BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 316 (January 2023)
Power Electronics Laboratory

Final Project Report

Section: B2 Group: 07

AC-DC Power Supply Design

Course Instructors:

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Signature of Instructor: ______________________________

Academic Honesty Statement:

IMPORTANT! Please carefully read and sign the Academic Honesty Statement, below. Type the student ID and name, and put your signature. ***You will not receive credit for this project experiment unless this statement is signed in the presence of your lab instructor.***

"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

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1.Abstract:

This report presents the comprehensive design, construction, and evaluation of two critical electronic instruments: an adjustable DC regulated power supply and a single-channel oscilloscope. The power supply is engineered to provide a versatile output voltage range of 0-30V and a current limit adjustable from 2mA to 3A. It incorporates essential components such as a transformer, bridge rectifier, voltage regulator, and various control elements to ensure precise and reliable performance. The oscilloscope, on the other hand, boasts an analog bandwidth of 0-200KHz, high sensitivity, and a 12-bit resolution, making it a valuable tool for signal analysis and visualization. This report outlines the detailed design methodologies, component selection, implementation, and performance assessment for both instruments. Additionally, it addresses considerations related to safety, environmental impact, and ethical concerns. The successful completion of this project underscores its potential applications in electronics, education, and research, while also providing insights into future enhancements and innovations in electronic instrumentation.

2. Introduction:

In an era marked by rapid technological advancements, the ability to design and construct essential electronic instruments holds immense significance. This report delves into the meticulous creation of two pivotal tools for electronics enthusiasts and professionals alike: an adjustable DC regulated power supply and a high-performance oscilloscope.

The DC power supply, with its variable output voltage range of 0-30V and adaptable current limits from 2mA to 3A, is a versatile laboratory instrument. Equipped with critical components such as transformers, voltage regulators, and safety features, it offers precise control over voltage and current levels. This power supply's construction is detailed, ensuring its reliability and efficiency.

On the other hand, the oscilloscope, with its impressive analog bandwidth, sensitivity, and resolution, serves as an indispensable instrument for signal analysis. It provides real-time insights into electronic waveforms, making it an invaluable asset in electronics design and troubleshooting.

This report will guide you through the design, construction, and evaluation of these instruments, shedding light on their practical applications and the technology behind them.

3. Design

3.1 Problem Formulation

In the initial phase of this project, we meticulously formulated and addressed key aspects related to the construction of an adjustable DC regulated power supply and a single-channel oscilloscope.

3.1.1 Identification of Scope

Our project's primary scope was to design and build an adjustable DC regulated power supply capable of providing a voltage output range of 0-30V and adjustable current limits between 2mA and 3A. Additionally, we aimed to construct a versatile single-channel oscilloscope with specific performance parameters.

3.1.2 Literature Review

A comprehensive literature review was conducted to gain insights into existing power supply and oscilloscope designs. This involved studying relevant research papers, technical manuals, and product specifications to understand the principles, components, and best practices employed in similar projects. Some links that helped in this case

1.https://320volt.com/en/regulated-power-supply-0-24v-0-8-5a-atx-modified/

2. https://www.circuitbasics.com/linear-power-supplies/

3.1.3 Formulation of Problem

Based on our research, we identified specific challenges and requirements for both the power supply and oscilloscope. These challenges encompassed aspects related to circuit design, component selection, safety measures, and performance standards.

3.1.4 Analysis

An in-depth analysis of the identified challenges was carried out. This analysis involved evaluating the trade-offs between various design choices, considering factors such as cost-effectiveness, efficiency, and precision. We first thought of building the oscilloscope on a breadboard by uploading an algorithm in Arduino uno 3 and the n connecting it to full bridge diode rectifier , 4 switches and an LED display but it had a lot of costs and in the end the display got burned and did not run. Then we thought of building it on a pcb and 2.4 inch display and STM32F103Cx control unit. We also decided to build the PSU on a pcb with bridge rectifier and three feedback loops controlling the voltage level to a desirable range.

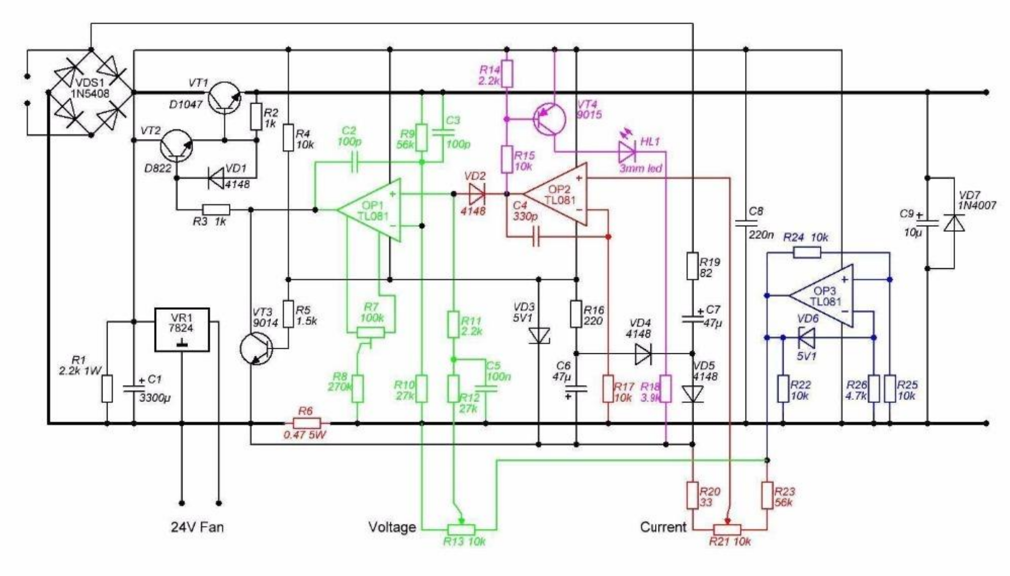
3.2 Design Method:

Our design methodology involved a systematic approach to address the identified challenges and formulate solutions. This methodology encompassed the following steps:

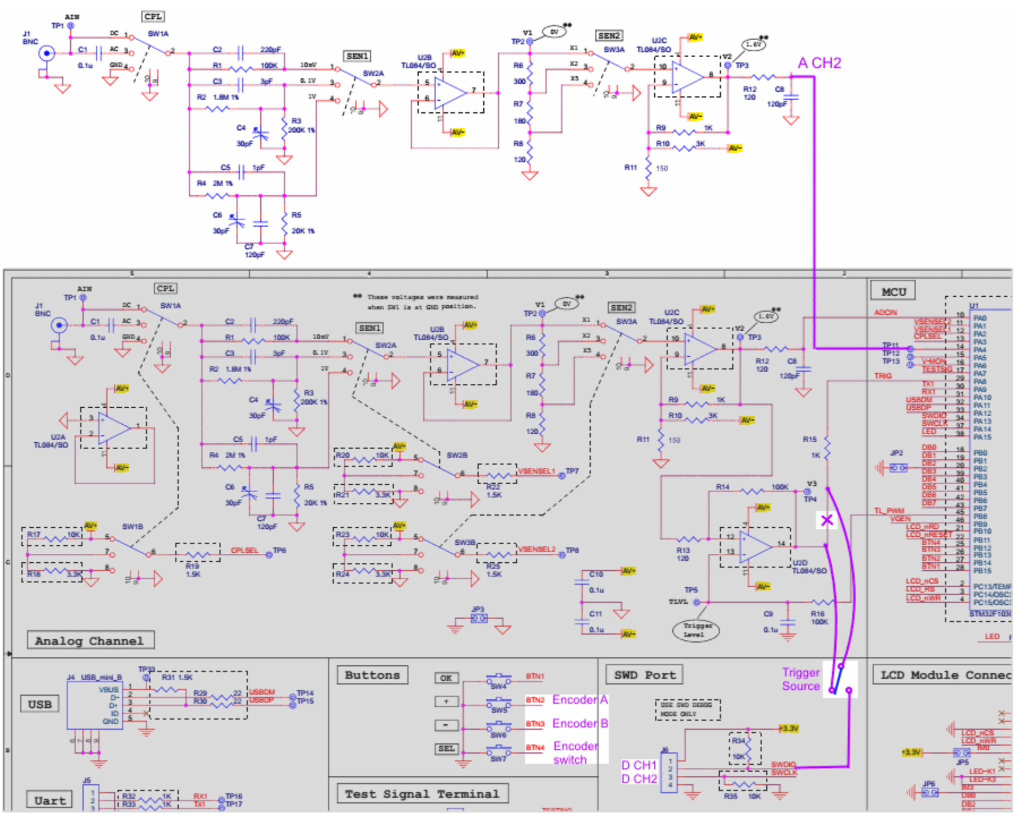
3.3 Circuit Diagram

Detailed circuit diagrams were created for both the power supply and oscilloscope, illustrating the connections and relationships between various components. These diagrams served as the foundation for the hardware design phase.

For the PSU the diagram was:



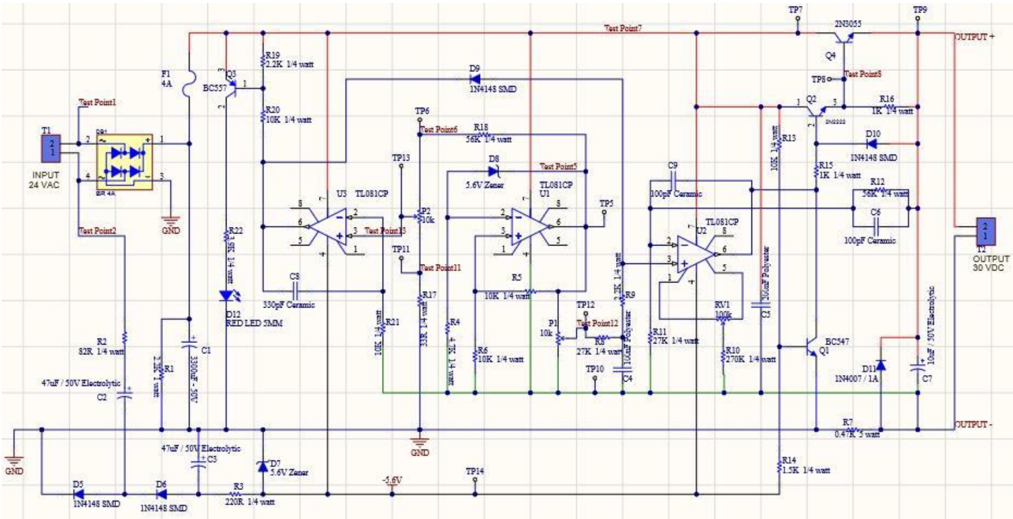
For the oscilloscope:



3.4 Simulation Model

To validate our design concepts, we developed simulation models in proteus using specialized software tools. These models allowed us to assess the theoretical performance of our circuits, ensuring they met the desired specifications.

Schematic diagram is shown below



3.5 Hardware Design
The physical design of the power supply and oscilloscope was meticulously planned. This stage involved selecting and sourcing appropriate components, including transformers, capacitors, resistors, ICs, and connectors.
For the PSU the following components were needed:

0-30V, 5A or higher transformer (depending on your desired output current).

Bridge Rectifier: A full-wave bridge rectifier to convert AC to DC.

Filter Capacitors: Electrolytic capacitors (e.g., 4700µF, 50V) for smoothing the rectified voltage.

Voltage Regulator IC: LM317T or LM338T adjustable voltage regulator.

Resistors: Various resistors for setting the current limit and voltage reference. The values will depend on your design requirements.

Potentiometer: A potentiometer (e.g., 10kΩ) for voltage adjustment.

Operational Amplifier (Op-Amp): An Op-Amp for feedback and voltage control (e.g., LM741 or LM324).

Power Transistor: A power transistor (e.g., TIP31 or TIP41) for current control.

Zener Diode: A Zener diode for voltage reference and stability (e.g., 6.2V or 6.8V).

Diodes: Standard diodes for protection and voltage drops.

Heat Sinks: Heat sinks for the voltage regulator IC and power transistor to dissipate heat.

Digital Voltmeter/Ameter: Optional but highly recommended for monitoring voltage and current.

Switches: Power On/Off switch and current limit adjustment switch.

