EEE 316 PROJECT

Phase Angle Control Method of Power Regulation Using TRIAC

Submitted By

Group No: 01

1906066 - Sheikh Abu Al Raihan

1906067 – Kazi Abid Hasan

1906068 – Md. Hasnat Karim

1906069 – Md. Nahid Mustafa

1906070 – Md. Mostaqul Islam

Submitted To

Iftekharul Islam Emon
Lecturer
Department of EEE, BUET

Sadat Tahmeed Azad
Lecturer (PT)
Department of EEE, BUET

TABLE OF CONTENTS

Introduction

AC phase angle control is a technique used to control the amount of power delivered to a load by adjusting the phase angle of the AC waveform. This technique is commonly used to control the characteristics of the load, such as speed of fans and intensity of lights by varying the amount of power delivered to the load.

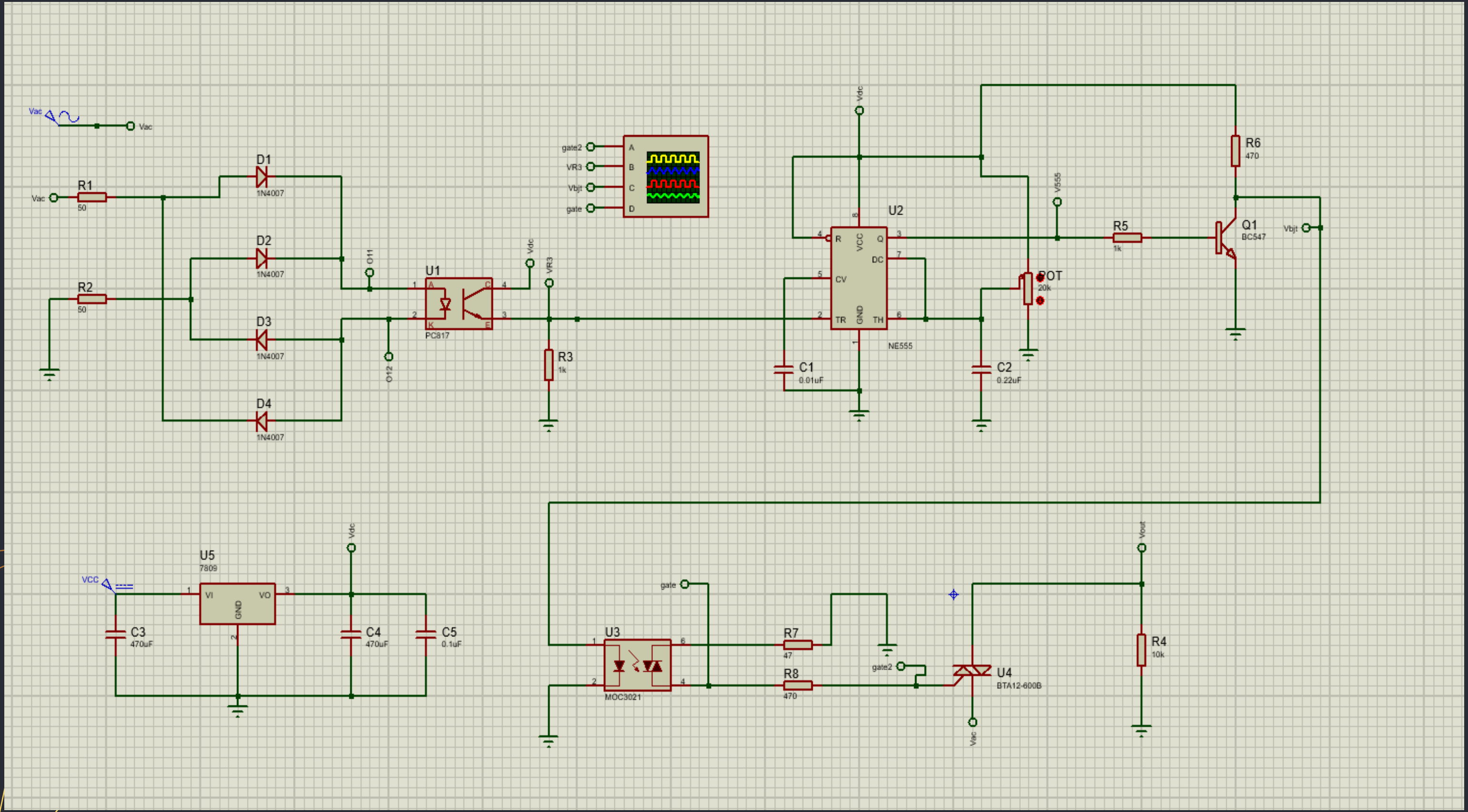
Overview

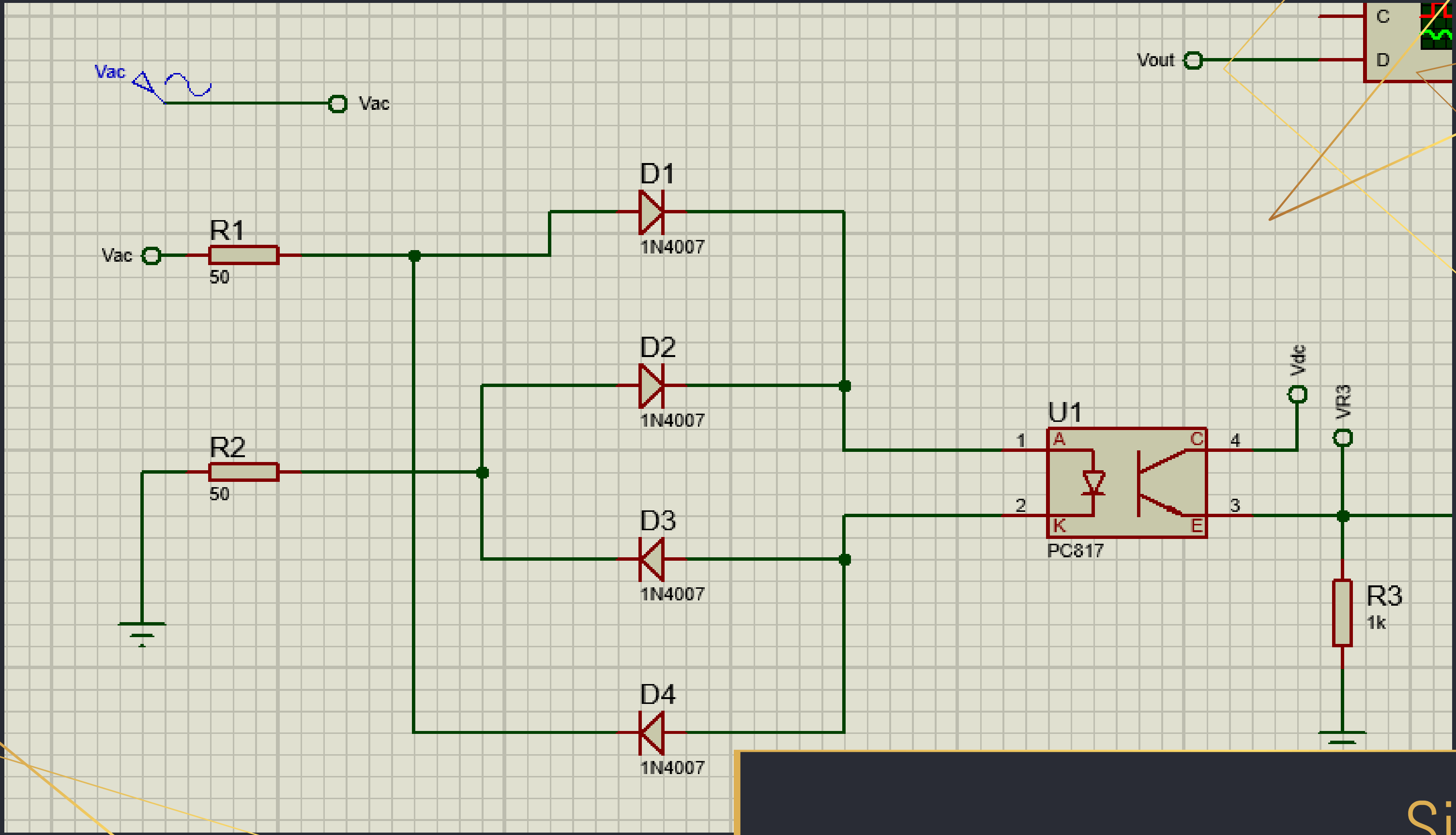
In phase angle control, thyristors are used to selectively pass only a part of each AC cycle through to the load. By controlling the phase angle or trigger angle, the output RMS voltage of the load can be varied. This method is also known as AC power regulation via phase angle control. Our project proposes a method of triggering the gate of thyristor and a method of controlling it without using microcontroller. Using generic components, a method compatible to different operating frequency is simulated and verified. A 555 timer is operated by feeding the voltage output from e zero crossing detector circuit to create pulses of different duty cycle followed by fine amplification and gate driver circuit to trigger the thyristor. This method removes the use of additional control mechanism used by software and proposes a manual control over the power regulation that is used to control different aspects of loads.

