



# **UNDERSTANDING POWER SUPPLY UNIT**

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# POWER SUPPLY UNIT

## Purpose of the Study

The purpose of the study is to discuss the nature of the Power Supply Unit is to learn how to convert mains AC to low-voltage regulated DC power for the internal components of a computer. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the main voltage.

## Function

Power supply converts the alternating current (AC) from a wall socket of mains electricity to a low-voltage direct current (DC) to operate peripheral devices. Several direct-current voltages are required, and they must be regulated with some accuracy to provide stable operation. A power supply rail or voltage rail refers to a single voltage provided by a PSU.

## Benefits

- You will learn the different functions of the components inside the PSU
- Differences between breadboard and PCB and how to transfer components
- If the component you are using is suitable with the PSU
- Checking the voltage rectifier and resistor if they are working by using a multimeter

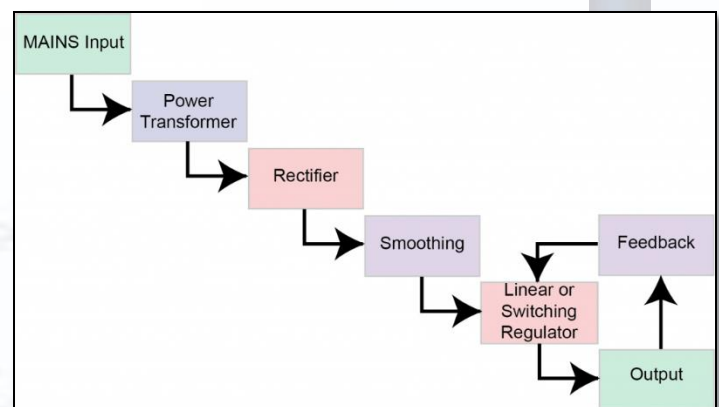
## Part of the study

It converts from AC to DC by first passing through the bridge type of rectifier and other parts of components to construct an adjustable regulated power supply that can provide DC voltage. The frequency provided by the DC Voltage that ranges is 1.2 to 30V. And it is used with a Potentiometer so you can meter the lowest to highest it gives.

## Theory

A power supply takes the AC from the wall outlet, converts it to unregulated DC, and reduces the voltage using an input power transformer, typically stepping it down to the voltage required by the load. For safety reasons, the transformer also separates the output power supply from the mains input.

Power supplies can be broadly divided into linear and switching types. Linear power converters process the input power directly, with all active power conversion components operating in their linear operating regions. In switching power converters, the input power is converted to AC or to DC pulses before processing, by components that operate predominantly in non-linear modes.



Power supply is a device or circuit that provides electrical energy to power electronic devices or systems. Its primary function is to convert input electrical energy from a source using transformer 220V to 24V into the desired output voltage and current for the connected load. Here's how a typical power supply operates:

**Input Stage:** The power supply takes in electrical energy from an external source. The input voltage can vary depending on the type of power supply and the application. For example, in household electronics, the input voltage might be 220V AC from transformer.

**Rectification:** If the input voltage is AC (Alternating Current), as is common with household power, the power supply often includes a rectification stage to convert it into DC (Direct Current). This is typically done using diodes or bridge rectifiers. In the case of battery-powered devices, this stage might not be necessary, as the input is already DC.

**Filtering:** After rectification, the DC voltage may still have some ripple or fluctuations. Filtering components like capacitors are used to smooth out this voltage and make it more stable.

**Voltage Regulation:** The power supply often includes voltage regulation circuitry to maintain a constant output voltage, even when the input voltage or load changes. This is crucial because many electronic devices require a steady and specific voltage to operate correctly. Voltage regulation is typically achieved using components like voltage regulators or feedback control circuits.

**Current Limiting:** Some power supplies also include current-limiting features to protect the connected device from excessive current. This can be important for preventing damage to sensitive components.

**Output Stage:** The now-stabilized and regulated DC voltage is provided at the output terminals of the power supply. This output voltage and current should match the requirements of the connected electronic device or system.

**Safety Features:** Modern power supplies often incorporate safety features such as over-voltage protection, over-current protection, and short-circuit protection to prevent damage to the power supply or connected equipment in case of faults or abnormal conditions.

**Cooling:** In cases where the power supply generates a significant amount of heat, it may include cooling mechanisms such as fans or heat sinks to dissipate heat and keep the components within safe operating temperatures.