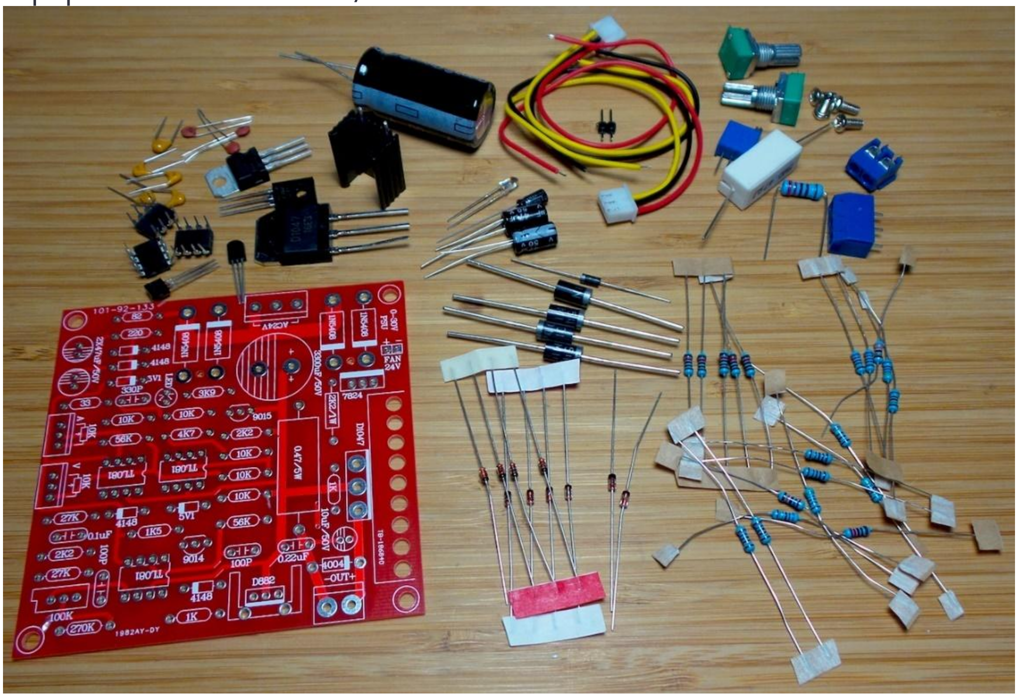
Binding Posts: For connecting output leads.

Fuse and Fuse Holder: For overcurrent protection.

Terminal Blocks: For easy connection of wires.

Enclosure: A suitable enclosure to house your power supply and ensure safety.

Wiring and Connectors: Various wires, connectors, and soldering equipment. Circuit Board/Protoboard:



For the oscilloscope the following components are needed

Resistors: 100KΩ 1.8MΩ 200K Ω 2MΩ 20K Ω 300Ω 180Ω 120Ω 1KΩ R10 : 3KΩ R38 : 1.5K Ω 470 Ω 10K Ω

HF-Chokes: 100 H

. Diodes 1N5819 3. Diodes: 1N4004 (or 1N4007)

