BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

Department of Electrical and Electronic Engineering

Course No: EEE 316

Course Title: Power Electronics Laboratory

Project Name—

IR Controlled TRIAC Dimmer Circuit

Submitted By— **Lab Group 6 (1906168, 1906175, 1906176, 1906179, 1906190)**

Section C2 , Level 3, Term 2

Submitted to—

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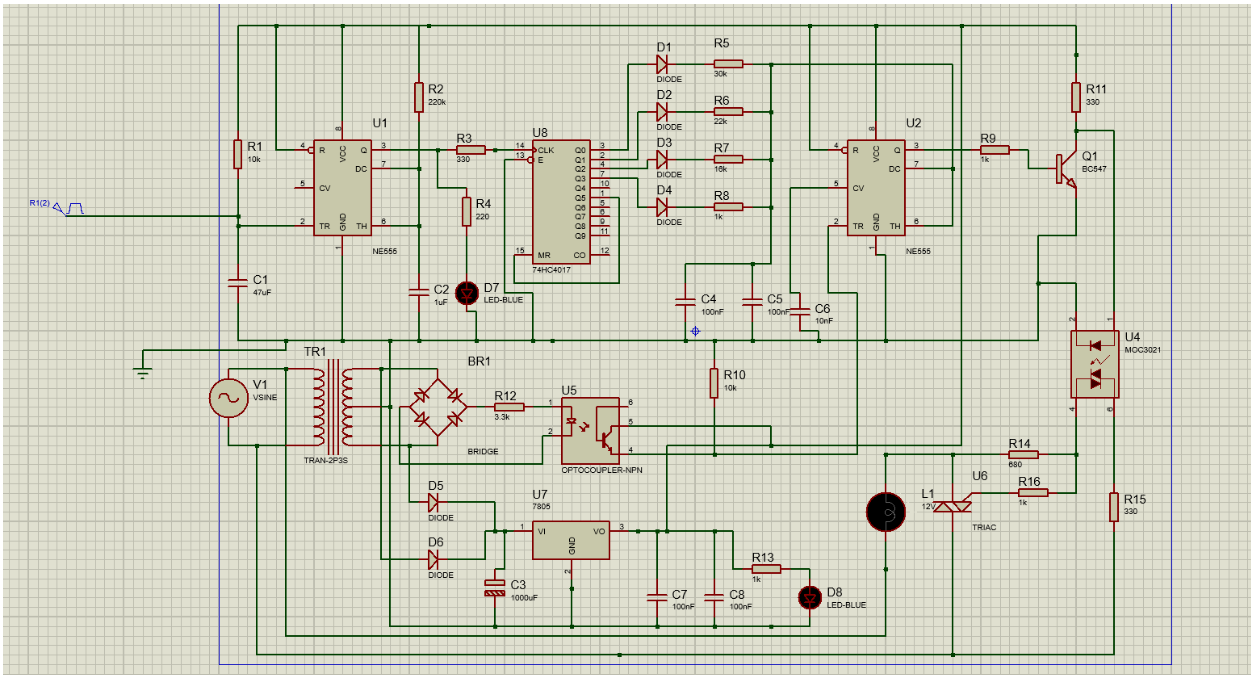
Objective:

To make a TRIAC dimmer circuit for AC appliances without using any microcontroller.

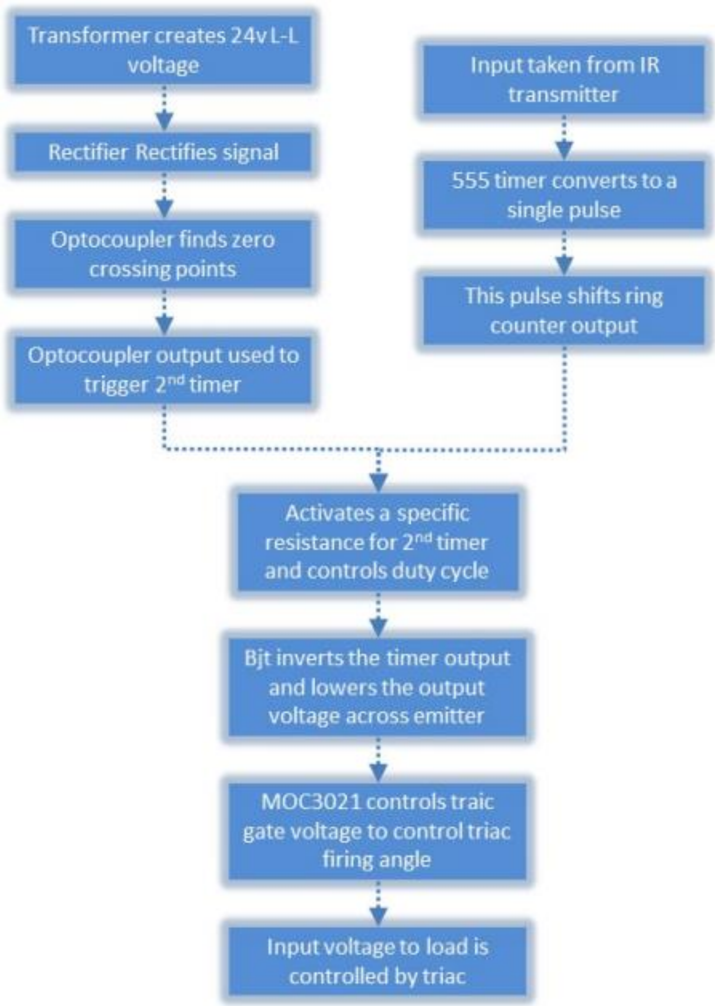
Components:

- TSOP1738 -1
- 555 timer IC -2
- CD4017 -1
- MCT2E Optocoupler -1
- MOC3021 TRIAC Driver -1
- LM7805 -1
- BT136-1
- BC547 Transistor -1
- 12-0-12 Transformer -1
- 1n4007 Diode -10
- Capacitor 1000uF, 1uF, 4.7uF, 0.01uF, 0.1uF (4)
- Resistor 10K (2), 1k (3), 220k, 22k, 15k, 3.3k, 220ohm, 680, 330 (3)
- LED

Circuit Diagram:



Flow Chart



Transformer creates 24v L-L voltage
Rectifier Rectifies signal
Optocoupler finds zero crossing points
Optocoupler output used to trigger 2nd timer
Input taken from IR transmitter
555 timer converts to a single pulse
This pulse shifts ring counter output
Activates a specific resistance for 2nd timer and controls duty cycle
Bjt inverts the timer output and lowers the output voltage across emitter
MOC3021 controls traic gate voltage to control triac firing angle
Input voltage to load is controlled by triac

Description and Proteus simulation:

TSOP1738 and first 555 timer IC:

When the TSOP1738 gets an IR signal, it triggers the first 555 timer which is connected in monostable multivibrator mode. This Multivibrator is used for generating a single pulse every time when we press any of button on the remote control. Output of the timer is used as clock pulse for the CD4017 counter.

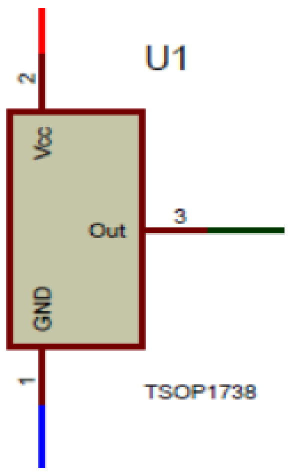


Fig: IR Receiver

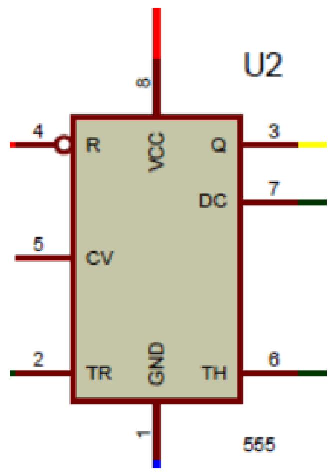


Fig: 555 timer

CD4017 counter:

Out of the ten outputs of decade counter (Q0 through Q9), only four (Q0 through Q4) are used to control the AC load. Q5 output is used to reset the counter. Here it is used for changing the Time Period of next 555 timer in Monostable Multivibrator by changing its timing Resistor value.

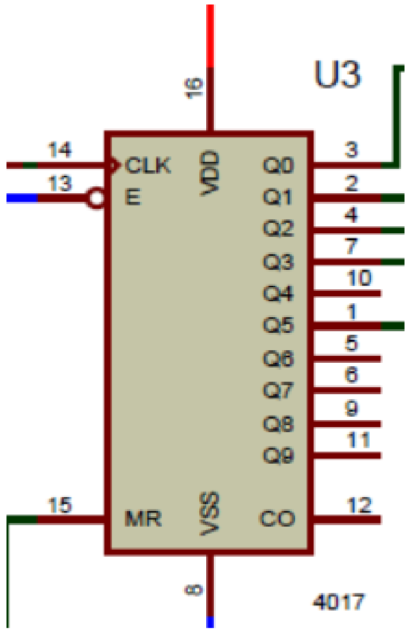


Fig: CD4017 counter

Second 555 timer:

This is also set at monostable multivibrator mode. With the help of capacitor and the selected resistance, this multivibrator generates an output pulse at its output pin for fixed time period, whenever trigger pin goes low. Multivibrator trigger pin will wait for zero crossing pulse coming from MC2TE optocoupler.

12-0-12 Transformer:

This transformer is used to convert 220V (L-N) ac to 12V (L-N) ac signal so that IC don't get high voltage. These ICs do not work at higher voltages.

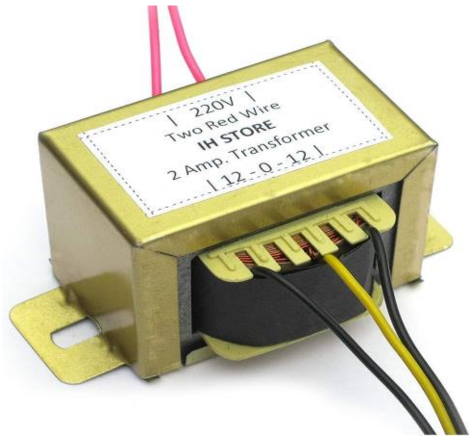


Fig: 12 – 0 - 12 transformer

MC2TE optocoupler:

Optocoupler MCT2E is wired as a zero-crossing detector that supplies trigger pulses to the second monostable multivibrator (555 timer) during zero crossing. This optocoupler is driven by a full bridge rectifier.