**Control and Monitoring:** Some power supplies have control interfaces or monitoring circuits that allow users or systems to adjust the output voltage by using potentiometer and checking the voltage from voltmeter.

In summary, a power supply takes in electrical energy, converts it to the required form (usually DC), regulates the voltage and current, and delivers a stable and controlled output to power electronic devices while ensuring safety and reliability. The specific design and operation of a power supply can vary depending on its intended application and complexity.



### Components List:

Voltmeter 1.2V to 30V

Pontentiometer 10 times adjustable

Transformer (220V to 24 to 30V AC)

Rectifier (4 Diodes - 1N400X 3 to 7)

Electrolytic Capacitors

- C1 - 1000  $\mu$ F,50V
- C3 - 470  $\mu$ F,50V
- C4 - 10  $\mu$ F,50V

Film Capacitor

C2 - 0.1 $\mu$ F, 50V

VOLTAGE REGULATOR

LM317T (Thru Hole)

LM317X (1.5A)

T0-220 (Packaging)

HeatSink for LM317

Resistors

- R1 - 220 Ohm, 1/2 Watt
- R2 - 1k Ohm, 1/2 Watt
- VR1 - Potentiometer 10K ohm
- Potentiometer Cover

1.5 A to 2A Fuse

Breadboard for testing. PCB for final output

Jumper Wire / Solid Wires

Terminal Blocks or Banana socket for output.

**Materials:** Soldering iron set      Fuse  
Breadboard      PCB and Case  
Multimeter      Wire and plug  
Banana plug and socket