Components

1. Breadboard
2. Jumper Wire
3. Diode D1N4007
4. Resistors : 47, 100, 470, 1k, 10k
5. Potentiometer : 20k
6. Capacitors : 0.01 μF, 0.1 μF
7. Octocoupler : PC 817, MOC 3021
8. 555 Timer NE555
9. TRIAC BTA-12 600B
10. Veroboard
11. Stapler Wire

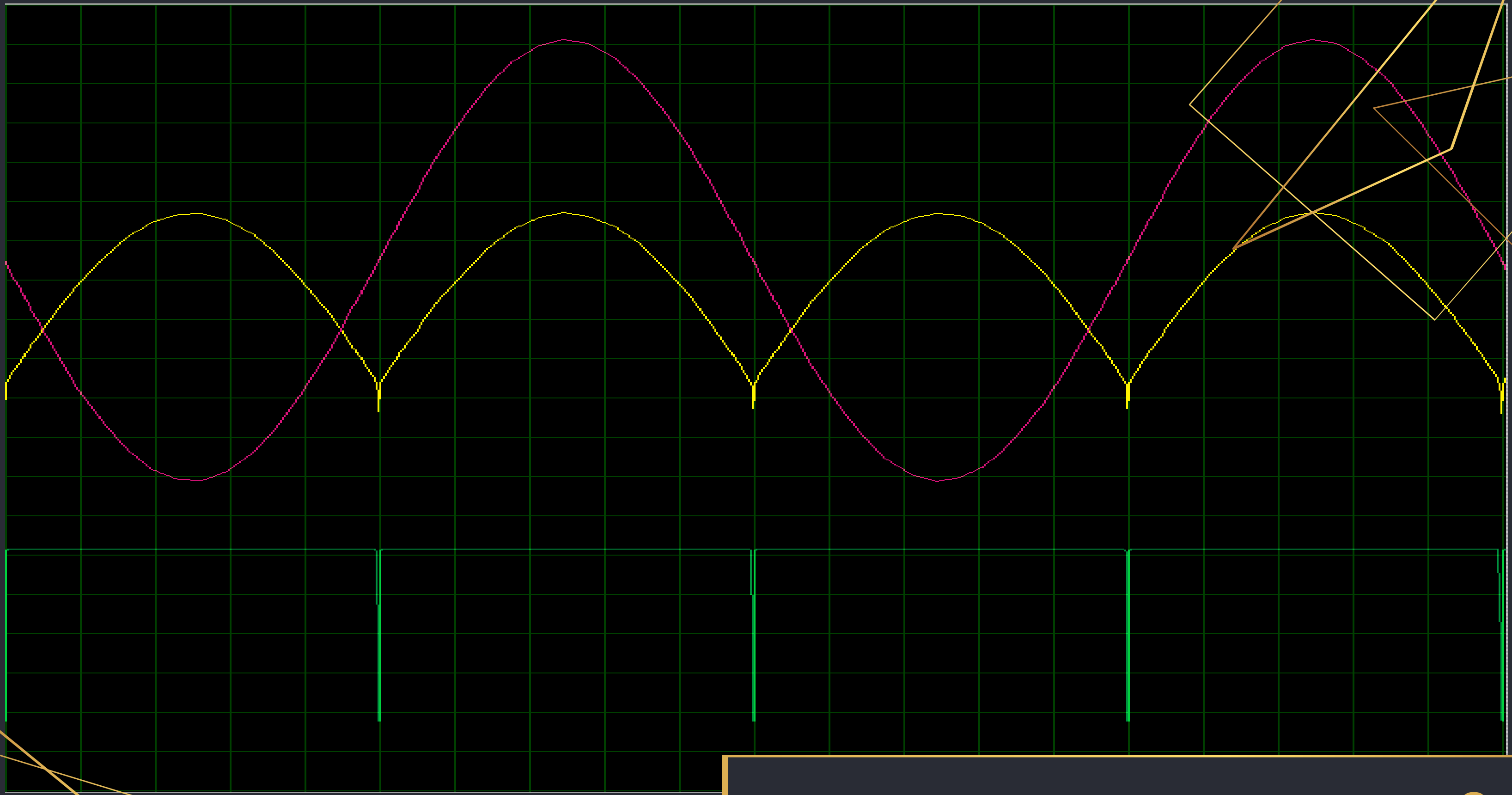
Main Circuit Diagram





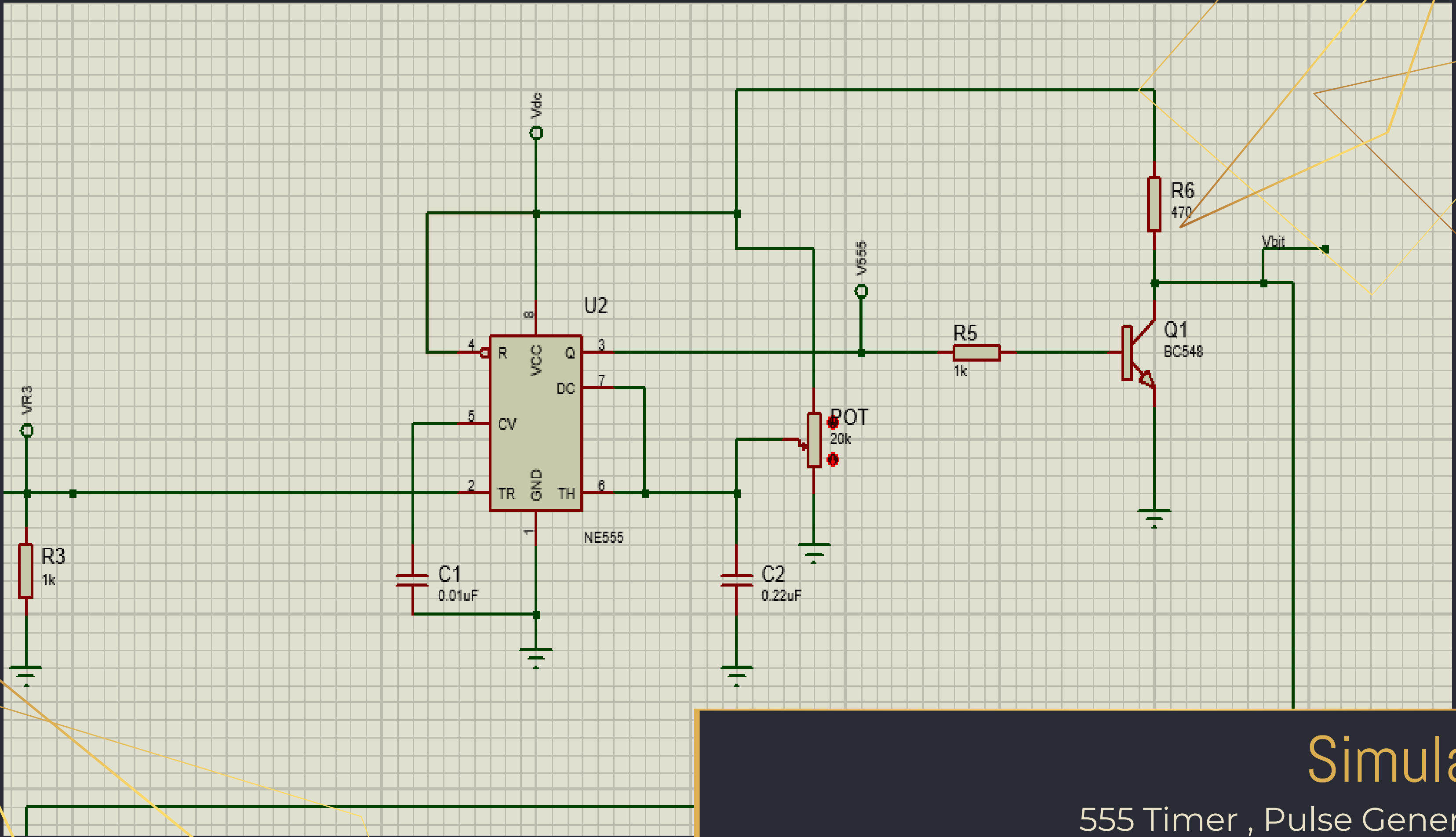
Simulation

Full Wave Rectifier & Zero Crossing Detector



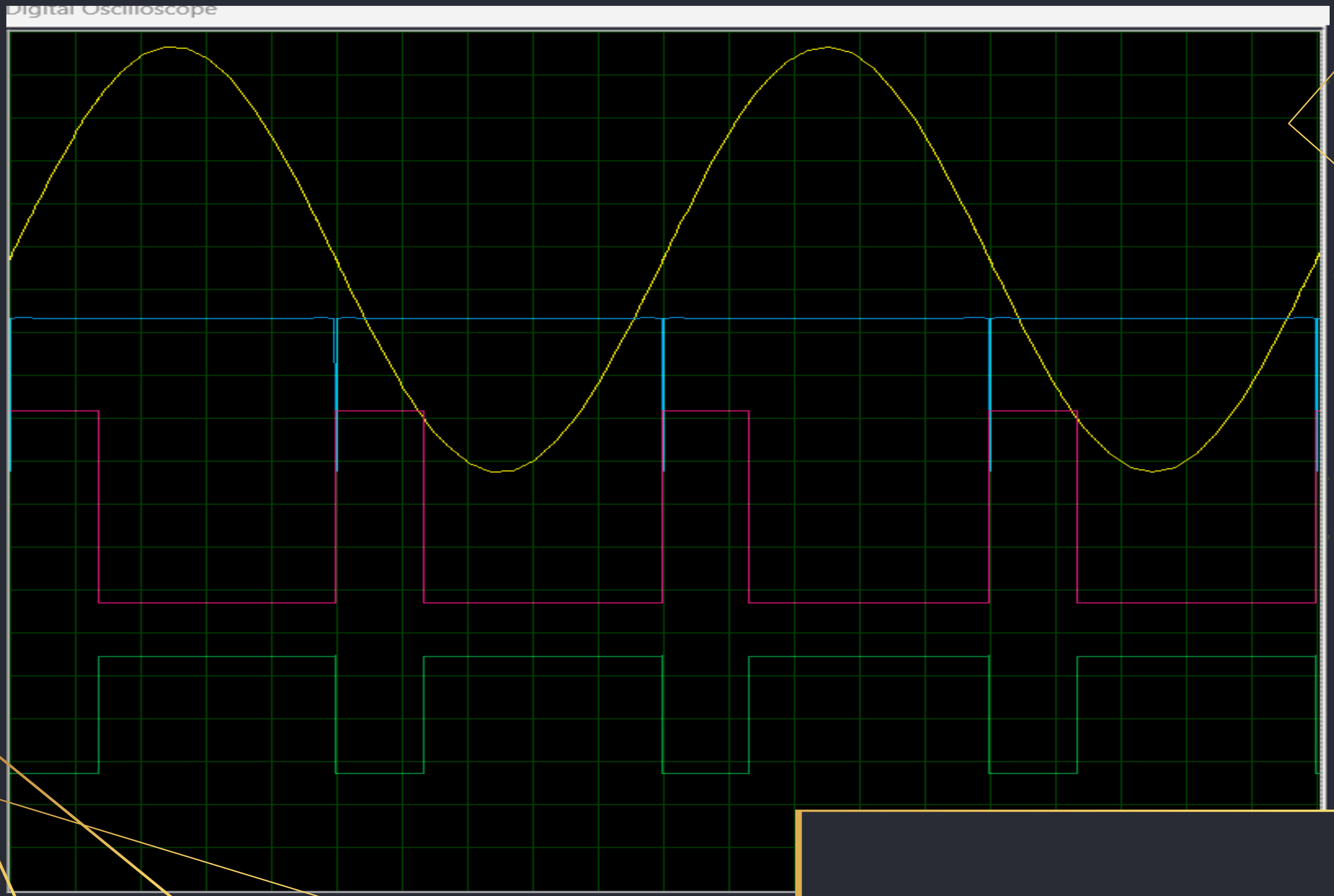
Output

Full Wave Rectifier & Zero Crossing Detector



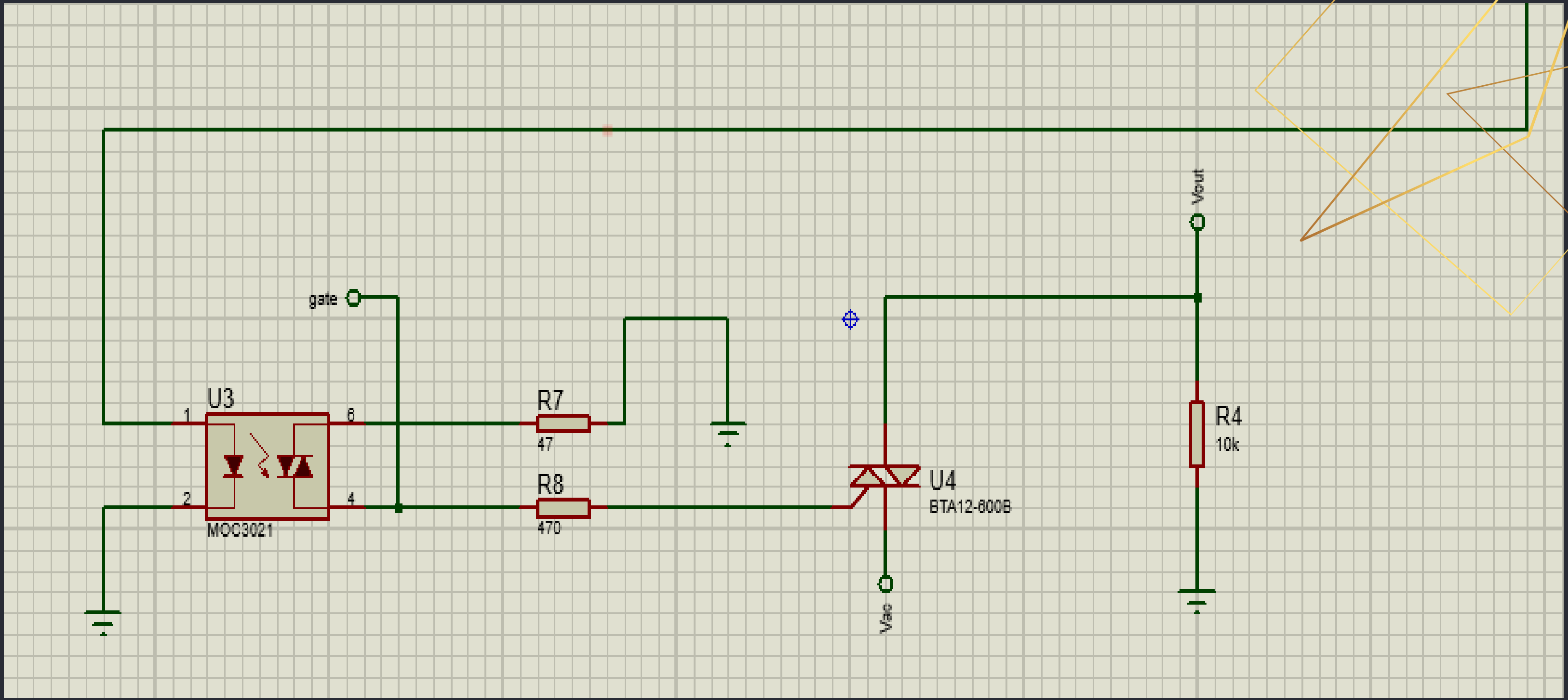
Simulation

555 Timer , Pulse Generation & Amplification with BJT



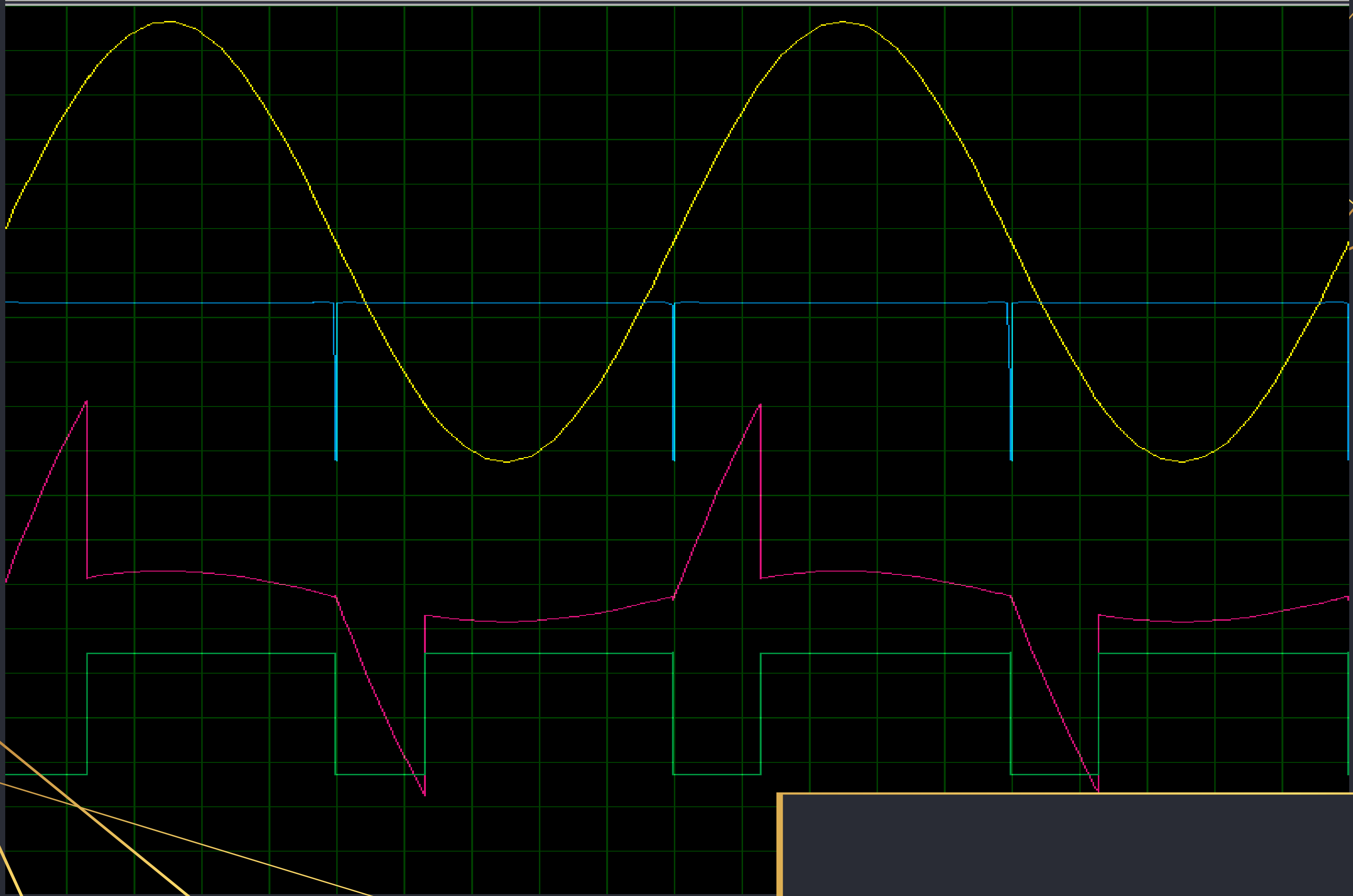
Output

555 Timer , Pulse Generation &
Amplification with BJT



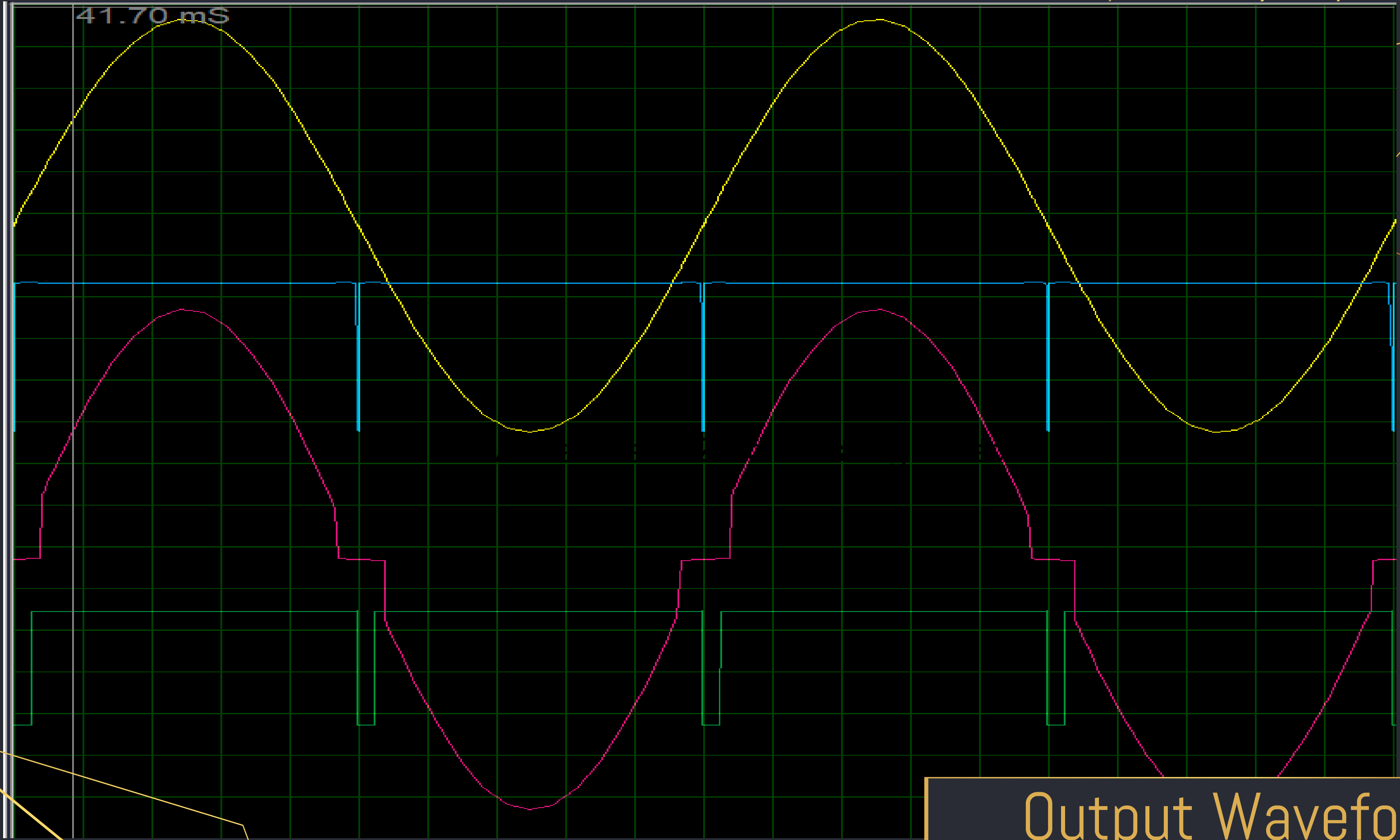
Simulation

TRIAC Driver



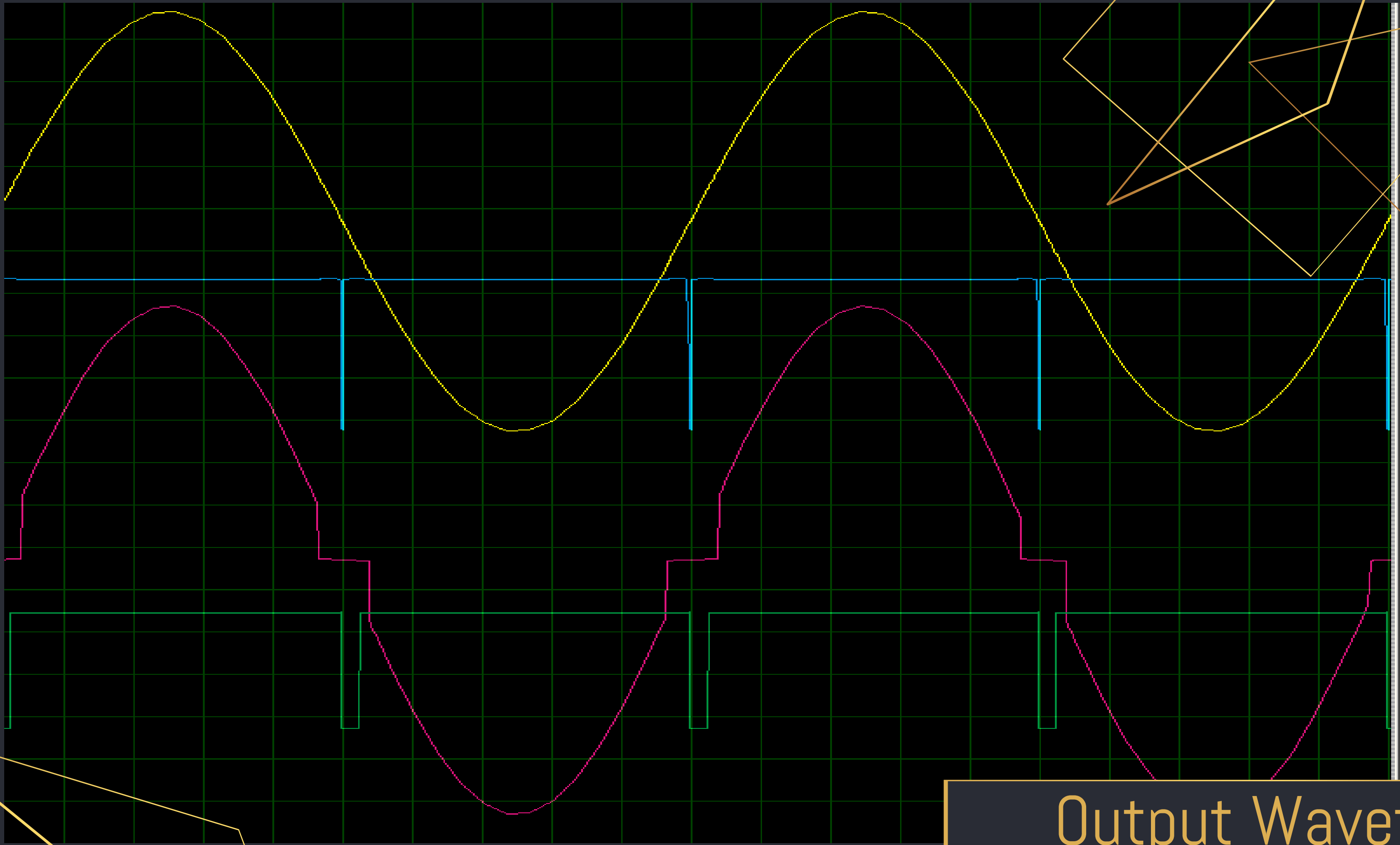
Output

TRIAC Driver



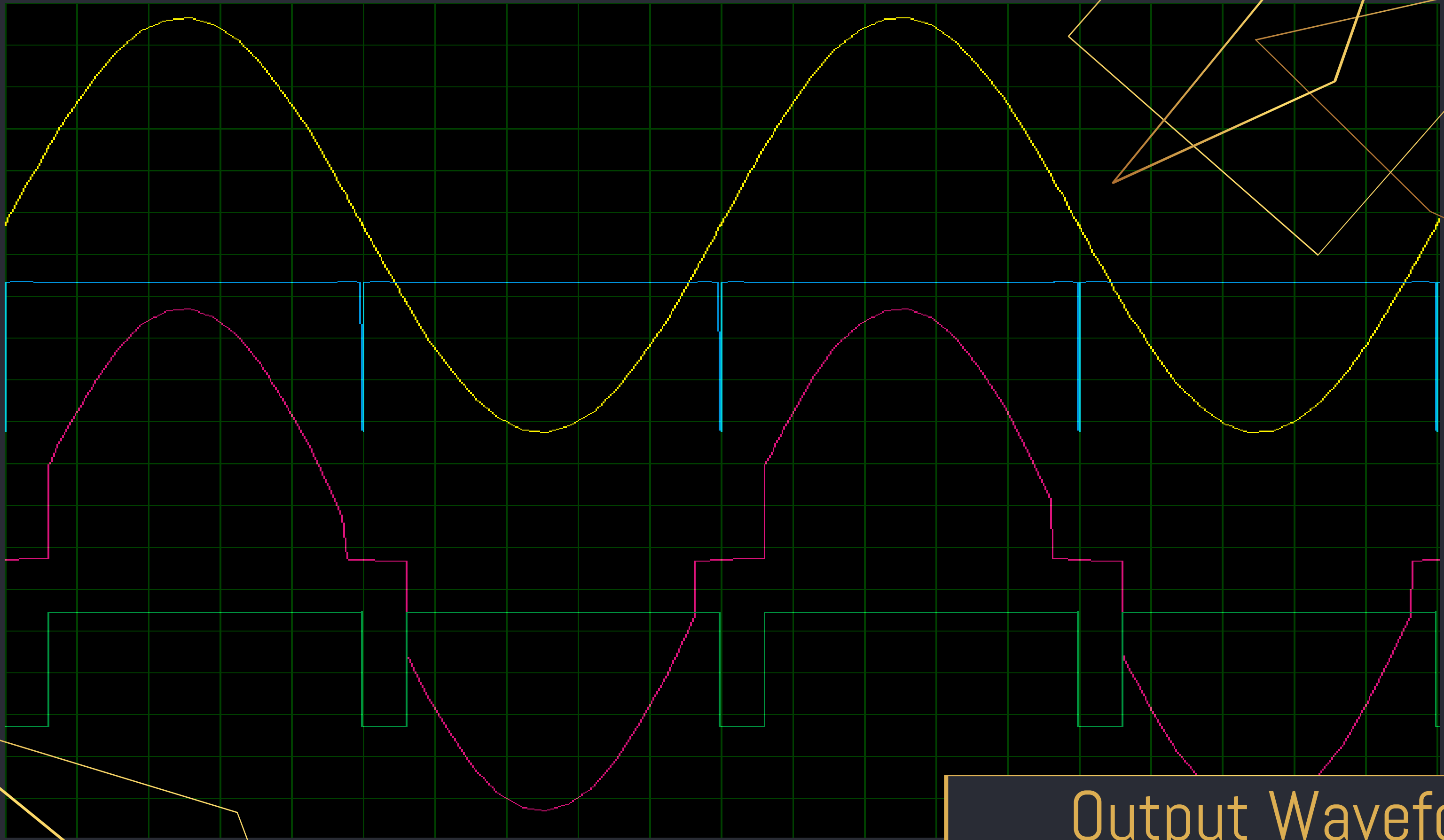
