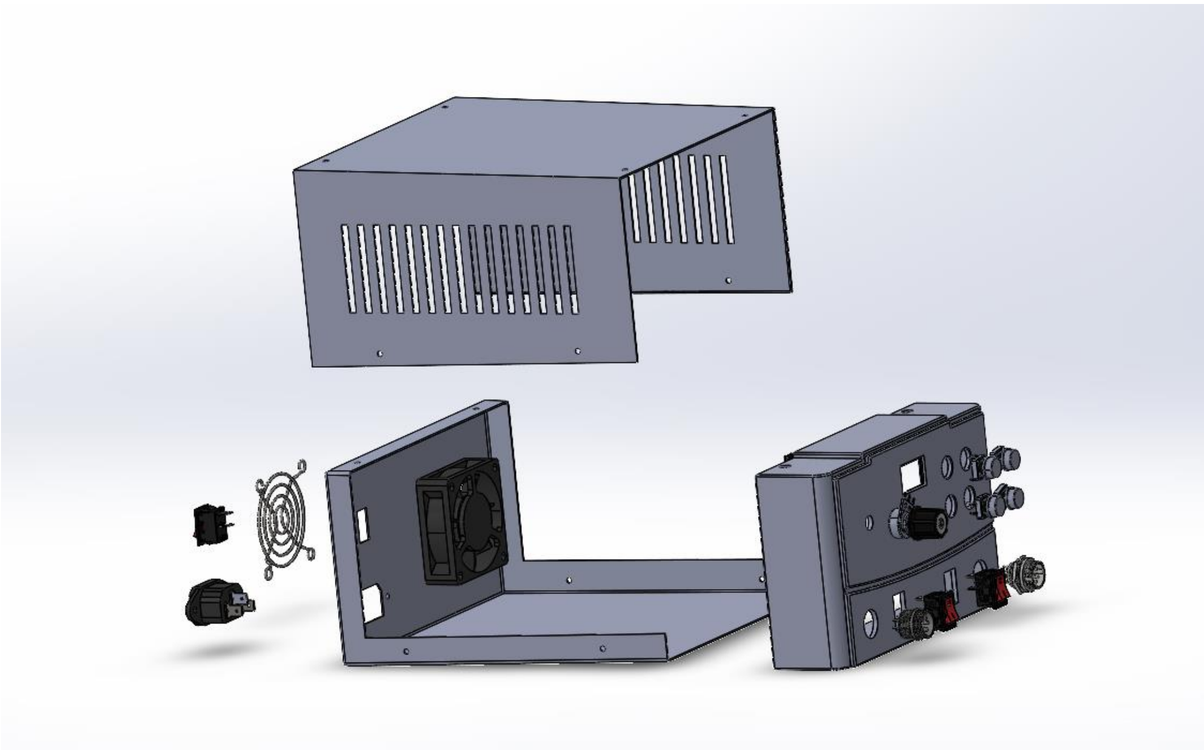