## Banana plug and socket



## Fuse



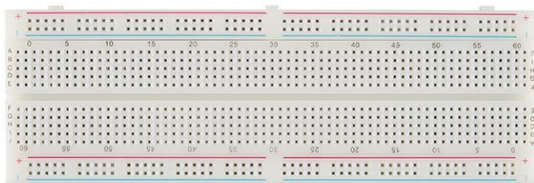
## Multimeter



## Soldering Iron Set



**PCB**



## Bread board



## Wire and Plug

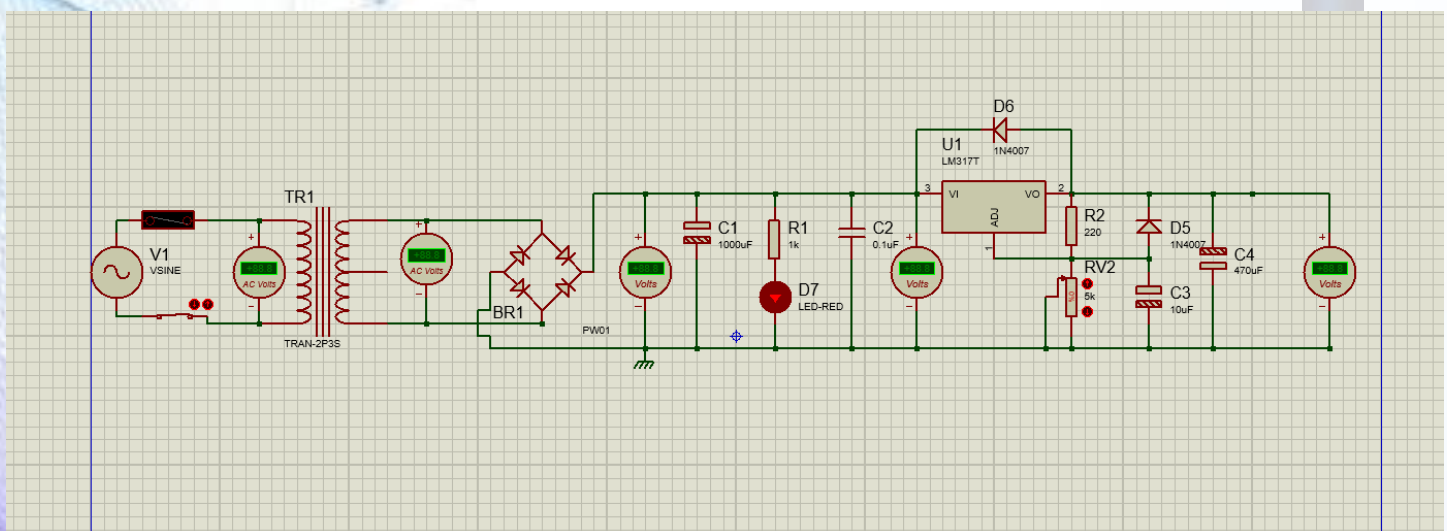


## PSU Case

## Components List:

Item	Component ID	Description	Part number	Quantity
1	Transformer	220V to 24 to 30V AC		1
2	Diode	Rectifier	1N4001	6
3	C1	1000 uF,50V		1
4	C2	0.1uF, 50V		1
5	C3	470 uF,50V		1
6	C4	10 uF,50V		1
7	U1	Voltage Regulator	LM317T	1
8	LM317X (1.5A)	Voltage Regulator	T0-220	1
9	R1	Resistors - 220 Ohm, 1/2 Watt		1
10	R2	Resistors - 1k Ohm, 1/2 Watt		1
11	VR1	Potentiometer 10K ohm		1
12	LED	RED Color		1
13		Heat sink		1
14		Fuse		1
15		Terminal block		4
16		Banana plug and socket		2

## Schematic Sample Input:





## Breadboard Sample output:

Breadboarding is a common technique used in electronics to build and test circuits without soldering. Here are the basic procedures for breadboarding:

### Materials You'll Need:

**Breadboard:** This is the main platform for building your circuit. Breadboards come in different sizes, but the most common is the full-sized breadboard with rows and columns of holes for components.

**Components:** Gather the electronic components you need for your circuit, such as resistors, capacitors, LEDs, transistors, integrated circuits (ICs), wires, and a power supply.

**Wire:** You'll need various jumper wires to make connections on the breadboard.

**Power Supply:** If your circuit requires an external power source, make sure you have the appropriate voltage supply.

**Tools:** You may need tools like wire cutters, wire strippers, and a multimeter for testing.

### Procedures:

**Understand the Breadboard:** A typical breadboard has rows and columns of interconnected holes. The rows are typically labeled with numbers or letters, while the columns are usually labeled with numbers. There is a gap (usually in the middle) that separates the two sides of the breadboard. Components on one side won't connect to components on the other side, except through jumper wires.

**Plan Your Circuit:** Before you start placing components, have a clear plan for your circuit. Draw a schematic or diagram to visualize the connections and component placements.

**Component Placement:** Begin by placing your components on the breadboard. Insert components like resistors, capacitors, transistors, and ICs into the breadboard's holes. Pay attention to the component's orientation if it matters (e.g., the direction of an LED or the pinout of an IC). Bend the component leads (legs) as needed to fit into the breadboard holes.

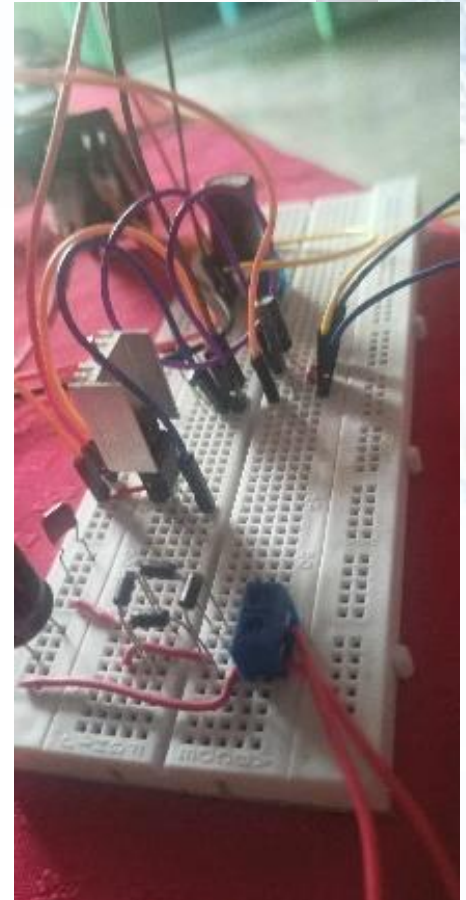
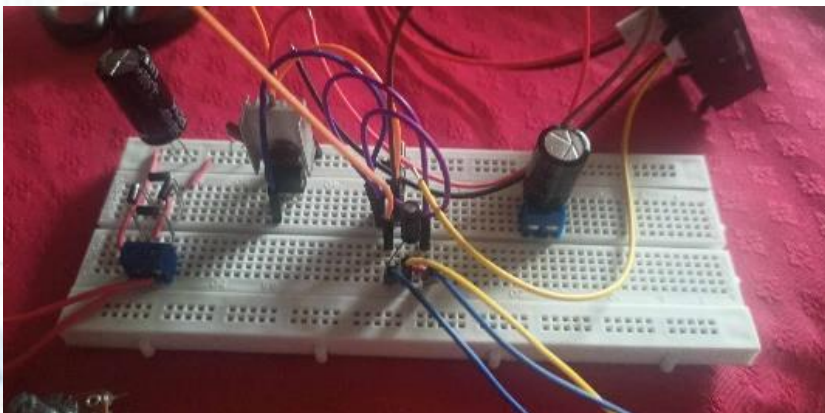
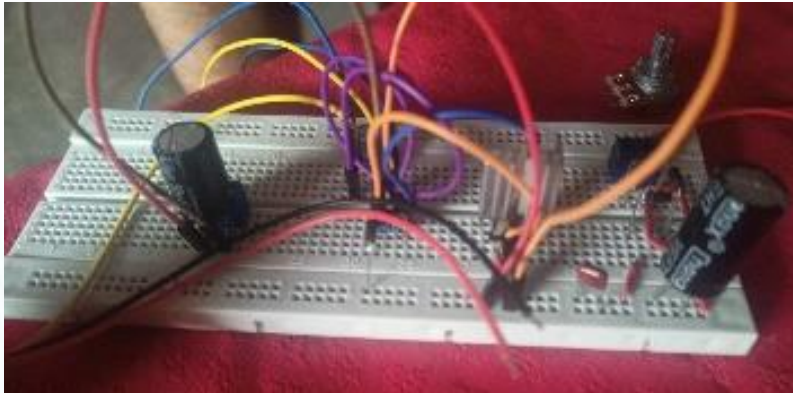
**Connect Power:** If your circuit requires an external power source, insert the power supply wires into the breadboard to provide the necessary voltage. Connect the power supply's positive (usually red) and negative (usually black) wires to the appropriate rows on the breadboard. Make sure the power supply voltage matches the requirements of your components.