Output Waveform

Varying Duty Cycle



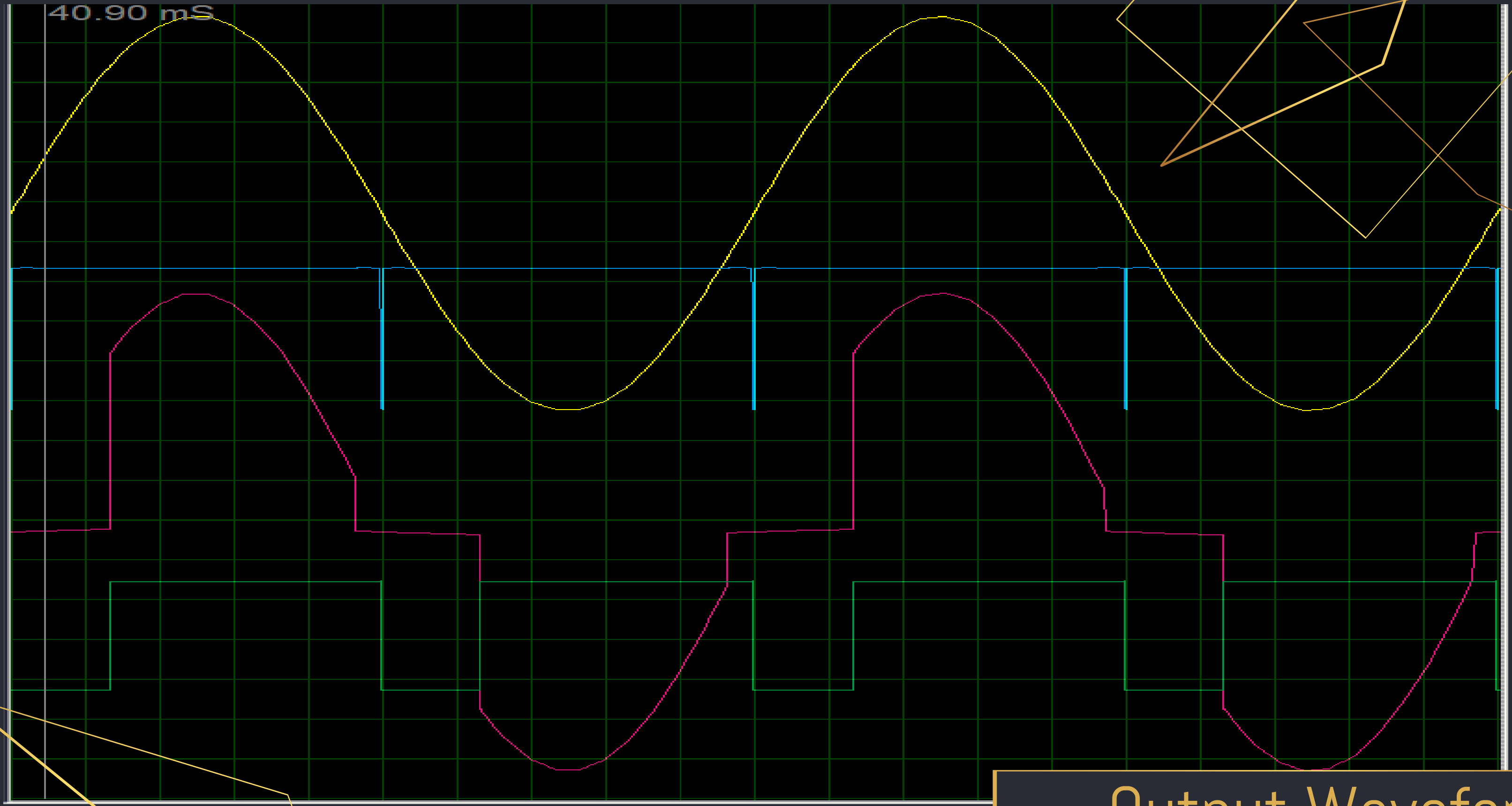
Output Waveform

Varying Duty Cycle



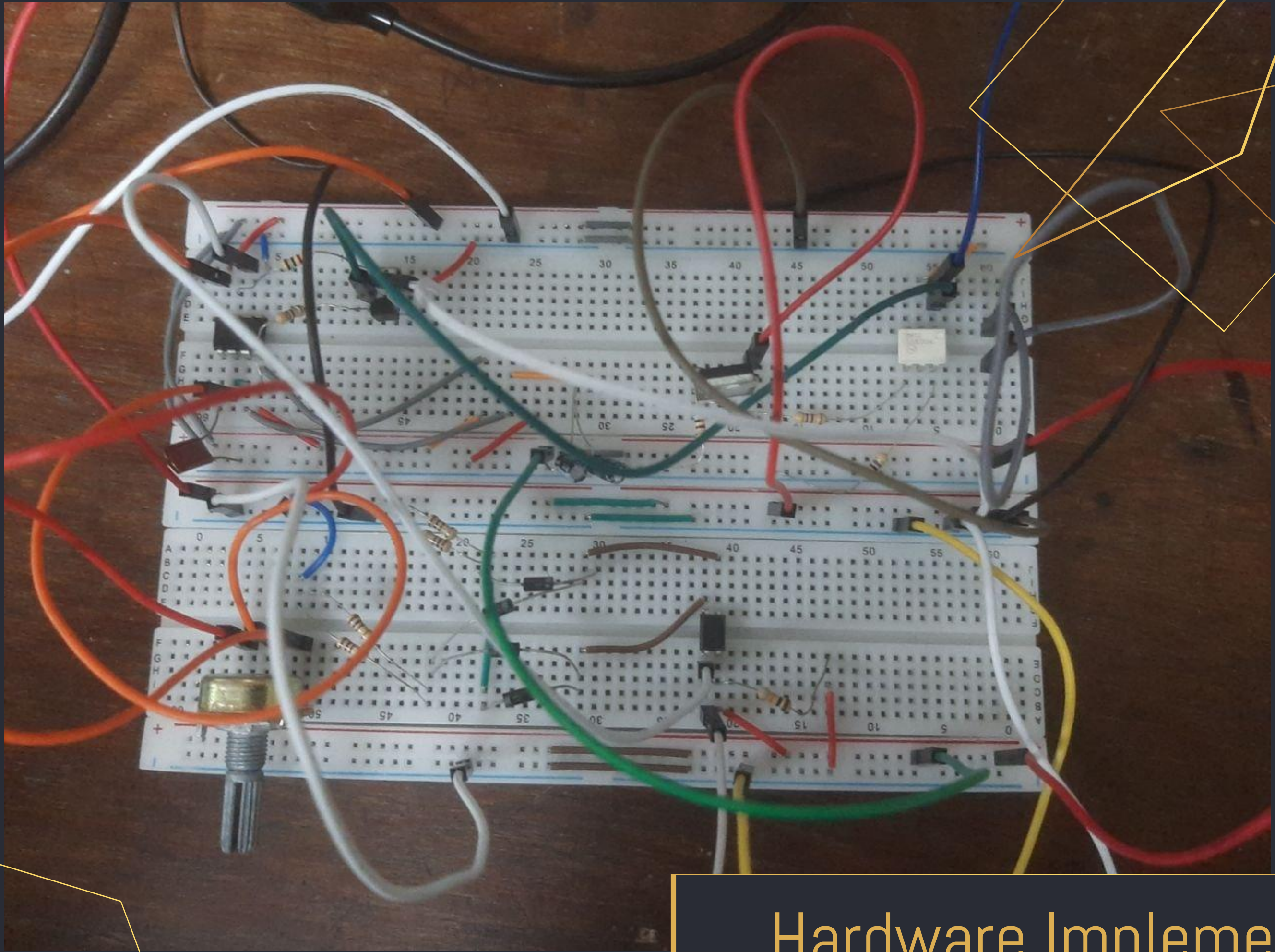
Output Waveform

Varying Duty Cycle

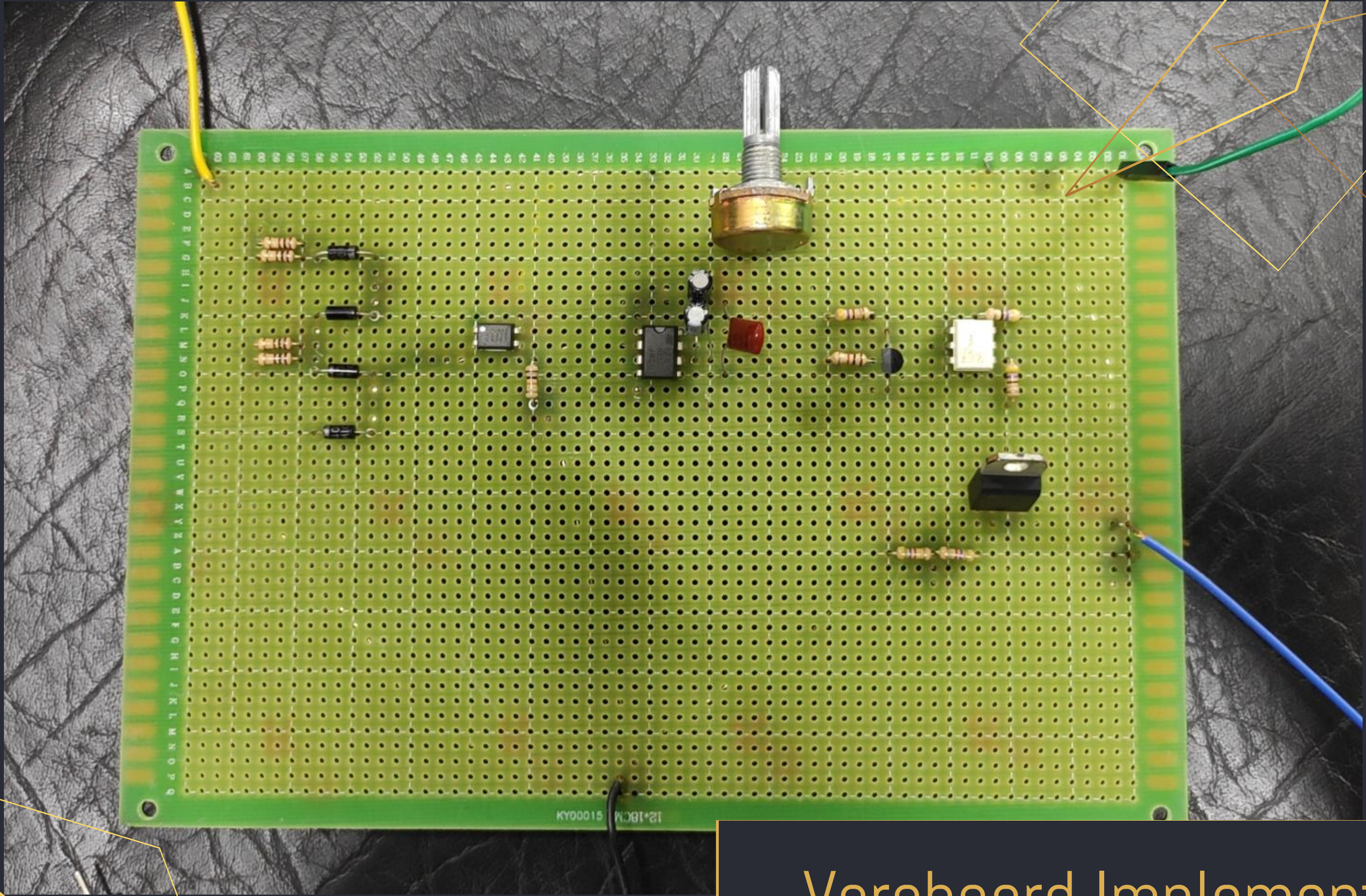


Output Waveform

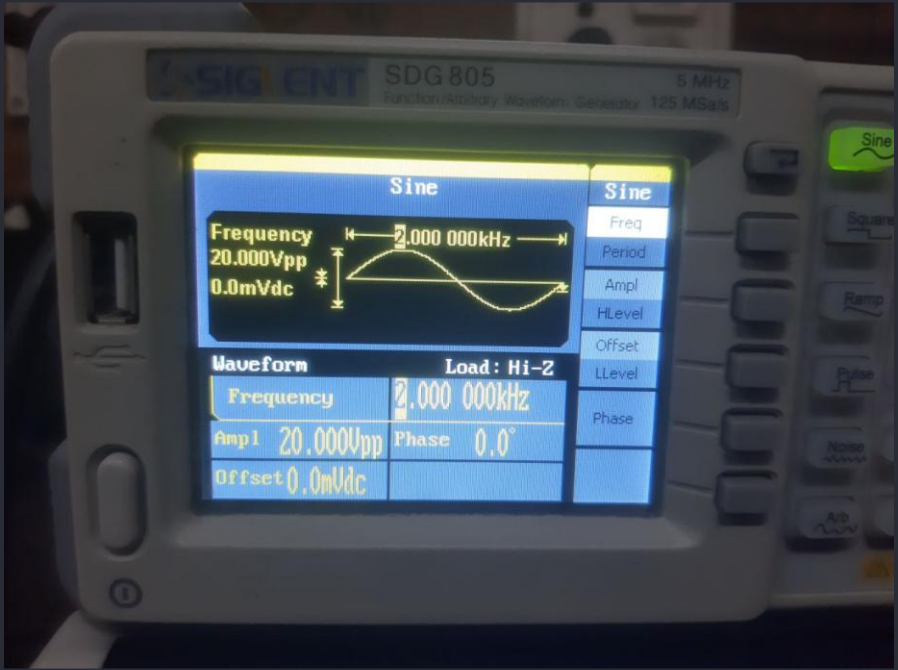
Varying Duty Cycle

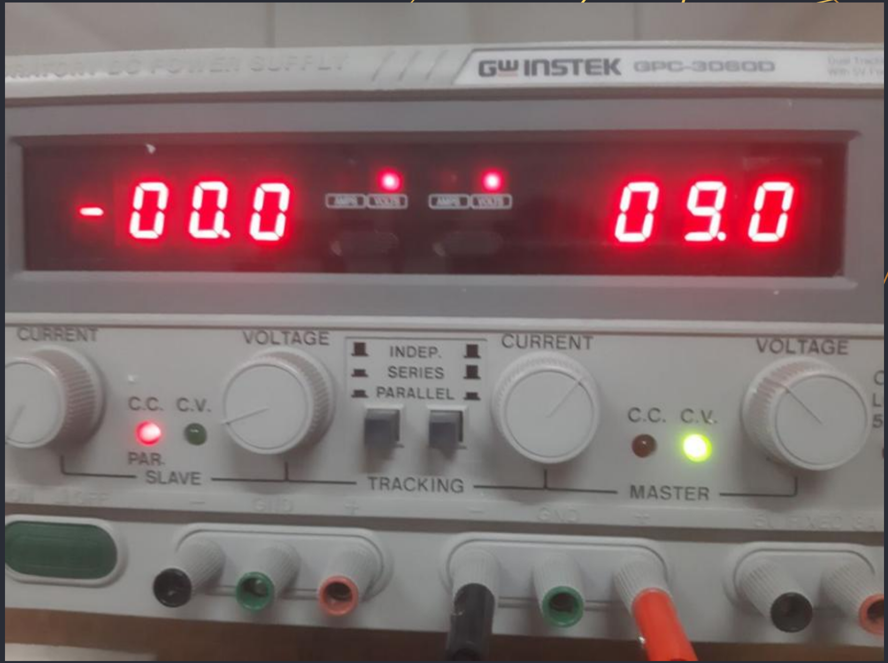


Hardware Implementation

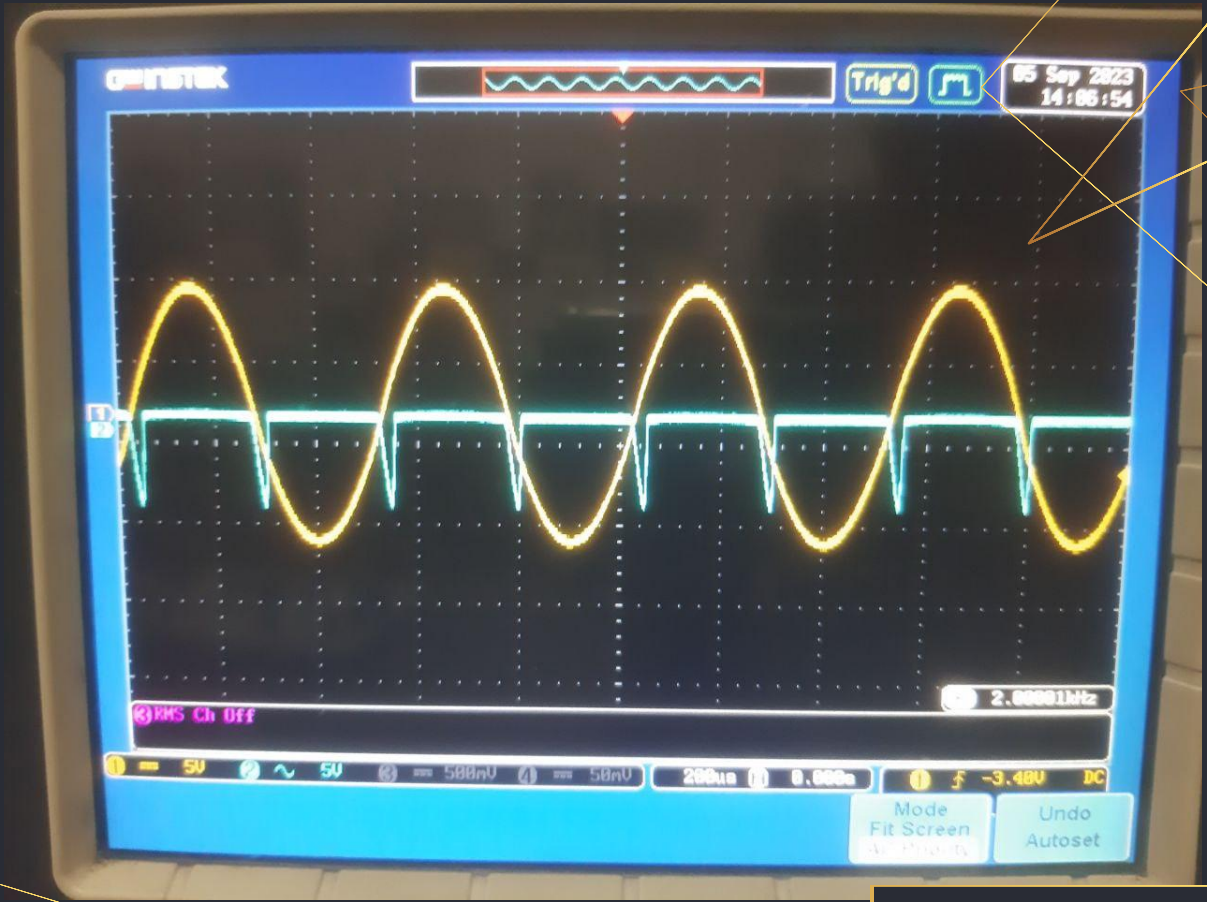


Veroboard Implementation



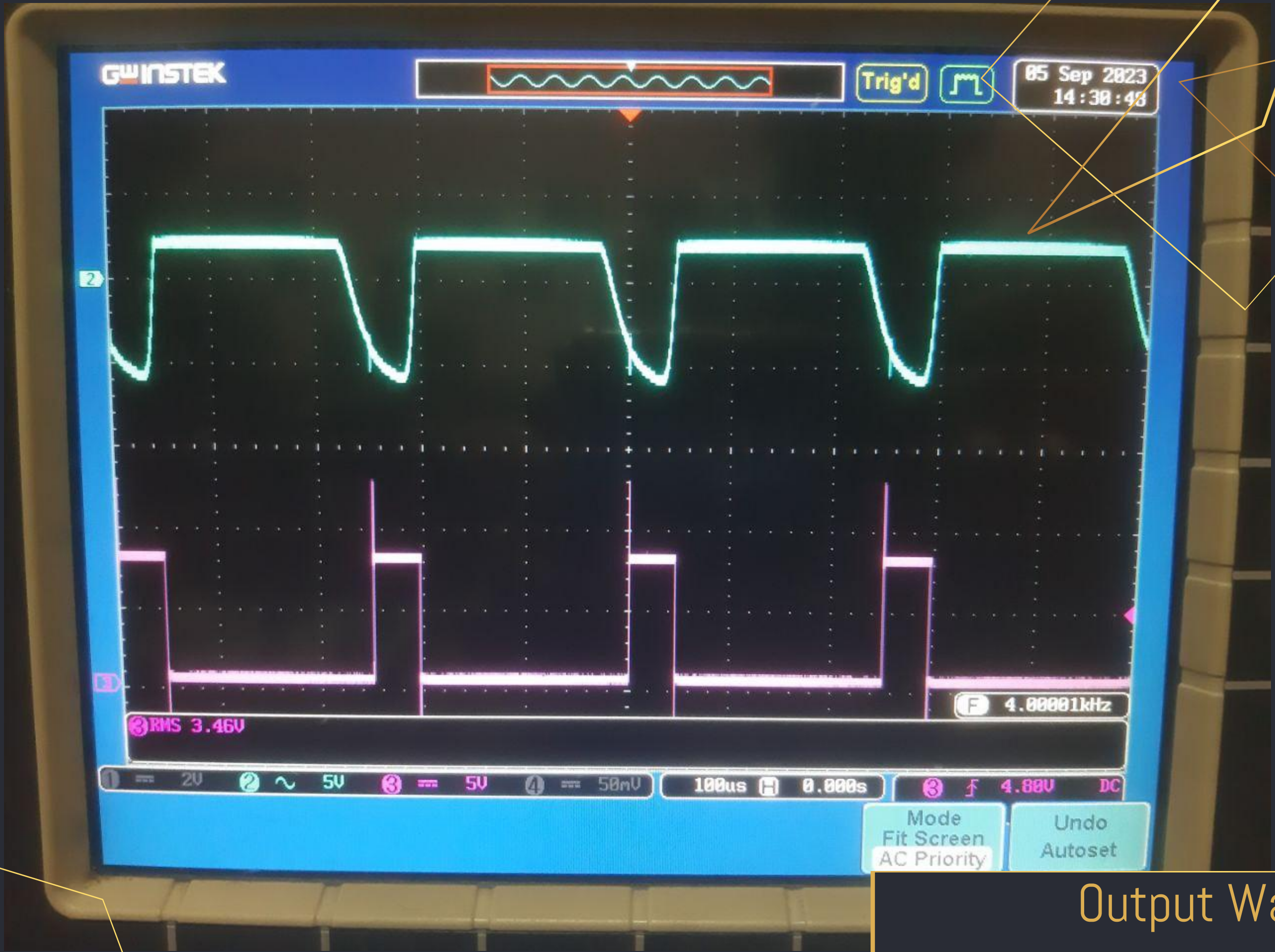


Power Supply



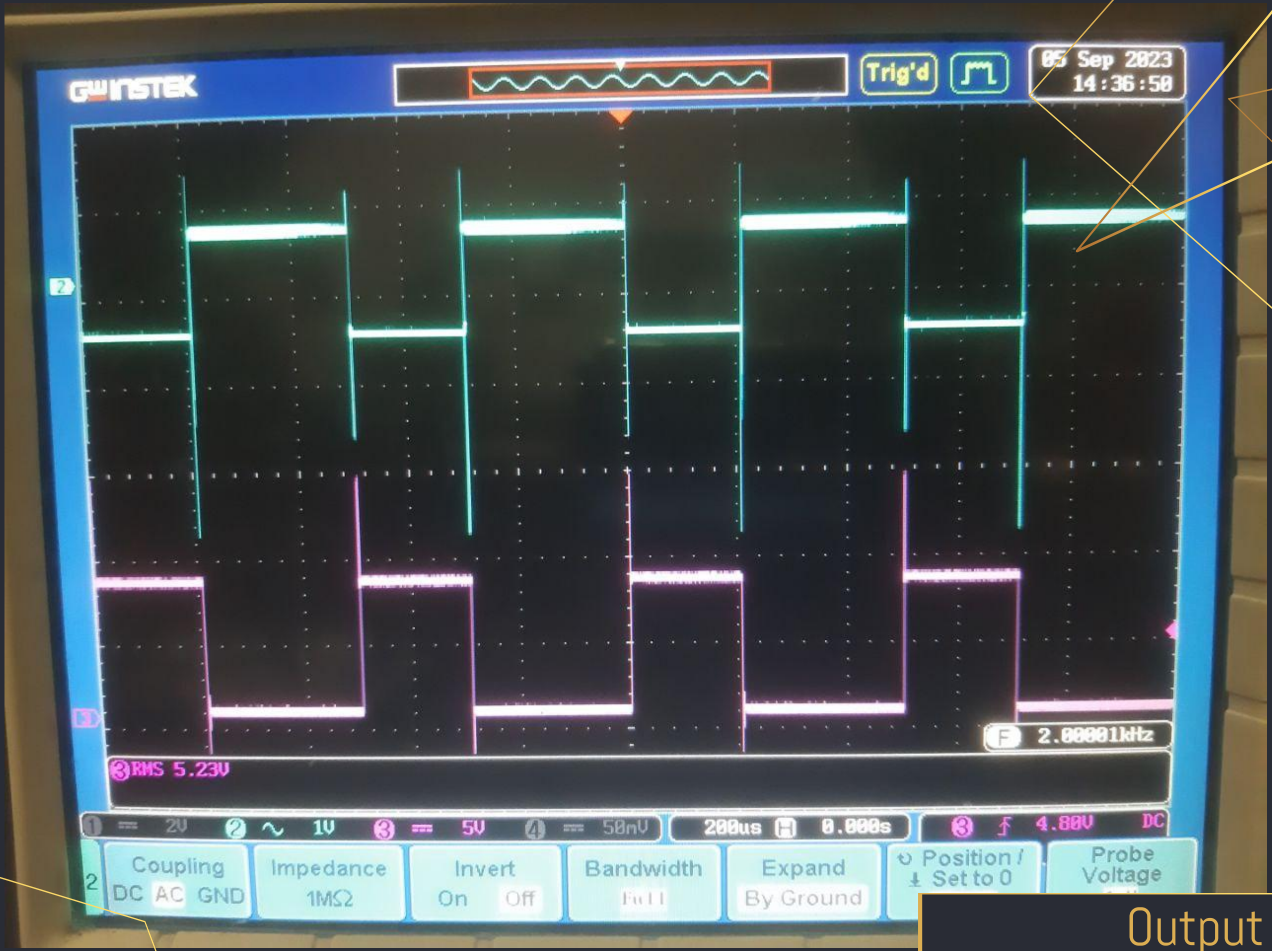
Output Waveform

Zero Crossing



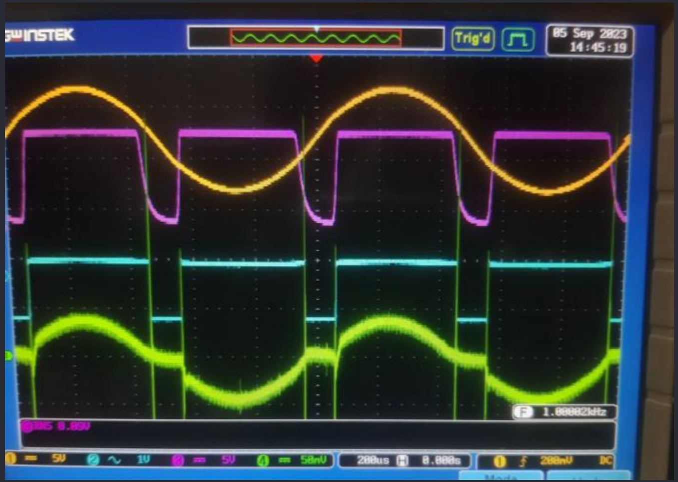
Output Waveform

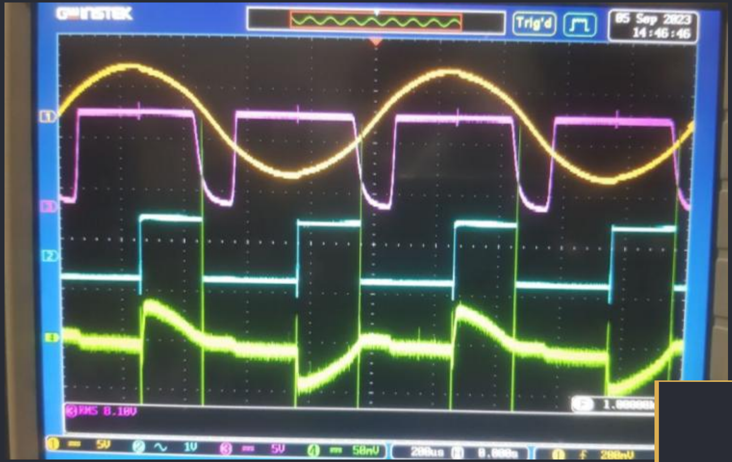
555 Timer



Output Waveform

BJT





Output Waveform

TRIAC Driver

Cost Analysis

1.	Breadboard	390 × 3	= 1170/-
2.	Jumper Wire	80 × 1	= 80/-
3.	Diode D1N4007	20 × 1	= 20/-
4.	Resistors : 47, 100, 470, 1k, 10k	1 × 50	= 50/-