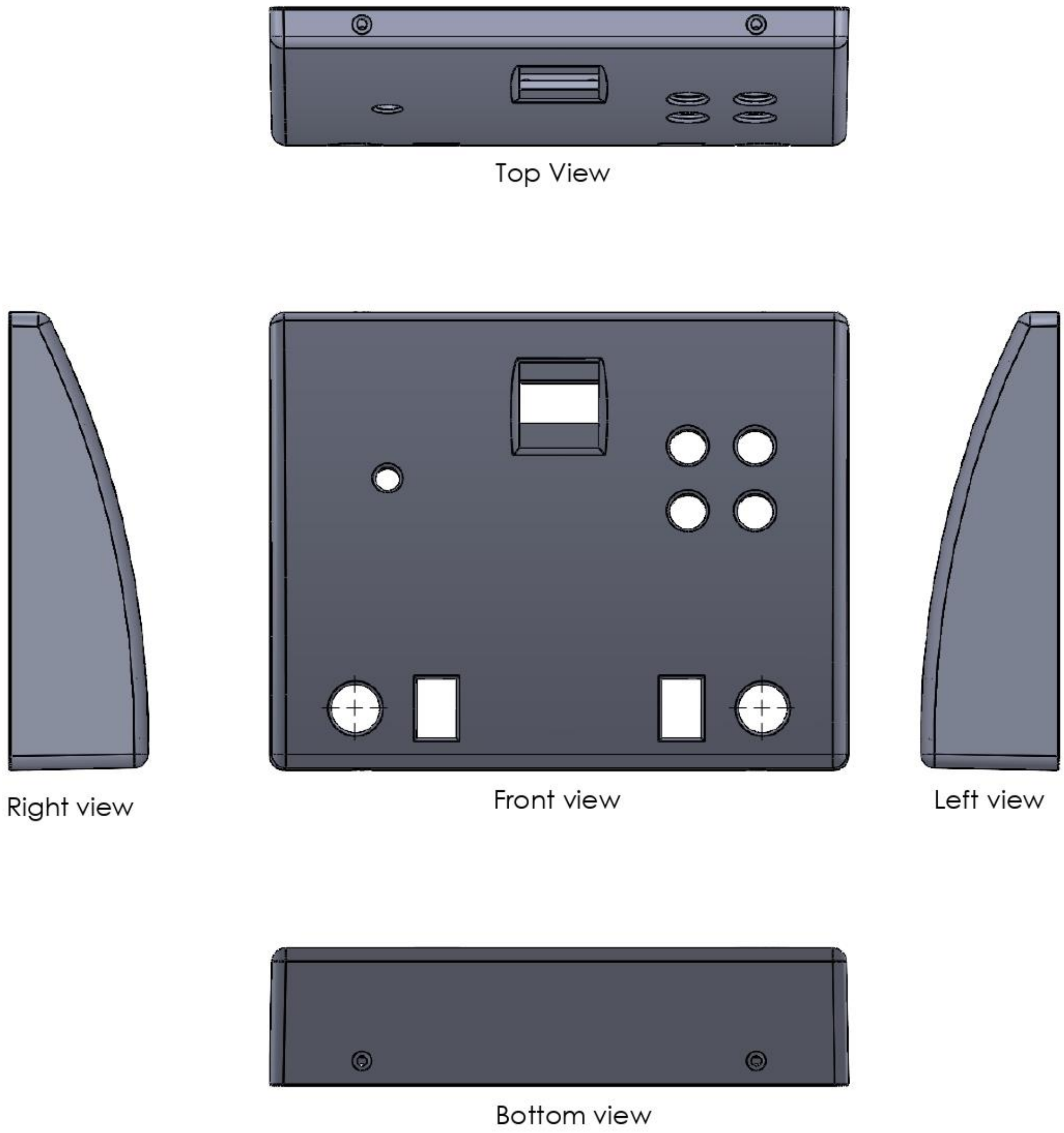