**Make Connections with Jumper Wires:** Use jumper wires to connect components as per your circuit diagram. Insert one end of the jumper wire into the hole where you want to start the connection and the other end into the hole where you want to finish the connection. Keep wires as short as possible to reduce interference and clutter. Color-code your wires if needed to keep track of different connections.

**Test Your Circuit:** Once all components are connected as per your circuit design, apply power to your circuit (if necessary) and check for proper functionality. Use a multimeter to measure voltages and currents at various points in your circuit to verify that it behaves as expected. Troubleshoot and make any necessary adjustments if your circuit doesn't work as intended.

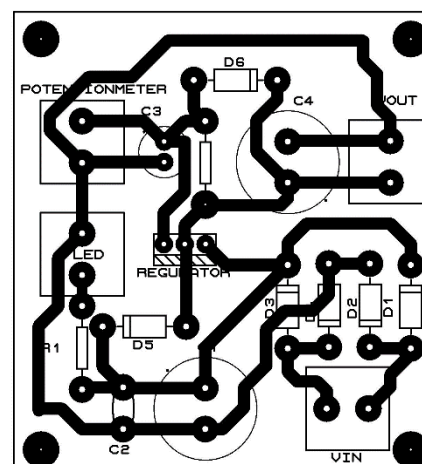
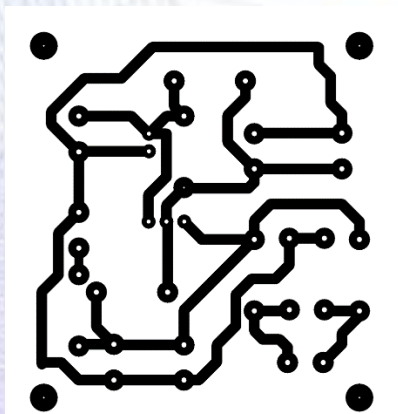
**Document Your Circuit:** If your breadboarded circuit works correctly, consider documenting it, either by taking photos, labeling components, or creating a clear diagram. This documentation will be helpful if you need to rebuild the circuit or transfer it to a permanent PCB.

**Clean Up:** When you're finished with your breadboarded circuit, carefully remove the components and wires. Store your components and wires properly for future use, and return the breadboard to its original state for your next project.