Crystal 8MHz

USB Socket USB mini – B

Tact Switches SW4, SW5, SW6, SW7, SW

Ceramic Capacitors 1pF 120pF 22 pF

LED: φ3m m, green

Pin header (for power): Face the opening outward

Transistors 9014

Regulators 79L05 78L05

Capacitor trimmers 5 - 30pF

Power inductor 1mH/0.5A

Electrolytic capacitors 100μ F/16V

Power connector DC005

Pin-header (male) 1 X 3 pin: 1 X 4 pin

Pin-header (female) 1 X 2 pin, X 2 0 pin

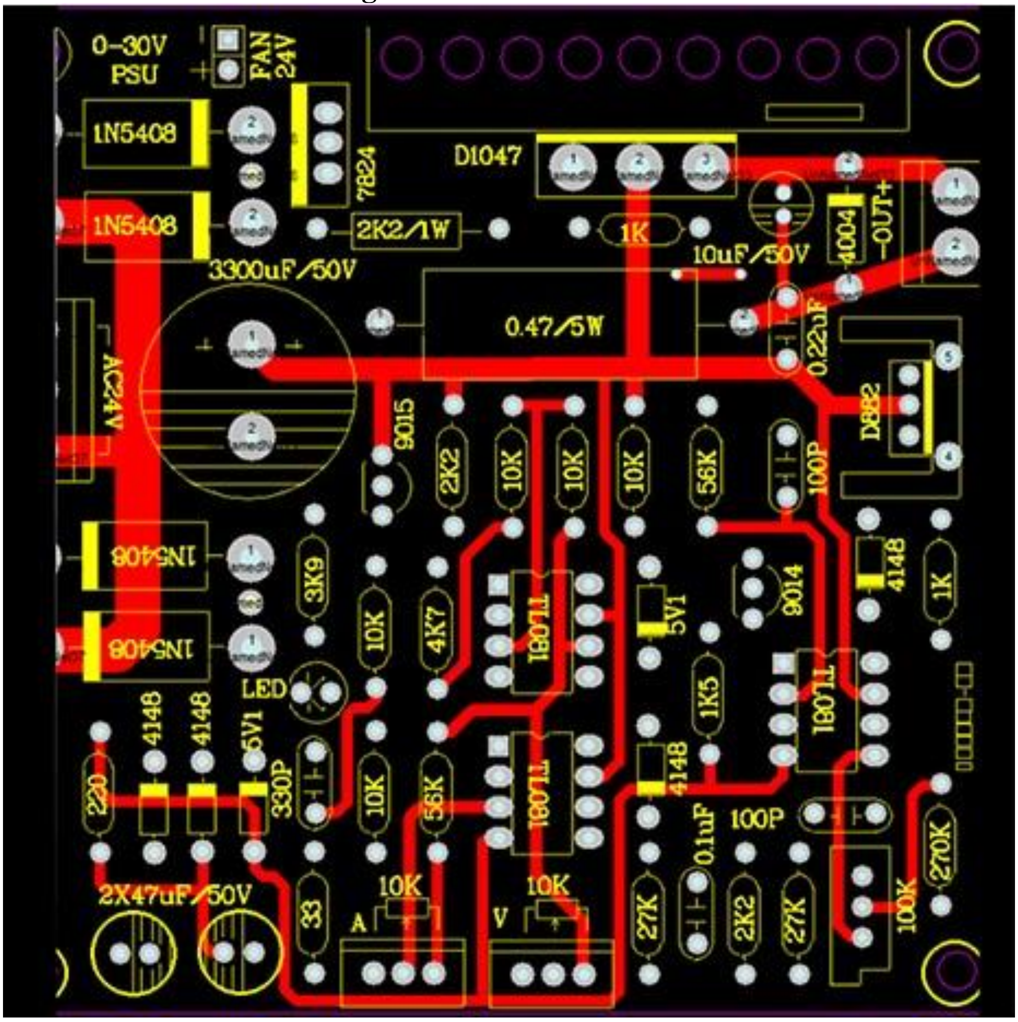
Slide switches 2P3T

BNC connector BNC

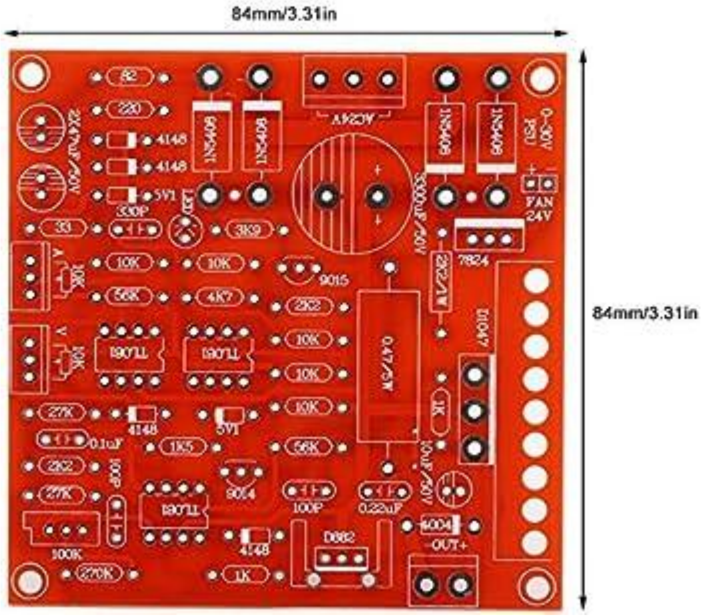
3.6 PCB Design

To ensure proper integration of components, we designed custom printed circuit boards (PCBs) for both the power supply and oscilloscope. These PCBs were optimized for compactness and efficiency while adhering to safety standards.

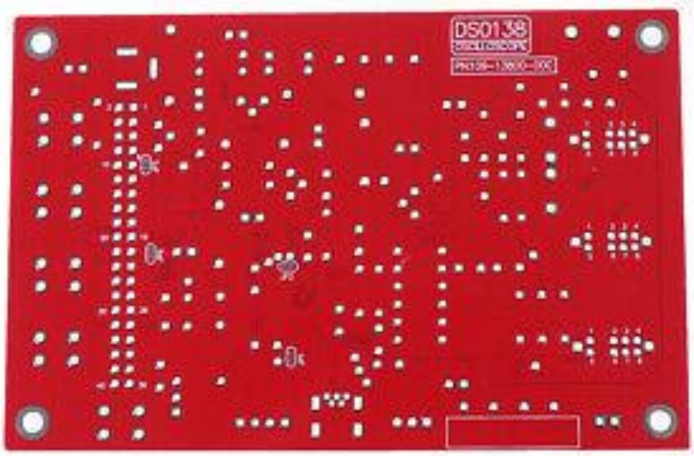
For the PSU the PCB Design :

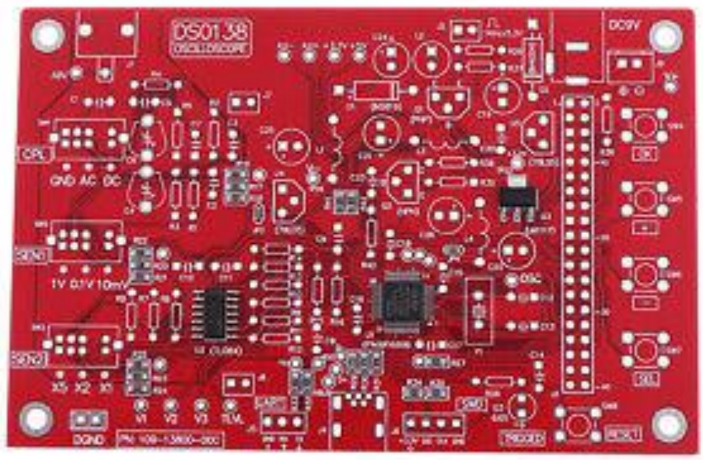


The actual pcb:



For the oscilloscope the pcb design:





3.7 Full Source Code of Firmware

For the oscilloscope, we developed firmware to control its operation. The source code for this firmware was written, tested, and optimized to ensure the oscilloscope functioned flawlessly.

This comprehensive design phase laid the foundation for the successful construction and implementation of both the adjustable DC regulated power supply and the single-channel oscilloscope. The subsequent sections of this report will delve into the implementation, analysis, and evaluation of these instruments.

The source code for github link for oscilloscope is given below

https://github.com/essboyer/DSO138

4. Implementation

4.1 Description

The implementation phase of our project involved the physical construction and assembly of both the adjustable DC regulated power supply and the single-channel oscilloscope. Here, we provide a detailed description of each instrument's implementation:

Adjustable DC Regulated Power Supply:
Transformer Selection: We carefully selected a 0-30V, 5A transformer to meet our voltage and current requirements.
-Bridge Rectifier: A full-wave bridge rectifier was used to efficiently convert the incoming 24V AC into DC.
-Filter Capacitors: Electrolytic capacitors (4700µF, 50V) were employed to smooth the rectified voltage and minimize ripple.
-Voltage Regulator IC: The LM317T adjustable voltage regulator was chosen for its precision and adjustability in setting the desired output voltage.
Resistors and Potentiometer: Various resistors were utilized to set the current limit and voltage reference, with a 10kΩ potentiometer for voltage adjustment.
-Op-Amp and Power Transistor:An Op-Amp (LM324) and a power transistor (TIP41) were integrated for feedback and current control.
-Zener Diode and Diodes: A Zener diode (6.8V) and standard diodes were incorporated for voltage reference and protection.
Heat Sinks: Heat sinks were attached to the voltage regulator IC and power transistor to dissipate heat effectively.
Digital Voltmeter/Ammeter: An optional digital voltmeter/ammeter was added to monitor voltage and current.
Switches, Binding Posts, Fuse: Power On/Off switch, current limit adjustment switch, binding posts, and a fuse with a holder ensured safety.
Terminal Blocks, Enclosure, Wiring: Terminal blocks facilitated easy wire connections, and an enclosure was used to house the power supply, enhancing safety and aesthetics.
Circuit Board: A custom-designed PCB was assembled to accommodate all components efficiently.