5.	Potentiometer : 20k	1 × 30	= 30/-
6.	Capacitors : 0.01 μF, 0.1 μF	55	= 55/-
7.	Octocoupler : PC 817, MOC 3021	200+40	= 240/-
8.	555 Timer NE555	10 × 8	= 80/-
9.	TRIAC BTA-12 600B	20 × 8	= 160/-
10.	Veroboard	180 × 2	= 360/-
11.	Stapler Wire	150 × 2	= 300/-
		Total	= 2545/-

Corrections & Adjustments

- Frequency Adjustment
- Amplitude Adjustment
- Resistance Adjustment

Scalability

1. **Modular design**
   The components used in our project such as the TRIAC, 555 timer, BJT, and optocoupler are standard electronic components that are widely available in various specifications. This means we can scale our project by using components with different ratings to handle different power levels.

2. **Load Handling Capacity**
   The project can be scaled up by selecting TRIACs and associated components with higher voltage and current ratings. This allows the system to control larger loads or work with higher-power applications while maintaining the same control principle.

3. **Multi-Load Control**
   It can extend the design to control multiple loads simultaneously. By replicating the phase angle control circuitry and using additional optocouplers, BJTs, and TRIACs, you can manage several loads independently, making the system adaptable to various scenarios

Scalability

4. ## Software Control

The phase angle control method we used is a software-controllable process. This means you can easily adjust the control algorithm or use more advanced control strategies to improve the performance or add more features to your project

5. ## Integration with Other Systems

Our project can be easily integrated with other systems or projects. For example, it can be used as a part of a larger power management system or smart grid system

Sustainability

Energy Efficiency