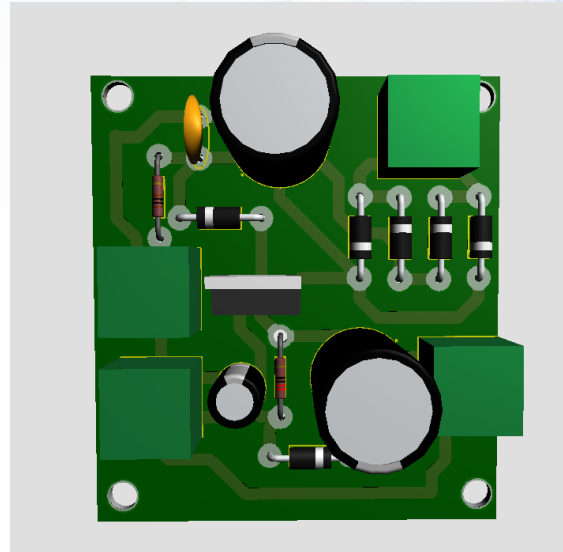
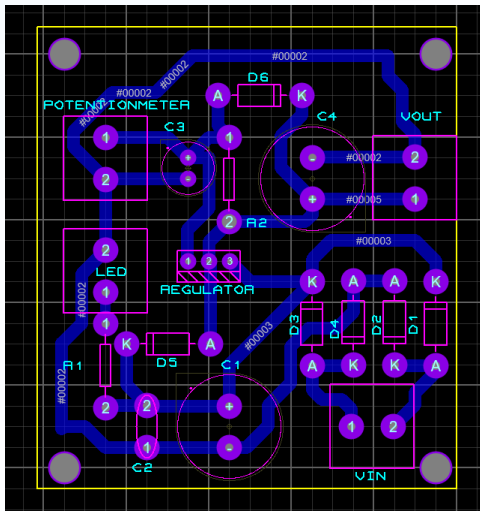
Breadboarding is a valuable skill for prototyping and experimenting with electronic circuits, allowing you to quickly iterate and test different designs before moving to a permanent circuit board.

**PCB Schematic sample input:**

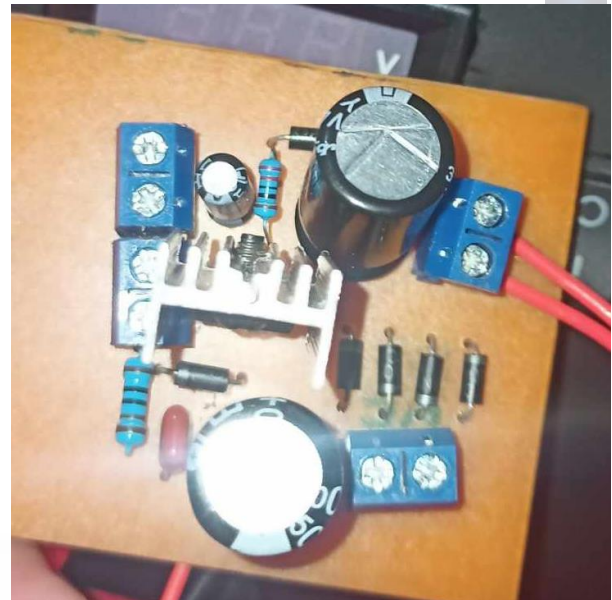
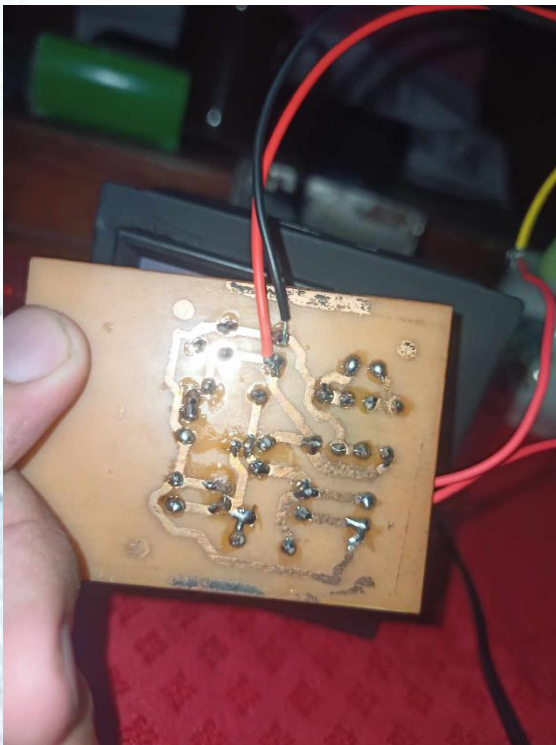




## PCB Schematic sample input:



## PCB Schematic sample output:



Creating a power circuit board requires careful planning, design, testing, and validation to ensure that it meets the power needs of your project reliably and safely. Depending on the complexity of your design, you may need to involve electrical engineers and PCB designers to assist with the process.