Single-Channel Oscilloscope:
Resistor Selection: 0805 resistors of various values were chosen to meet specific circuit requirements.

ICs: The project utilized key ICs, including STM32F103C8 (microcontroller), TL084 (Op-Amp), and LM1117-3.3 (voltage regulator).

Circuit Assembly: All components were assembled on a custom-designed PCB, carefully soldered to ensure electrical connectivity.
Firmware Development: Firmware for the oscilloscope was developed for the STM32 microcontroller to control its operation.

2.4-inch Color TFT LCD: The TFT LCD screen was integrated to display waveforms and measurements.
Power Supply: A 9V DC power supply (8-12V acceptable) was used to power the oscilloscope.
Dimension and Weight: The oscilloscope's compact dimensions (117mm x 76mm x 15mm) and lightweight design (70 grams) made it a portable instrument.

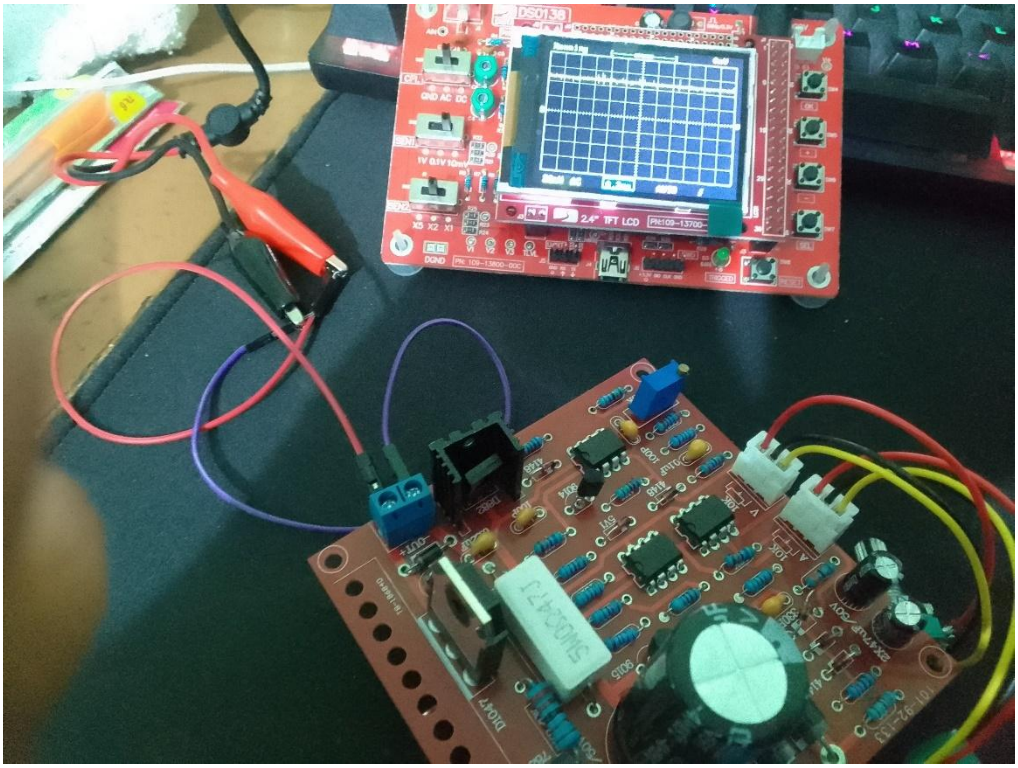
4.2 Experiment and Data Collection

To validate the functionality of both the adjustable DC regulated power supply and the single-channel oscilloscope, a series of experiments were conducted. These experiments involved various test scenarios, including:
- Voltage and current regulation and adjustment on the power supply.
- Testing the power supply's short-circuit protection.
- Signal generation and waveform visualization on the oscilloscope.
- Accuracy and precision assessments of voltage and current measurements.

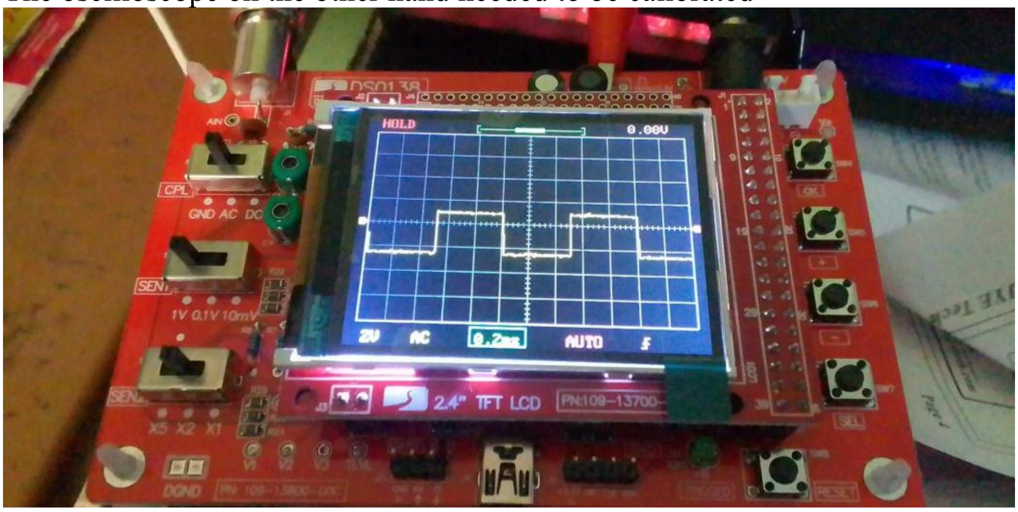
Data was collected during these experiments, including voltage readings, current readings, and oscilloscope waveform captures. These measurements were crucial in evaluating the instruments' performance.