Reduces energy wastage , contributing to a more efficient use of electrical power

Resource Conservation

Contributes to resource conservation by preventing unnecessary energy waste

Longevity and Durability

We prioritize design practices that promote the longevity and durability of your project

Applications

Light Dimming

It allows variable brightness level by adjusting the power delivered to the lamps

Heating System

The amount of heat generated can be controlled to maintain a desired temperature

Motor Speed Control

Controls the speed of AC motors like conveyor belts, fans & pumps

Temperature Control in Industry

It can be used for precise temperature control in industrial process like chemical reactors and plastic extrusion machine

Power Factor Correction

We can use it to reduce reactive power and improve overall system efficiency

Applications

Electric Vehicle Charging

It can be used to adjust the charging rate ensuring efficient & controlled charging

Welding Equipment

It helps control the heat generated during the welding process

HVAC system

Heating, ventilation and air conditioning systems can benefit from phase angle control for precise temperature and airflow control

Induction Heating

In the process of induction hardening and melting, it is used to precisely control the power supplied to induction coil

AC Voltage Regulators

These regulators help maintain a stable output voltage in the presence of varying input voltage conditions

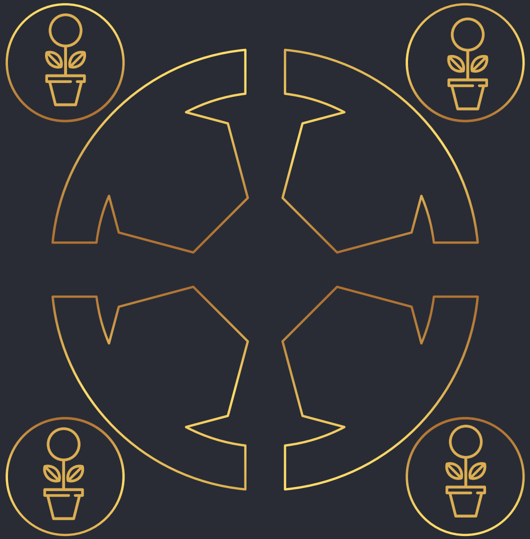
Environmental Impact

Energy Efficiency

Reduces energy consumption, especially in industries with high energy consumption

Reduced Emissions

Helps optimizing energy usage leading to lower greenhouse gas emission



Power Quality

Improved power quality can reduce electrical disturbance in the grid

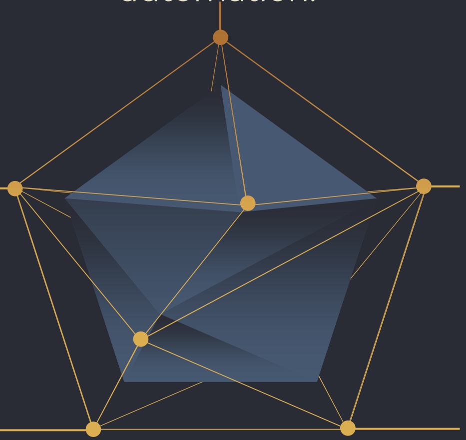
Renewable Energy Integration

Can be used to match the power generated by renewable energy sources

Social Impact

Job Creation

The deployment and maintenance of phase angle control systems can create job opportunities in industries related to power electronics, control systems, and automation.



Cost Saving

cost savings for consumers potentially reducing energy bills and improving affordability.

Electricity Access

In regions where electricity access is limited or unreliable, phase angle control can be used to stabilize and regulate power supply

Technological Advancement

contribute to technological advancements in the field of power electronics and control systems

Noise Pollution

In some applications phase angle control can reduce noise levels in industrial settings, which can have a positive impact on the working environment and nearby communities.

THANKS!

Do you have any questions?