## Procedures:

Creating a power circuit board typically involves designing a printed circuit board (PCB) that will handle power distribution, regulation, and protection for electronic devices. Here are the general procedures for designing and manufacturing a power circuit board:

### 1. Define the Requirements:

Clearly define the power requirements for your project, including voltage levels, current ratings, and any special features like voltage regulation or protection mechanisms.

### 2. Schematic Design:

Create an electronic schematic diagram using specialized software. The schematic represents the electrical connections and components used in your power circuit. Include components such as voltage regulators, capacitors, diodes, and connectors.

### 3. Component Selection:

Choose appropriate components based on your schematic design, ensuring they meet the power and voltage requirements of your project. Pay attention to component packages and footprint compatibility with your chosen PCB design software.

### 4. PCB Layout Design:

Transfer your schematic into a PCB layout using the same software. This involves arranging components on the board and routing traces to connect them. Consider factors like component placement, trace width, and spacing to ensure good thermal and electrical performance. Include layers for power and ground planes, which help with heat dissipation and noise reduction.

### 5. Create Gerber Files:

Once your PCB layout is complete, generate Gerber files. These are industry-standard files used by PCB manufacturers to manufacture the board. Check for design rule violations and make any necessary corrections before exporting the Gerber files.

### 6. Prototype and Test:

Before mass production, create a prototype of your power circuit board. You can order a small batch from a PCB manufacturer. Assemble the prototype with the selected components. Test the prototype to ensure that it functions as intended, meets power specifications, and doesn't overheat.

### 7. Design Iteration:

If there are issues or improvements needed, iterate on the design. Make necessary changes to the PCB layout and components. Reorder prototypes and retest until you're satisfied with the performance.

### 8. Finalize the Design:

Once the prototype meets your requirements and passes testing, finalize the PCB layout. Double-check that all components are correctly placed and oriented.

### 9. Manufacture the PCB:

Send your finalized Gerber files to a PCB manufacturer for production. Choose the appropriate board material, surface finish, and any additional requirements. Verify the manufacturer's capabilities and specifications to ensure they can meet your design's requirements.

### 10. Assembly:

Once you receive the manufactured PCBs, assemble them with the selected components, which may include soldering components onto the board. Follow good soldering practices and ensure that components are placed accurately.



### 11. Quality Control:

Perform quality control tests on the assembled power circuit boards to verify that they meet the specified power requirements and perform reliably.

### 12. Documentation:

Create detailed documentation for your power circuit board, including schematics, bill of materials (BOM), assembly instructions, and user guides.

### 13. Integration:

Integrate the power circuit board into your electronic device or system, making sure it interfaces correctly with other components and systems.

### 14. Testing and Validation:

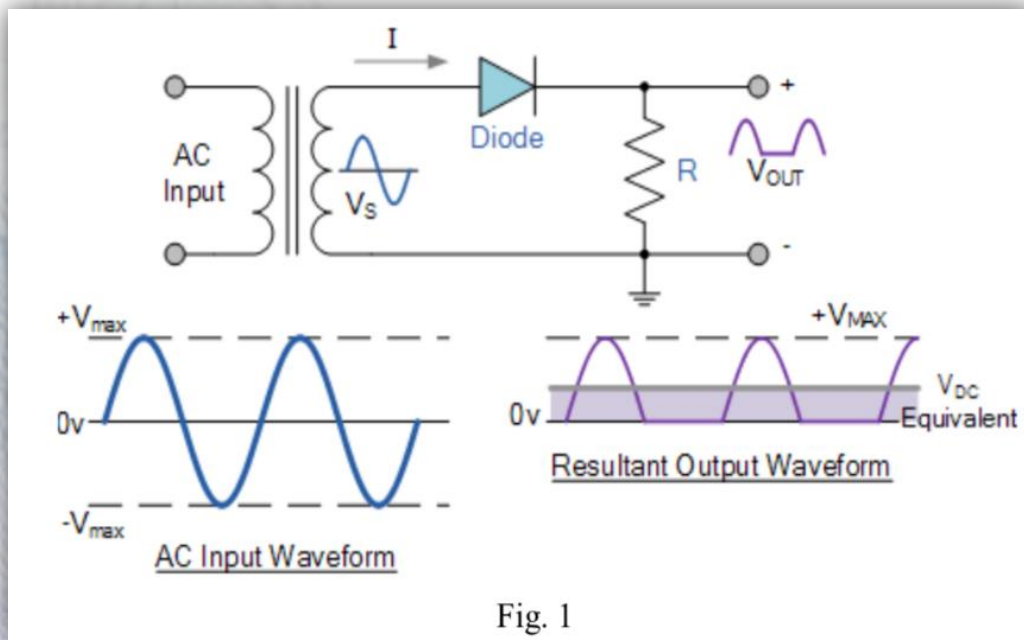
Conduct thorough testing and validation of the entire electronic system to ensure that the power circuit board functions correctly within the larger context of your project.