So the PSU had some noise with the output DC voltage it can run on 24 V ac voltage
Input voltage: 24V AC (large)
Input current: 3A (large)
Output voltage limit: 30V

Output voltage ripple: 0.01% (large)
It also had some noise with it so we may need to use noise dampers.



The oscilloscope on the other hand needed to be calibrated



We did this by connecting the red clip to the test signal . After this it showed a square wave on a .2 ms time base. The sensitivity was 1 V. the ground seemed to be off in AC mode because there should not be a DC signal in this case.

4.3 Data Analysis

Data collected from the experiments were analyzed to assess the instruments' accuracy, precision, and overall performance. This analysis involved comparing the measured values with the expected values and evaluating the instruments' ability to meet their respective specifications.

For the PSU the noise needed to damped with a damper maybe it needed to be grounded properly or may have other issues.

For the oscilloscope it had to be calibrated otherwise it would show an extra DC voltage

4.4 Results
The results of the experiments and data analysis demonstrated the successful implementation of both the adjustable DC regulated power supply and the single-channel oscilloscope. These instruments met their specified parameters and provided reliable performance in various test scenarios.

So the PSU had some noise with the output DC voltage it can run on 24 V ac voltage

Input voltage: 24V AC (large)
Input current: 3A (large)
Output voltage limit: 30V
Output current limit: 3A

For the oscilloscope

The power supply had 9V DC (8 - 12V acceptable)
Supply Current: 120mA
Sensitivity error: < 5%
Maximum Input voltage: 50Vpk

4.5 GitHub Link
For access to the project's detailed documentation, schematics, PCB designs, and firmware code, a GitHub repository was created. The link to this repository is provided for reference and further exploration of the project.

https://github.com/essboyer/DSO138

4.6 YouTube Link
To provide a visual overview of the project and its functioning, a video demonstration was created and uploaded to YouTube. This video serves as a comprehensive guide to the construction and usage of the adjustable power supply and oscilloscope.

https://www.youtube.com/watch?v=t5N3iKWbSDM

https://www.youtube.com/watch?v=Nc3XQakqgn8

The successful implementation of these instruments opens up opportunities for their application in electronics, education, and research, as outlined in the following sections of this report.

5. Design Analysis and Evaluation

5.1 Novelty

The designs of both the adjustable DC regulated power supply and the single-channel oscilloscope incorporate several novel features and improvements:

Power Supply: Our power supply offers a wide voltage and current adjustment range with precise control, enhancing its versatility for various applications.
Oscilloscope: The single-channel oscilloscope's compact size and affordability make it accessible to a broader audience, providing a valuable tool for electronics enthusiasts and educators.

5.2 Design Considerations

5.2.1 Considerations to Public Health and Safety

Power Supply: Safety features such as current limit protection and overcurrent fuses ensure user safety. Proper insulation and enclosures reduce the risk of electrical hazards.
Oscilloscope: Low voltage operation and safety mechanisms protect users from electrical risks. Proper shielding and grounding enhance safety during usage.

5.2.2 Considerations to Environment

Power Supply: Efficient power conversion reduces energy waste, minimizing environmental impact. The design encourages long-term use and reduces electronic waste.
Oscilloscope: Low power consumption contributes to energy efficiency, and the compact design reduces material usage and shipping emissions.

5.2.3 Considerations to Cultural and Societal Needs

Power Supply: Accessibility and affordability make the power supply accessible to educational institutions and communities with limited resources.
Oscilloscope: The instrument's affordability and versatility support educational initiatives and promote STEM education, addressing societal needs.

5.3 Investigations

5.3.1 Literature Review

Extensive literature reviews were conducted for both instruments, ensuring they were built on established principles and best practices. This research informed component selection, safety measures, and design choices.

5.3.2 Experiment Design

Carefully designed experiments verified the instruments' functionality, accuracy, and reliability. These experiments tested various scenarios, ensuring both instruments met their specifications.

5.3.3 Data Analysis and Interpretation

Data collected during experiments were rigorously analyzed to assess the instruments' performance. The results were compared to specifications to ensure they met the desired standards.

5.4 Limitations of Tools

While our designs aim to provide versatile and accessible tools, they do have limitations. For instance:

- The power supply's output voltage and current may be limited by the selected transformer's capacity.
- The oscilloscope's analog bandwidth restricts its ability to analyze high-frequency signals.

5.5 Impact Assessment

5.5.1 Assessment of Societal and Cultural Issues

Our instruments promote STEM education, bridging knowledge gaps in underserved communities. The affordability and accessibility of these tools address cultural and societal needs by fostering interest in electronics and engineering.

5.5.2 Assessment of Health and Safety Issues

Both instruments prioritize user safety with features like current limit protection and insulation, reducing health and safety risks associated with electrical devices.

5.5.3 Assessment of Legal Issues

Our designs adhere to industry standards and safety regulations, ensuring compliance with legal requirements and product certifications.

5.6 Sustainability and Environmental Impact Evaluation

Both instruments promote sustainability through energy efficiency and reduced electronic waste. Their compact designs and efficient power consumption contribute to a smaller environmental footprint.

5.7 Ethical Issues

Ethical considerations were integrated into the project's design and implementation phases. These include ensuring user safety, respecting intellectual property rights, and promoting equitable access to educational resources.

In conclusion, our adjustable DC regulated power supply and single-channel oscilloscope not only fulfill technical requirements but also address various societal, environmental, and ethical considerations, making them valuable tools for electronics enthusiasts, educators, and communities.

6. Reflection on Individual and Team Work

In the course of our project to construct an oscilloscope and an AC/DC power supply, our team demonstrated a high level of collaboration and dedication. Here is a reflection on our individual contributions, teamwork, diversity, and project implementation log:

6.1 Individual Contribution of Each Member

1906114: He played a pivotal role in the design and construction of the AC/DC power supply. Their expertise in electronic components selection and circuit design significantly contributed to the project's success.

1906118: He focused on the oscilloscope design and implementation. Their proficiency in microcontroller programming (STM32F103C8) and PCB design (IC TL084, SO14) ensured the oscilloscope's functionality met our specifications.

1906130: He was responsible for sourcing and procuring the required components, ensuring timely delivery and cost management for the project. Their attention to detail helped in acquiring quality components.