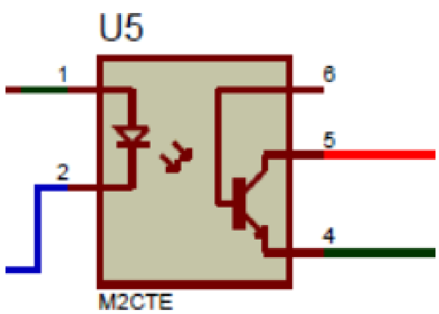


Fig: MC2TE optocoupler

BC547 Transistor:

BJT is used to convert the output of second 555 timer output to lower voltage. The base voltage is given from 555 timer output and it drives the BJT and the emitter to ground voltage is used as input for MOC3021 optocoupler. BJT inverts the output from second 555 timer.

MOC3021 optocoupler:

It drives the TRIAC BT136. It applies the gate pulse for firing the TRIAC.

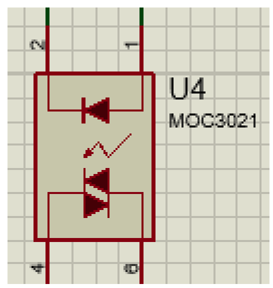


Fig: MOC3021 optocoupler

TRIAC (BT136):

Triac is driven by the voltage of MOC3021. When input of the gate signal of Triac is high then it passes positive cycle of ac input and rejects negative part. And when Triac voltage is low then it passes negative part and rejects positive part. Controlling the Triac shooting angle output of Triac can be controlled. The outputs are given at the last end of the report where we will see that it is giving 0 voltage because at that time Triac was off. So, controlling on and off time input of load can be controlled and fan regulation can be done.

<u>**Simulation Result from Proteus:**</u>

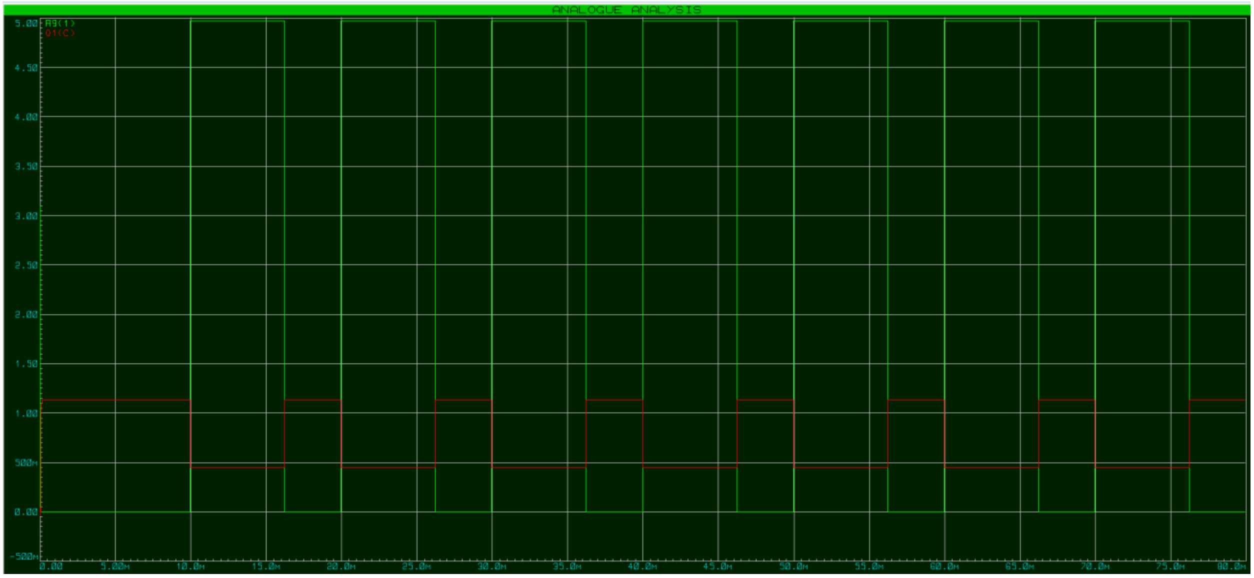


Fig: 2^{nd} timer output (green) & collector of BJT (red)

When diode D1 is on:

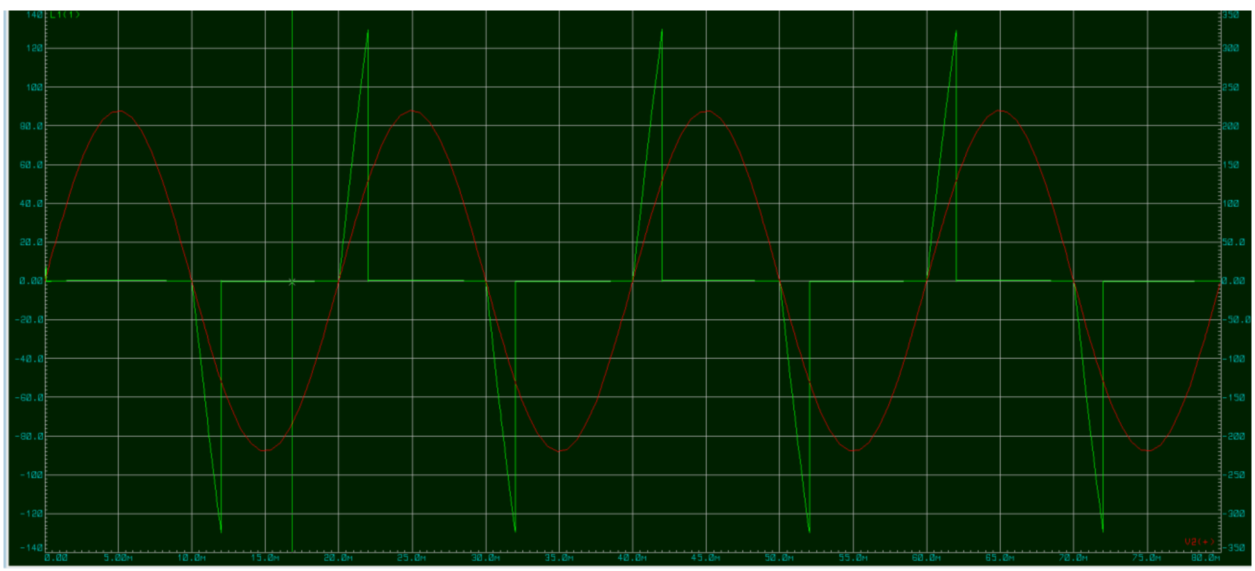


Fig: source sine wave (red) & output sine wave (green)

When diode D2 is on:

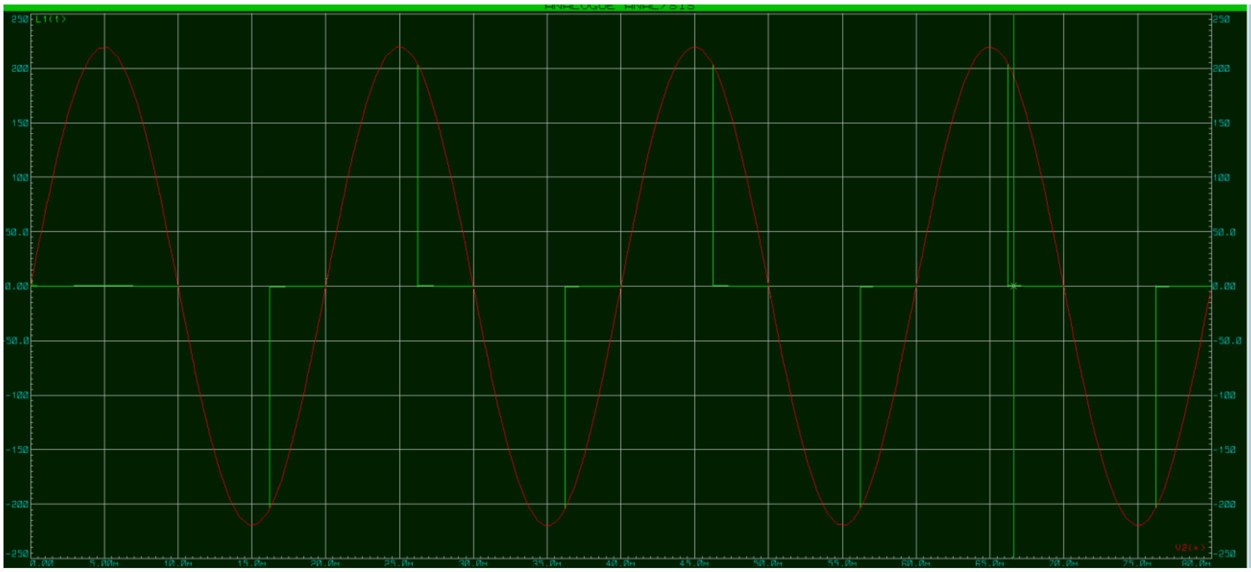


Fig: source sine wave (red) & output sine wave (green)

When diode D3 is on:

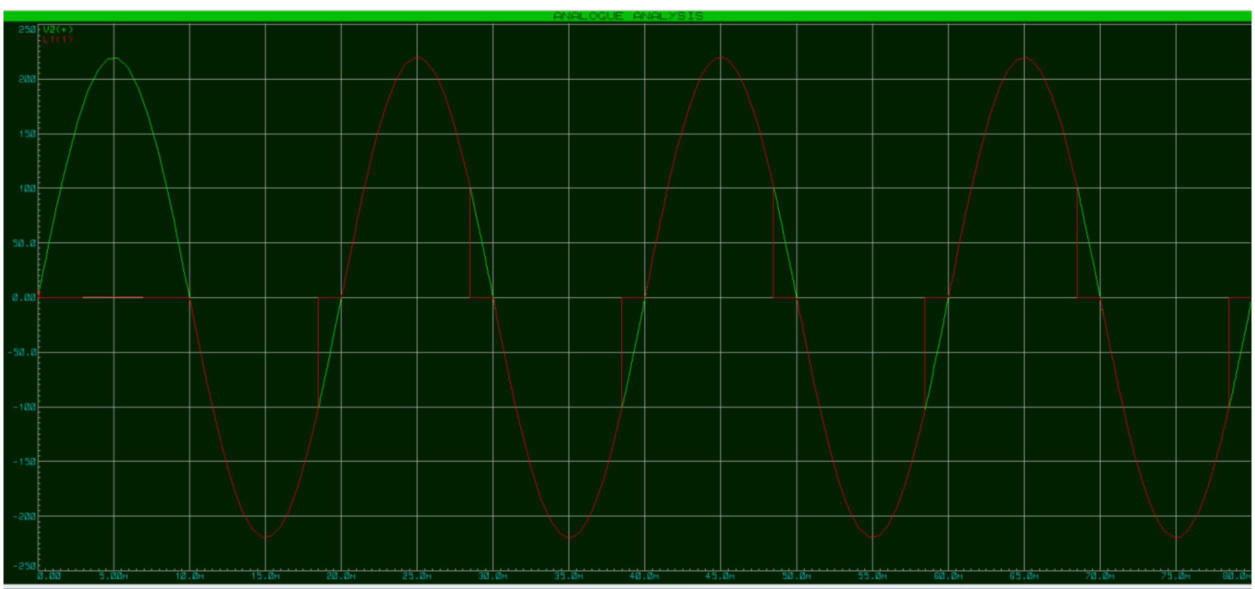


Fig: source sine wave (green) & output sine wave (red)

When diode D4 is on:

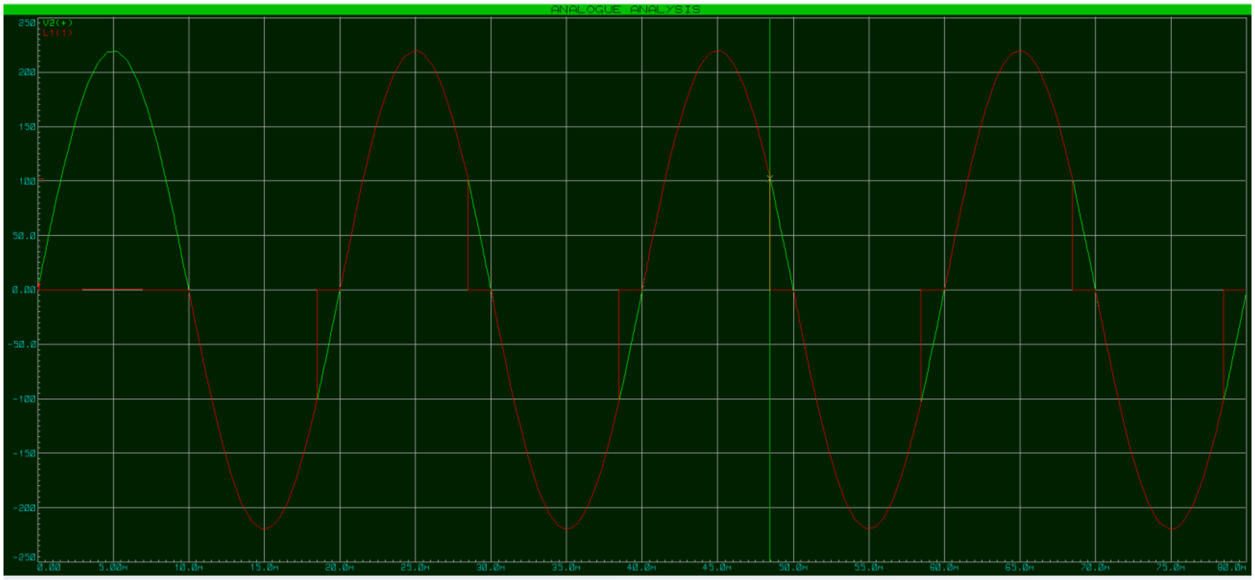


Fig: source sine wave (green) & output sine wave (red)

Off Condition:

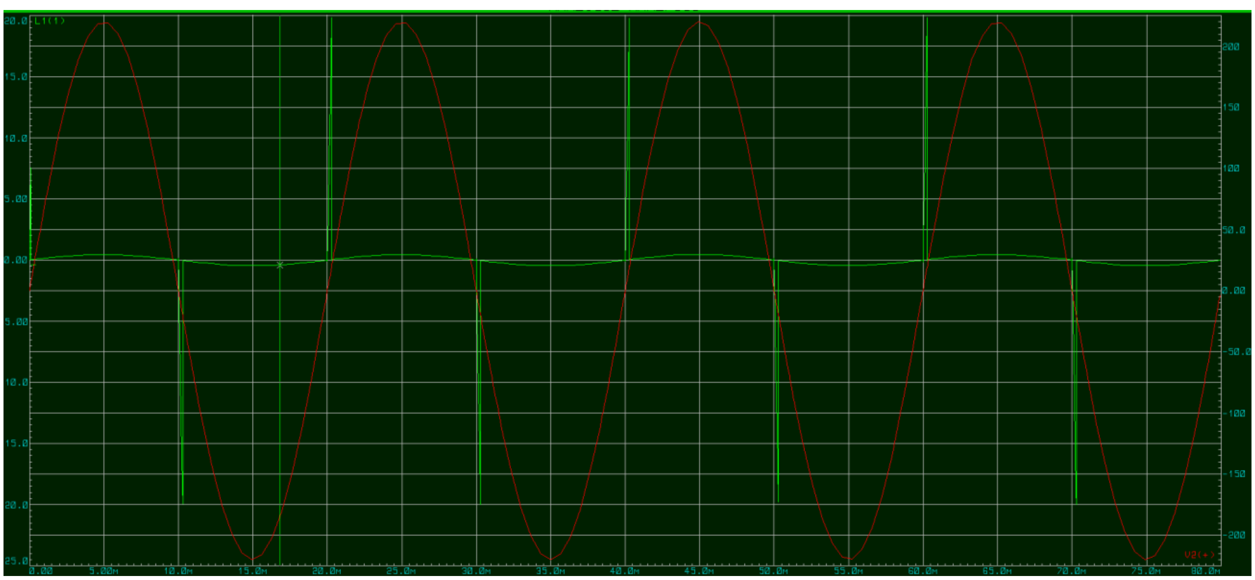


Fig: source sine wave (red) & output sine wave (red)

Oscilloscope Output:

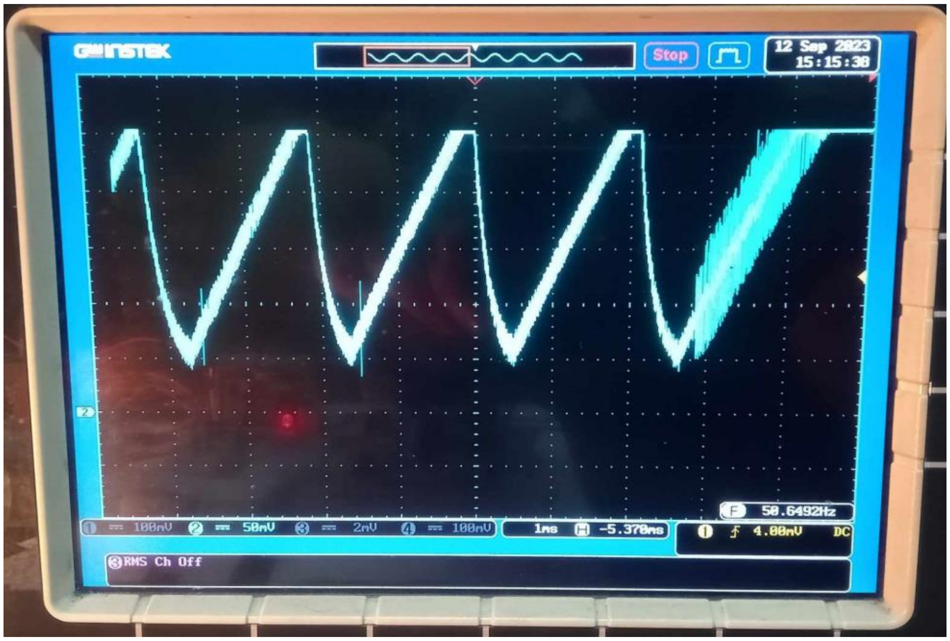


Fig: Output from IR receiver

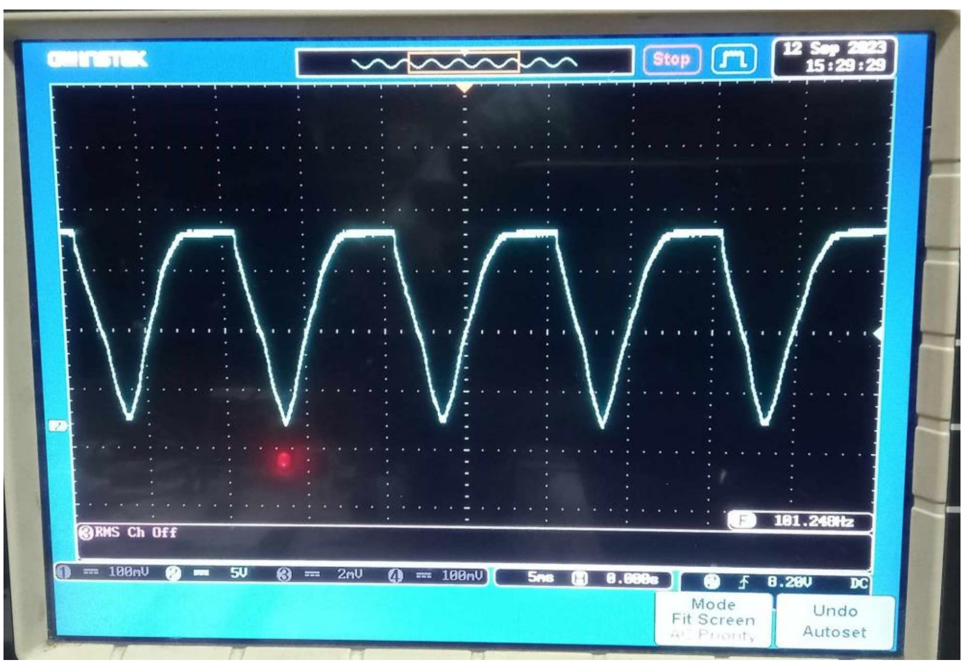


Fig: Output from full-bridge rectifier

Fig: Optocoupler zero-crossing output

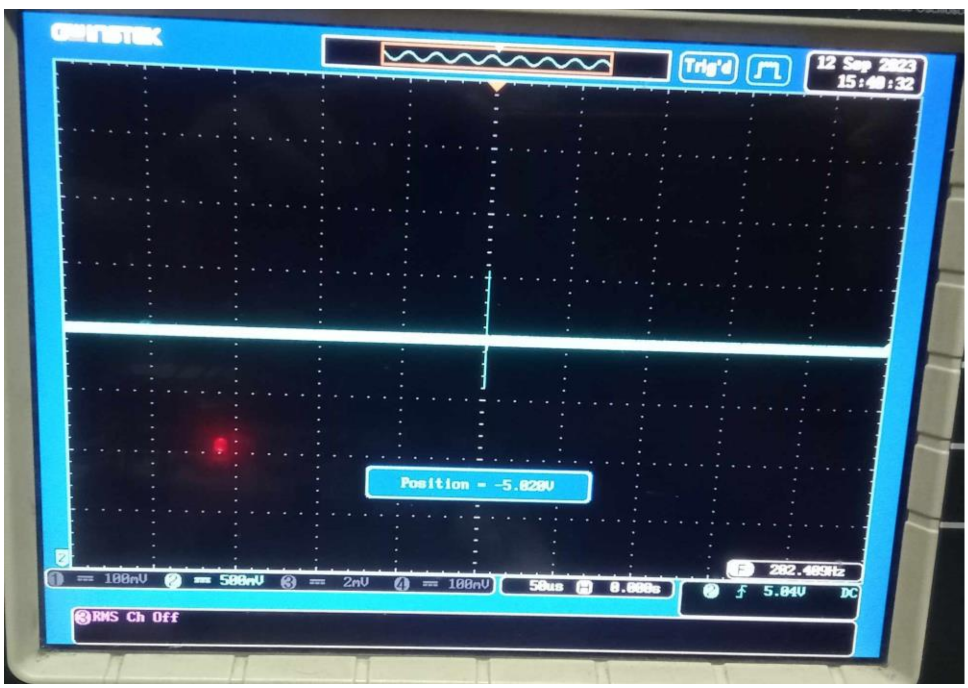


Fig: Output from voltage regulator 7808

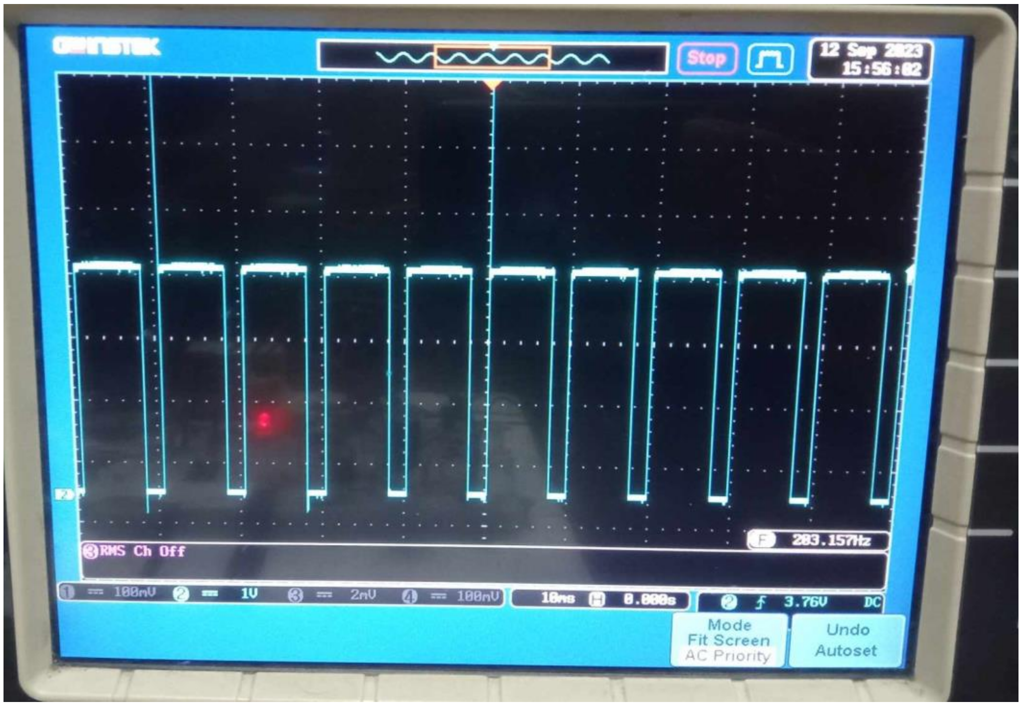


Fig: Output from 2nd 555 timer for 7ms

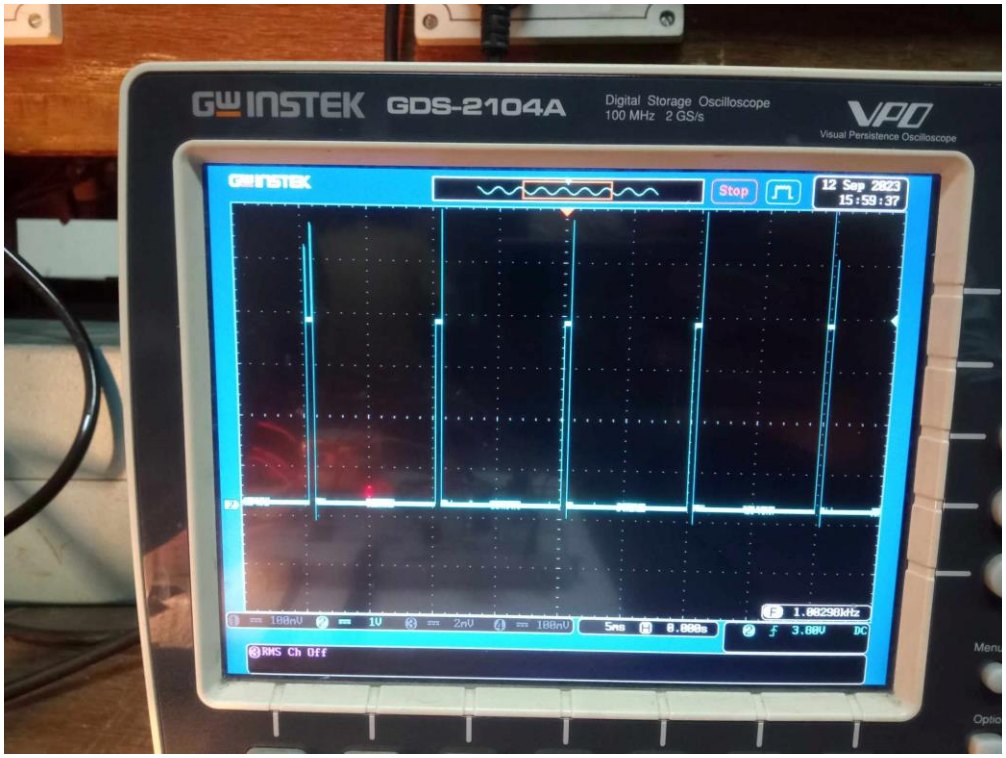


Fig: Output from 2nd 555 timer for 1ms

Applications of Our Project:

Environmental Applications:

Our light intensity controller circuit is a device that we can use to automatically adjust the brightness of a light source according to the surrounding environment or a predefined set point. As such this project can render great environmental applications. The most notable environment-based application of this project can be **Greenhouse Microclimate Monitoring and Control**. A light-intensity controller circuit can be used to regulate the artificial lighting in a greenhouse according to the natural light conditions and the plant growth requirements. This can improve crop productivity and quality, as well as reduce the energy consumption and greenhouse gas emissions of the greenhouse system.

Furthermore, our project can be used for efficient use of light and thus **save energy and reduce light pollution.** One application of this aspect can be street lighting management. A light intensity controller circuit can be used to dim or switch off the street lights when there is sufficient ambient light or low traffic volume. This can save electricity and maintenance costs, as well as prevent glare and light trespass for drivers and residents.

Social Applications:

Our project light intensity controller circuit can have a wide range of social applications as well. Some notable applications are as follows:

- **Improving public safety and security:** A light intensity controller circuit can be used to provide adequate and adaptive lighting for public places such as roads, parks, parking lots, etc. This can improve visibility and reduce the risk of accidents, crimes, and vandalism.