Figure 33-Full design exploded view



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

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

TITLE: Soldering Station Face

MATERIAL: ABS Plastic

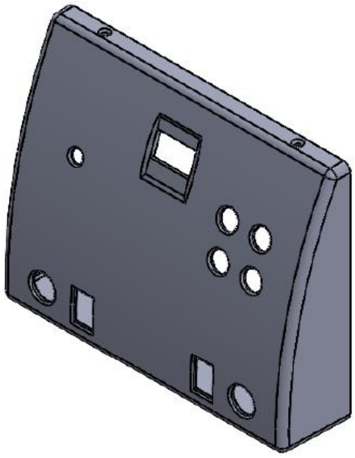
WEIGHT:

DWG NO. new_face

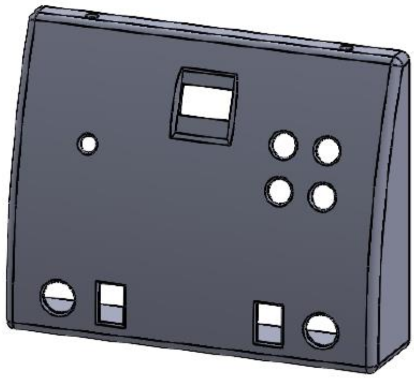
A4

SCALE: 1:2

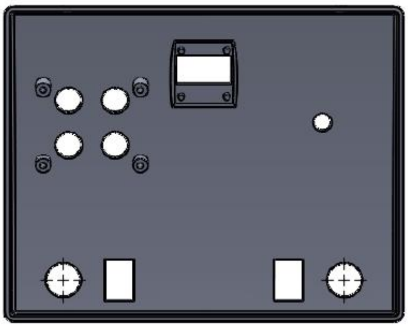
SHEET 1 OF 3



Isometric View



Dimetric View



Back view

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

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

TITLE: Soldering Station Face

MATERIAL: ABS plastic

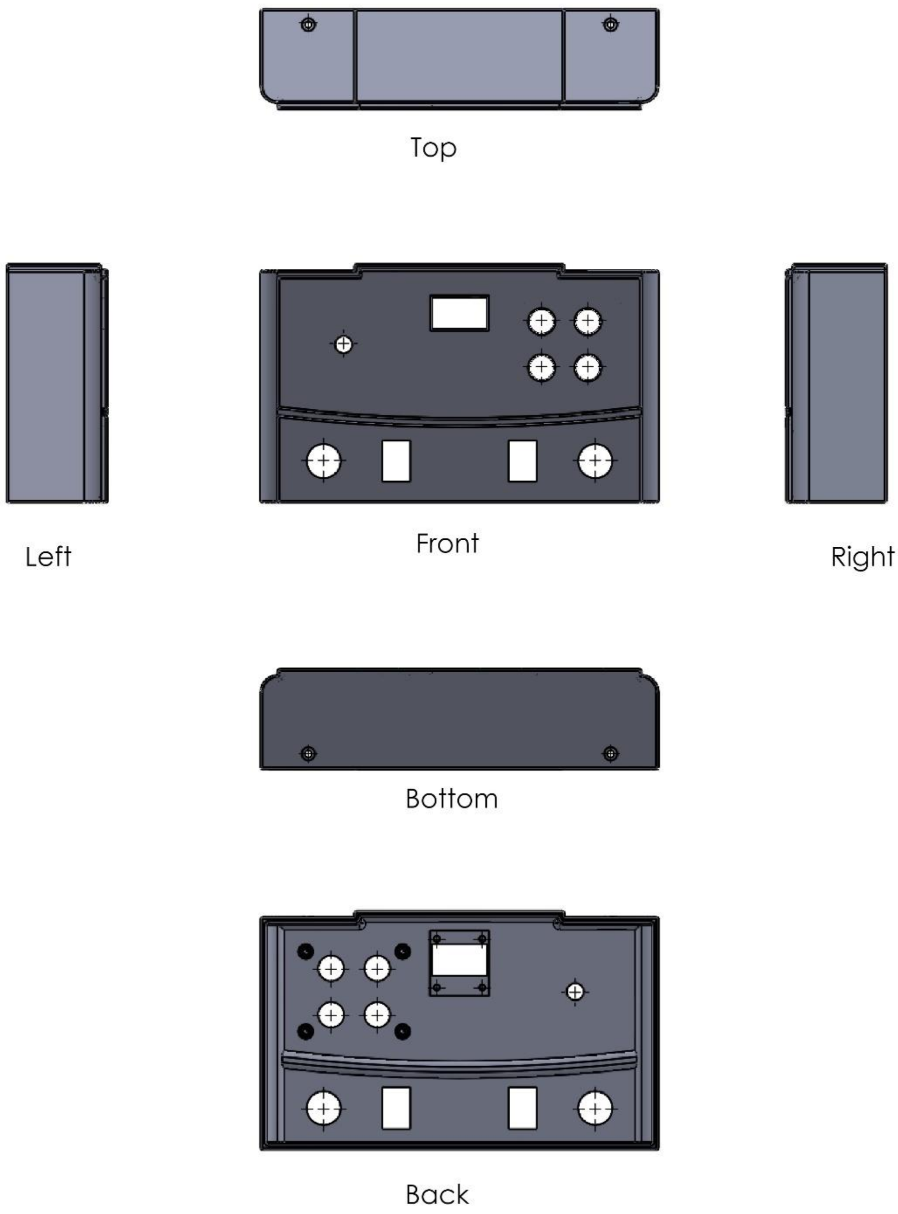
WEIGHT:

DWG NO. new_face

A4

SCALE: ~~1:4~~ 1:3

SHEET 2 OF 3



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

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

TITLE: Face

MATERIAL: ABS

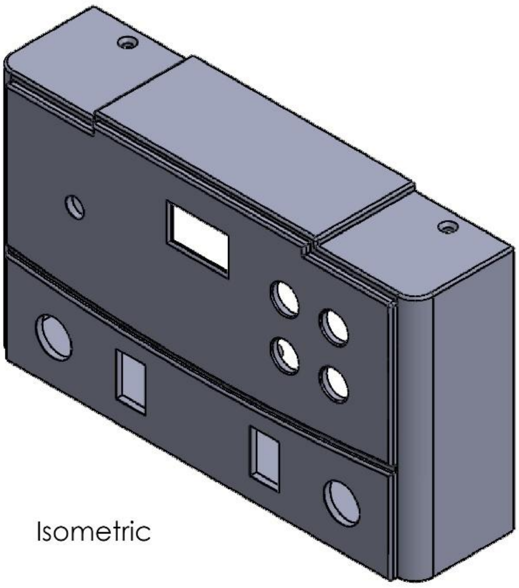
WEIGHT:

DWG NO. metal final face

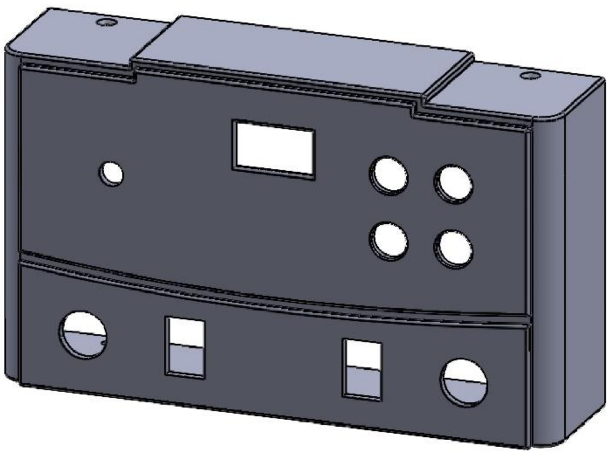
A4

SCALE: 1:3

SHEET 1 OF 2



Isometric



Dimetric

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION	

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

TITLE: Face

MATERIAL: ABS

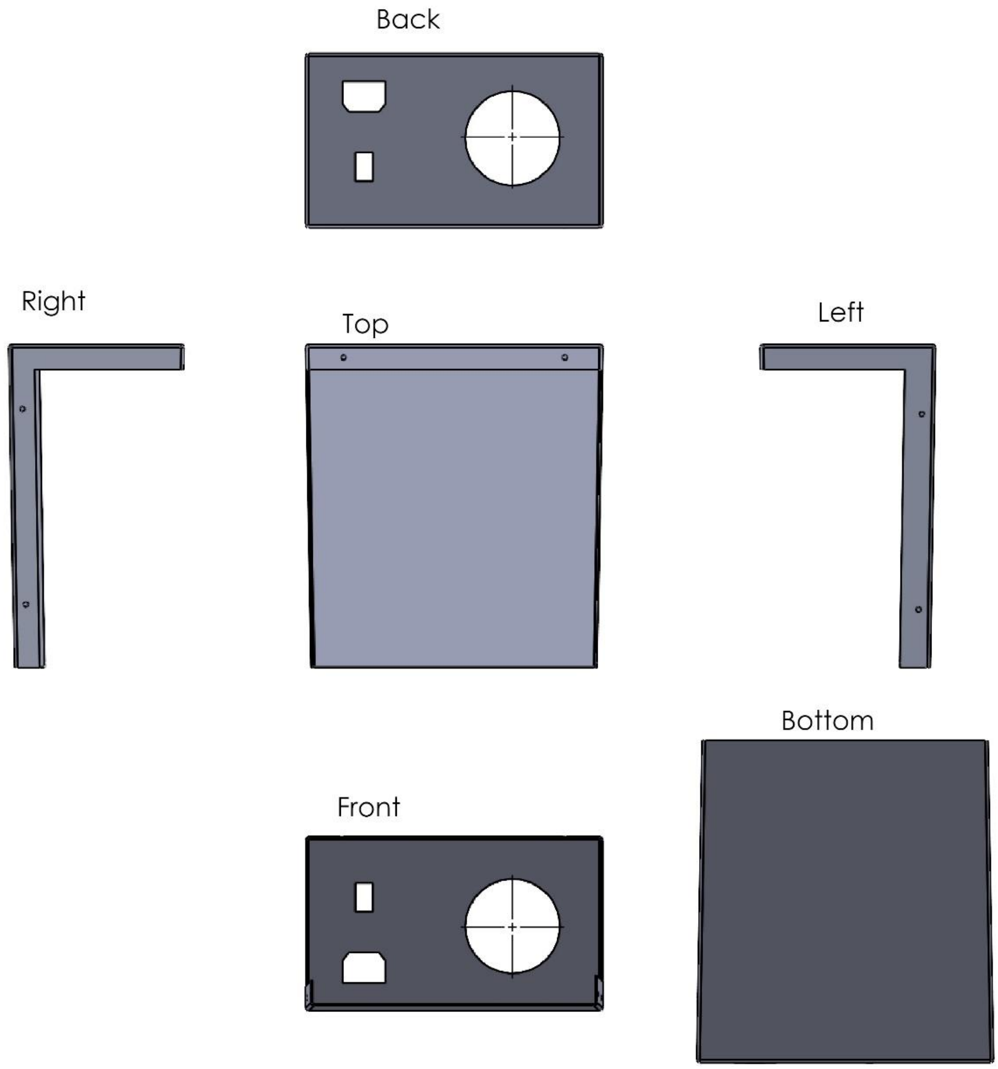
WEIGHT:

DWG NO. metal final face

A4

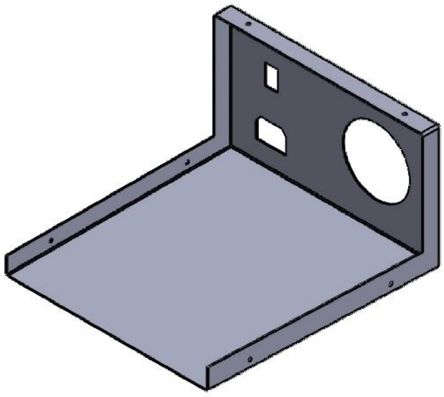
SCALE: ~~1:4~~ 1:2

SHEET 2 OF 2

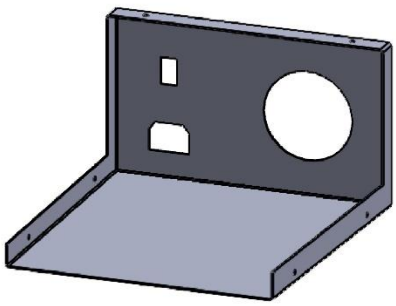


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION

	NAME	SIGNATURE	DATE		
DRAWN					TITLE: Body part 2
CHK'D					
APPV'D					
MFG					
Q.A				MATERIAL: Metal	DWG NO. box2_all — A4
				WEIGHT:	SCALE:1:4 — SHEET 1 OF 2