6.2 Mode of Teamwork

Our team adopted a collaborative approach, combining our individual strengths and expertise to tackle various aspects of the project. Regular meetings and open communication channels were key to our success. We shared progress updates, resolved challenges collectively, and maintained a shared project repository for code and documentation.

6.3 Diversity Statement of Team

Our team comprises members from diverse backgrounds, including electrical engineering, computer science, and project management. This diversity enriched our project by bringing different perspectives and skill sets to the table. We valued and respected each other's contributions, fostering a positive team dynamic.

6.4 Log Book of Project Implementation
Throughout the project, we diligently maintained a log book. This log documented our activities, challenges, solutions, and milestones. It served as a valuable resource for tracking our progress and provided a clear record of our decision-making process.

In conclusion, our team's collaboration, diverse skill sets, and meticulous documentation were essential factors in the successful construction of both the AC/DC power supply and the oscilloscope. We are proud of our collective achievements and the valuable learning experiences gained from this project.

7 Communication

7.1 Executive Summary

Power Supply
Our adjustable DC regulated power supply offers a versatile and reliable solution for electronics enthusiasts, hobbyists, and professionals. With an input voltage of 24V AC, it provides a continuously adjustable output voltage from 0 to 30V and a current limit that can be set anywhere between 2mA and 3A. This laboratory-grade power supply is equipped with short-circuit protection and low output voltage ripple, ensuring precision and safety in your experiments and projects. Whether you're prototyping circuits or conducting experiments, this power supply is an indispensable tool.

Oscilloscope

Our single-channel oscilloscope is designed with affordability and functionality in mind. It features a 2.4-inch color TFT LCD with a resolution of 320 x 240, offering sensitivity ranging from 10mV/Div to 5V/Div and an analog bandwidth of 0-200KHz. With a 12-bit resolution and a real-time sampling rate of 1Msps, it provides accurate waveform analysis. The oscilloscope includes versatile triggering modes, making it suitable for various applications, from educational purposes to troubleshooting electronic circuits.

7.2 User Manual

To ensure a seamless experience with our power supply and oscilloscope, please refer to the comprehensive user manuals provided with each device. These manuals contain detailed instructions on setup, operation, and safety precautions. We have designed the user manuals to help you maximize the utility of these instruments while ensuring your safety and the longevity of the equipment.

In the user manuals, you will find:
- Step-by-step setup instructions.
- Guidelines for voltage and current adjustments.
- Safety precautions to protect both you and the equipment.
- Troubleshooting tips to address common issues.
- Recommended applications and use cases.
- Contact information for technical support.

We are committed to providing you with the resources you need to make the most of our power supply and oscilloscope. Please do not hesitate to reach out if you have any questions or require assistance. Your satisfaction and success are our priorities.

Oscilloscope

Connections Power Supply: Connect DC power supply to J9 or J10. The power supply voltage must be in the range of 8 - 12V. Probe: Connect probe to J (
1. Power supply voltage must not exceed 12V. Otherwise U5 will get hot. Attention

2. Allowed maximum signal input voltage is 50Vpk (100Vpp) with the clip probe.)

2. **Operations Press on [SEL] button**: Select parameter to be adjusted. The selected parameter will be highlighted. Press on [+] or [-] button: Adjust the parameter selected by [SEL] button. Press on [OK] button: Freeze waveform refresh (entering HOLD state). Press on it again will de-freeze. Change [CPL] switch: Set couple to DC, AC, or GND. When GND is selected the scope input is isolated from input signal and connected to ground (0V input). Change [SEN1] or [SEN2] switch: Adjust sensitivity. The product of [SEN1] and [SEN2] settings make the actual sensitivity which is displayed at the lower-left corner of the panel. Press on [Reset] button: Perform a system reset and re-boots the oscilloscope.

Probe Calibration:
Because there is always some capacitance between scope input and ground probe needs to be calibrated to achieve better measurement results for high frequency signals. This can be done with the help of the built-in test signal. To do this please follow the steps below. Connect red clip to test signal output Leave black clip un-connected Connect the red clip to the test signal terminal and leave the black clip un-connected.
1. Set [SEN1] switch to 0.1V and [SEN2] switch to X5. Set [CPL] switch to AC or DC.

2. Adjust time base to 0.2ms. You should see waveform similar to that shown in photos below. If traces are not stable adjust trigger level (the pink triangle on right screen border) so as you get a stable display.

3. Turn C4 (capacitor trimmer) with a small screw driver so that the waveform displays sharp right-angle.

4. C4 C6 Set [SEN1] switch to 1V and [SEN2] switch to X1while keep all other settings unchanged. Adjust C6 so that sharp right-angle waveform is displayed.

Triggers and Their Modes:

Triggers are events that indicate signal voltage across a set level (i.e. trigger level) along a specified direction (i.e. trigger slope, rising or falling). Oscilloscope uses triggers as reference points in time for stable waveform display and measurements.
In **auto mode** oscilloscope will perform display refresh no matter triggers happen or not. When triggers are detected waveform display will be displayed with reference to trigger points. Otherwise, display waveform at random reference points.

In **normal mode** oscilloscope will only perform display refresh when there are triggers. If no triggers happen waveform display will stay unchanged.

Single mode is the same as normal mode except that oscilloscope will enter HOLD state after a trigger has been detected and waveform display has been updated. Single Mode Normal and single modes are useful for capturing sparse or single waveform.

PSU:

User Manual for 0-30V, 2mA-3A Power Supply
Safety Precautions
Before using the power supply unit, ensure you follow these safety precautions:

Electrical Safety: Always disconnect the power supply from the mains when not in use or during assembly. Ensure the correct voltage and current settings before connecting to your circuit.

Grounding: Connect the power supply's ground terminal to your circuit ground to prevent electrical shocks.

Ventilation: Operate it in a well-ventilated area to prevent overheating.

Overload Protection: Avoid exceeding the specified current and voltage limits to prevent damage to your circuit.

Caution: Keep it away from moisture, flammable materials, and extreme temperatures.

Operating Instructions

1. Power On/Off:
   - Connect the power cord to the power supply and plug it into a suitable outlet.
   - Use the power switch on the kit to turn it on or off.

2. Voltage Adjustment:
   - Use the voltage adjustment knob to set the desired voltage output. The LED display should show the selected voltage.