### 15. Deployment:

Deploy your electronic device or system, incorporating the power circuit board into the final product.

## Data

Record the measurements taken to verify the operation. These should include the Range of Adjustment, the No-Load Output Voltage, the Transformer Secondary Voltage, the Rectifier Voltage Output and the Peak to Peak Ripple at full output load.





## Conclusion

It appears you're referring to a specific project involving a power supply unit (PSU). To provide insights into what might have been learned during the project, what issues might have arisen, and how they could have been resolved or improved, I'll provide some common examples:

### Learnings from the Project:

**Understanding Power Requirements:** One key takeaway might be a better understanding of the power requirements of the project, including voltage, current, and stability needs.

**Component Selection:** Learning to select appropriate components (e.g., voltage regulators, capacitors, transformers) that meet the project's specifications.

**PCB Design Skills:** Developing PCB design skills and knowledge about how to route traces, create ground and power planes, and optimize the layout for efficient power distribution.

**Prototyping and Testing:** Gaining experience with prototyping and testing to verify that the power supply meets its design objectives and does not have overheating or voltage regulation issues.

**Troubleshooting Skills:** Learning how to troubleshoot common power supply problems, such as short circuits, overvoltage, or voltage drop.

### Issues and Resolutions:

**Overheating:** If the PSU components or the PCB design caused overheating, this issue could be resolved by selecting components with higher power ratings or improving thermal management through heat sinks or better airflow.

**Voltage Regulation:** If the PSU had trouble maintaining a stable voltage output, it might require a more robust voltage regulation circuit, possibly with feedback control.

**Component Failure:** In case of component failure, the faulty component(s) would need to be identified and replaced.

**Inadequate Current Capacity:** If the PSU couldn't supply enough current for the project's requirements, you might need to redesign the circuit to handle higher current loads or select higher-rated components.

**Safety Concerns:** Safety issues, such as short circuits or improper grounding, would require careful inspection and correction of the wiring or circuit design.

## Improvement Ideas for PSU Performance:

**Higher Efficiency:** Improve the efficiency of the PSU to reduce energy wastage and heat generation. This can be achieved by selecting efficient components and designing the circuit for optimal power conversion.

**Improved Voltage Regulation:** Enhance voltage regulation to provide a more stable and accurate output voltage under varying load conditions. This could involve using advanced voltage regulators or feedback control mechanisms.

**Reduced Noise and Ripple:** Minimize output noise and voltage ripple by adding additional filtering components like low-ESR capacitors or inductors.

**Multiple Outputs:** Consider adding multiple output channels to the PSU, each with its own voltage and current settings, to accommodate different power requirements simultaneously.

**Remote Monitoring and Control:** Implement remote monitoring and control features, such as digital interfaces or adjustable voltage and current settings, to make the PSU more versatile and user-friendly.

**Short-Circuit and Overload Protection:** Enhance protection features to safeguard against short circuits and overloads, which can prevent damage to both the PSU and the connected devices.

**Efficient Cooling:** Improve cooling solutions, such as using efficient fans or heat sinks, to keep the PSU components within safe temperature limits.

**Reduced Footprint:** If size is a concern, work on reducing the physical footprint of the PSU while maintaining performance and safety.

**Redundancy:** Consider adding redundancy to critical parts of the power supply to ensure continued operation in case of component failure.

The specific improvements needed would depend on the project's requirements, and the learning process from the initial project can help inform these enhancements. Continuous testing, iteration, and learning are key to developing high-quality power supply solutions.