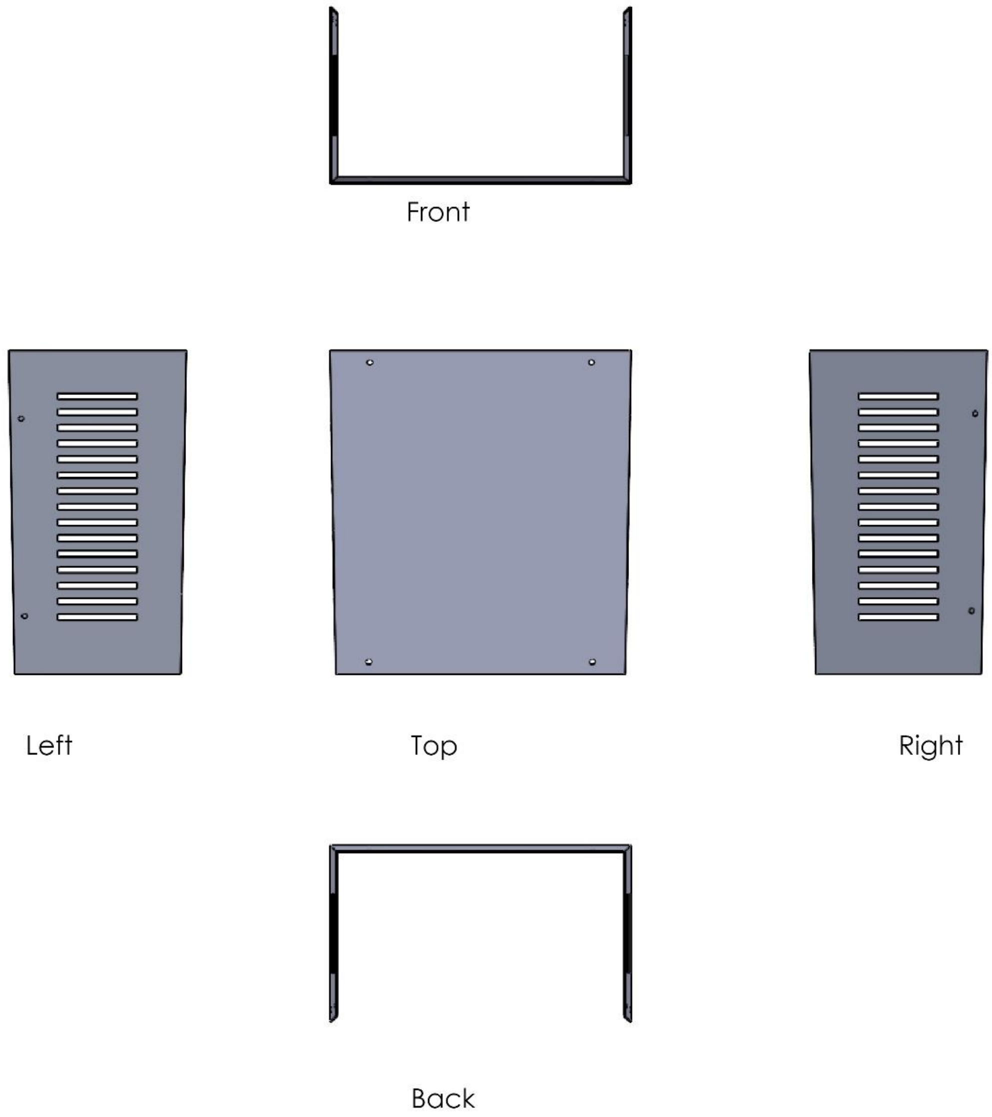


Isometric



DIametric

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION		
	NAME	SIGNATURE	DATE		TITLE: Body part 2	
DRAWN						
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL: Metal	DWG NO. box2_all	A4
				WEIGHT:	SCALE:1:4	SHEET 2 OF 2



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

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

TITLE: Body Part 1

MATERIAL: Metal

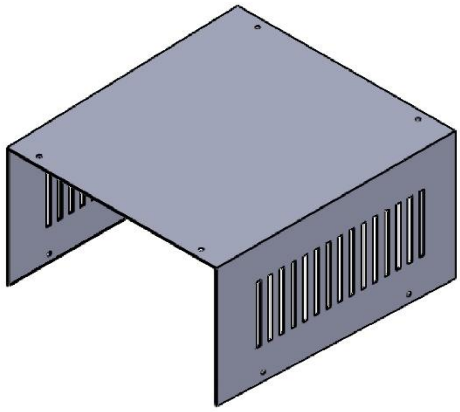
WEIGHT:

DWG NO. box1_all

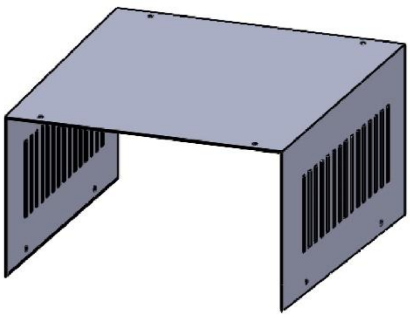
A4

SCALE:1:4

SHEET 1 OF 2



Isometric



Dimetric

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBURR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING

REVISION

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

TITLE:

Body part 1

MATERIAL:

metal

WEIGHT:

DWG NO.

box1_all

A4

SCALE:1:4

SHEET 2 OF 2