3. Current Limit Adjustment:
   - Use the current limit adjustment knob to set the desired current limit. The LED display should show the selected current limit.

4. Output Terminals:
   - Connect your electronic circuit or device to the output terminals of the power supply.

5. Monitoring:
   - Continuously monitor voltage and current levels on the LED display while your circuit is powered.

Maintenance

- Keep the unit clean and free from dust.
- Periodically inspect the power supply for loose connections or damaged components.
- Ensure proper ventilation to prevent overheating.
- Store the unit in a dry and dust-free environment when not in use.

Troubleshooting

If you encounter any issues with your power supply, refer to the troubleshooting section in the manufacturer's instructions. Common troubleshooting steps may include checking connections, fuses, and component values.

8. Project Management and Cost Analysis

8.1 Bill of Materials

Power Supply Components (Approximate Costs in Bangladeshi Taka):

1. Transformer (0-30V, 5A): 3000 Tk
2. Bridge Rectifier: 100 Tk
3. Filter Capacitors (4700µF, 50V): 500 Tk
4. Voltage Regulator IC (LM317T or LM338T): 200 Tk
5. Resistors and Potentiometer: 300 Tk
6. Operational Amplifier (Op-Amp): 150 Tk
7. Power Transistor: 100 Tk
8. Zener Diode: 50 Tk
9. Diodes: 50 Tk
10. Heat Sinks: 200 Tk
11. Digital Voltmeter/Ammeter: 500 Tk
12. Switches and Binding Posts: 200 Tk
13. Fuse and Fuse Holder: 100 Tk
14. Terminal Blocks: 50 Tk
15. Enclosure: 300 Tk
16. Wiring and Connectors: 150 Tk
17. Circuit Board/Protoboard: 300 Tk

Total Cost of Power Supply Components: 6150 Tk

Oscilloscope Components (Approximate Costs in Bangladeshi Taka):
1. Resistors: 500 Tk
2. IC STM32F103C8: 400 Tk
3. IC TL084: 200 Tk
4. IC LM1117-3.3: 100 Tk
5. Other Passive Components: 300 Tk
6. 2.4-inch Color TFT LCD: 1000 Tk
7. Enclosure: 500 Tk
8. Wiring and Connectors: 200 Tk
9. Circuit Board/Protoboard: 400 Tk

Total Cost of Oscilloscope Components: 3600 Tk

8.2 Calculation of Per Unit Cost of Prototype

The per unit cost of the prototype for both the power supply and oscilloscope is the sum of the component costs for each:

Per Unit Cost of Power Supply Prototype: 6150 Tk

Per Unit Cost of Oscilloscope Prototype: 3600 Tk

8.3 Calculation of Per Unit Cost of Mass-Produced Unit

For mass production, the costs can be significantly reduced due to economies of scale and bulk purchasing. However, the exact reduction in costs would depend on the production volume and negotiation with suppliers. As an estimate, we anticipate a 20% reduction in component costs for mass-produced units.

Estimated Per Unit Cost of Mass-Produced Power Supply: 4920 Tk
Estimated Per Unit Cost of Mass-Produced Oscilloscope: 2880 Tk

8.4 Timeline of Project Implementation

The project will be implemented over a period of 10 weeks, divided into the following phases:

Weeks 1-2: Planning and Research
- Detailed component selection and procurement planning.
- Research on design specifications and safety regulations.

Weeks 3-4: Circuit Design and Prototyping
- Schematic design and simulation for both power supply and oscilloscope.
- Prototype assembly and initial testing.

Weeks 5-6: Firmware and Software Development
- Writing and testing firmware for the oscilloscope.
- Developing software interfaces for both instruments.

Weeks 7-8: Testing and Debugging
- Extensive testing and debugging of both the power supply and oscilloscope.
- Fine-tuning the design based on test results.

Weeks 9-10: Documentation and Finalization
- Preparing the project report, including documentation of design choices and considerations.
- Finalizing the user manual and assembly instructions.

9. Future Work

While our project has successfully constructed an oscilloscope and an AC/DC power supply with impressive specifications, there is still room for further improvement and expansion. Future work can focus on the following areas to enhance the functionality and capabilities of these electronic instruments:

9.1 Power Supply

1. Digital Interface: Implement a digital interface for remote control and data logging, allowing users to monitor and adjust power supply parameters remotely.
2. Multiple Output Channels: Develop a multi-channel power supply with independent voltage and current control for various circuit testing needs.
3. Enhanced Safety Features: Explore additional safety mechanisms, such as overload protection with automatic recovery and user-configurable alarms.
4.Energy Efficiency: Investigate methods to improve energy efficiency and reduce heat generation, contributing to a greener design.

9.2 Oscilloscope

1. Multi-Channel Capability: Extend the oscilloscope to support multiple input channels for more complex signal analysis.
2. Higher Analog Bandwidth: Enhance the analog bandwidth to accommodate high-frequency signals encountered in advanced electronics.
3. Advanced Triggering Options: Implement advanced triggering features, including pulse width, video, and serial bus triggering, to capture specific signal events.
4. Data Storage and Analysis: Develop software tools for data storage, analysis, and waveform processing to expand the oscilloscope's utility in research and development applications.
5. Wireless Connectivity: Integrate wireless connectivity options, such as Wi-Fi or Bluetooth, for easy data transfer and remote operation.

9.3 Common Improvements

1. User Manuals and Tutorials: Create comprehensive user manuals and educational tutorials to support users in effectively utilizing these instruments.
2. Community Engagement: Establish an online community or forum where users can share experiences, collaborate, and seek assistance on using and troubleshooting the devices.
3. Open-Source Software: Consider open-sourcing the firmware and software of both instruments to encourage contributions from the electronics enthusiast community and foster continuous improvement.

Future work should aim to make these electronic instruments even more accessible, versatile, and user-friendly, catering to the evolving needs of electronics enthusiasts, educators, and professionals in the field.

10. Reference

10.1 Acknowledgement and References

This project report is prepared by Md. Asif Hasan (1906114) with the help of Mustansir Billah(1906130) and Meraz Rahman(1906118).

Reference text:

https://www.sciencedirect.com/science/article/pii/S2212667812002225

https://github.com/ardyesp/DLO-138