- **Enhancing user comfort and satisfaction:** A light intensity controller circuit can be used to customize the lighting level according to the user's preference or activity. This can create a more pleasant and relaxing atmosphere for the user, as well as reduce eye strain and fatigue.
- **Certain Professions:** Appropriate light adjustment can be necessary for people of certain professions. For example, photography and videography, people working in the medical sector etc.

- **Promoting social awareness and responsibility**: A light intensity controller circuit can be used to demonstrate the importance of energy conservation and environmental protection. By using less electricity and reducing light pollution, the user can contribute to the social welfare and sustainability

Practical Considerations of Our Project:

While preparing our project, no hazardous chemical or substance has been used. Also, there are no risks of emission of harmful gases. Furthermore, we are powering a direct AC supply, not from any DC batteries. So, there are no risks of incurring harm to the environment through disposal of used-up batteries. So, we can say our project is safe to get the green signal from **environmental considerations.**

Also, the overall cost of our project has been very much temperate. So our project can be available for use for the people of social levels. So it can be said that our project adheres to **social considerations** as well.

Evaluation of Sustainability:

Our project has shown very stable outputs in every run of our project. Despite using a high-voltage AC supply, our circuit hasn't shown any signs of wearing and tearing. Also, none of the components has been found to be damaged. Rather all of them have been functioning properly as per theory. So we can say that our project is **sustainable.**

Further Work:

Our project is currently capable of increasing the light intensity up to four stages. There is unfortunately no provision for reducing the light intensity. However, since the decade counter can give outputs from 0 to 9, we can rearrange our setup to increase the light intensity in ten stages. We can also arrange provisions to decrease light intensity. All of these can be done with just some small additions to our current project circuit.