TEE 401 Electronic Manufacturing

Mini Project

DC to AC Inverter Circuit

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Bachelor of Technology Honors in Electronic

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1. Introduction

Electricity can be classified into two types that is alternating current (AC) and direct current (DC). AC current alternates its direction periodically between positive and negative cycles and is commonly used to power homes and businesses through power lines. The frequency of AC current usually ranges from 50 to 60 Hz depending on the country. Due to its ability to travel long distances with minimal power loss, AC current is an efficient method of power transmission.

On the other hand, DC current flows only in one direction and maintains a constant polarity. This type of electricity can be found in batteries, electronic devices, and vehicles. Unlike AC current, DC current does not change its direction periodically. However, it is less efficient than AC current for long distance transmission due to higher power losses.

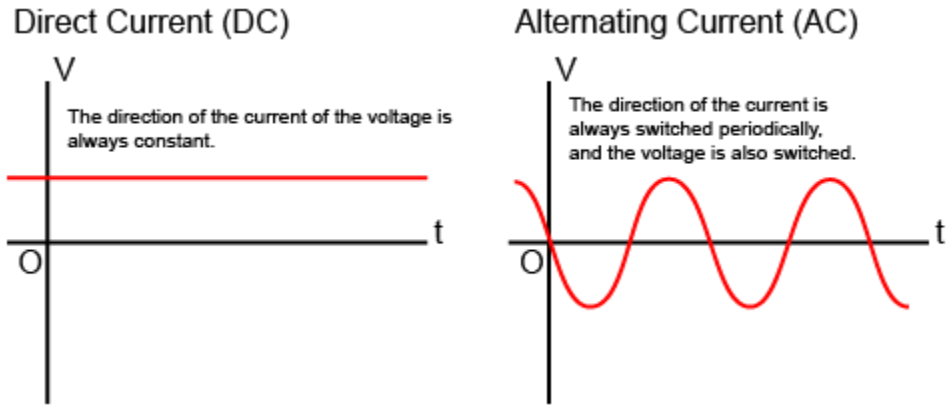

Figure 1

i) What is inverter?

A DC to AC inverter is an electronic device that converts DC (direct current) power into AC (alternating current) power that can be used to power AC devices. There are 3 main types of inverters - sine wave, modified sine wave and square wave.

Figure 2

Pure sine wave is the best waveform, as it is the shape of an (ideal) AC electrical signal from the wall. The highest-quality inverters produce a true sine wave output, which requires expensive components in the inverter. True sine wave outputs are normally found only in higher-end models.

Square wave is basic version of a sine wave. Instead of the voltage smoothly increasing from the negative maximum to the positive maximum and back again, it shifts suddenly from negative to positive, stays there for half a cycle, and then jumps to full negative and stays there for half a cycle, then repeats.

A modified sine wave inverter produces a waveform that resembles a square wave with a few extra steps. The modified sine wave is noisier and rougher than a pure sine wave, causing clocks and timers to run faster or not work at all.

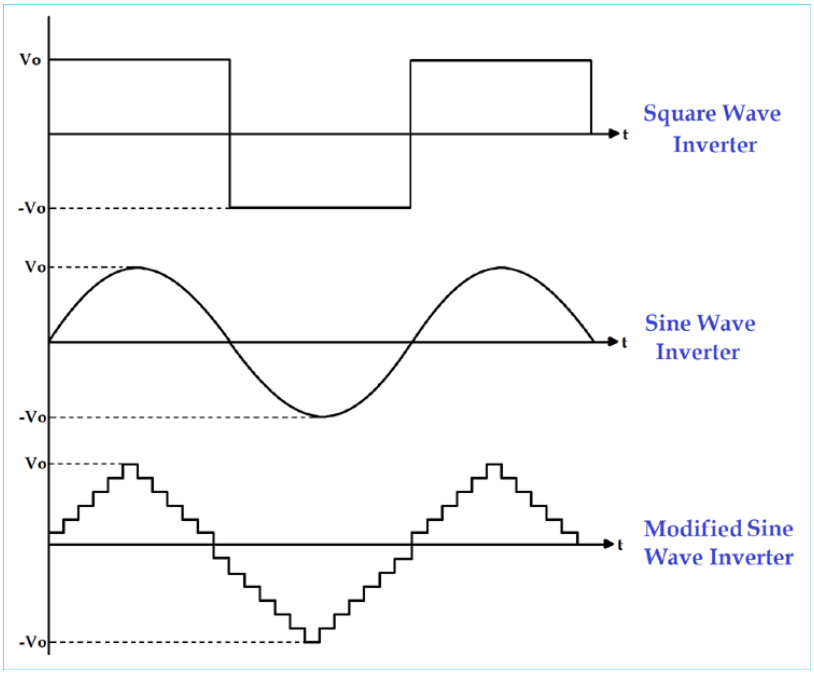

Figure 3

ii) Method

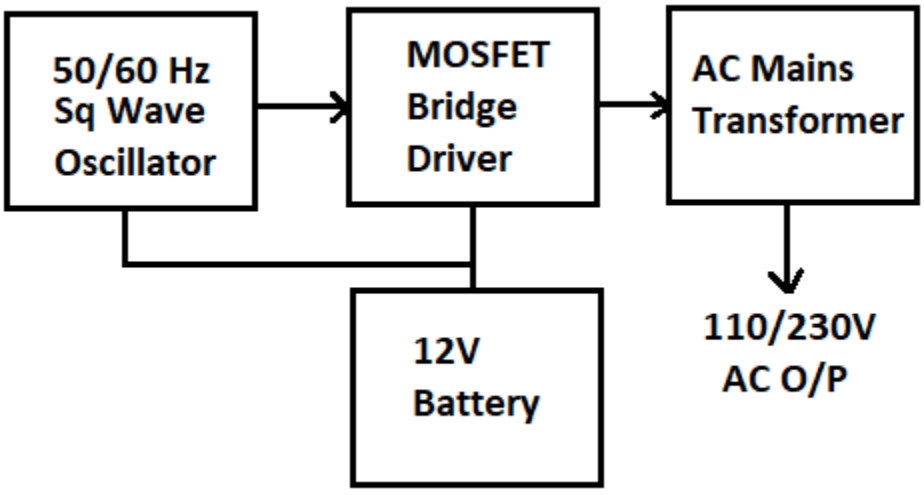

Figure 4

H-Bridge Circuit

Most of the inverter consists of simple H-Bridge arrangement. The circuit is an implementation of a single-phase H-Bridge circuit using Insulated Gate Bipolar Transistors (IGBT).

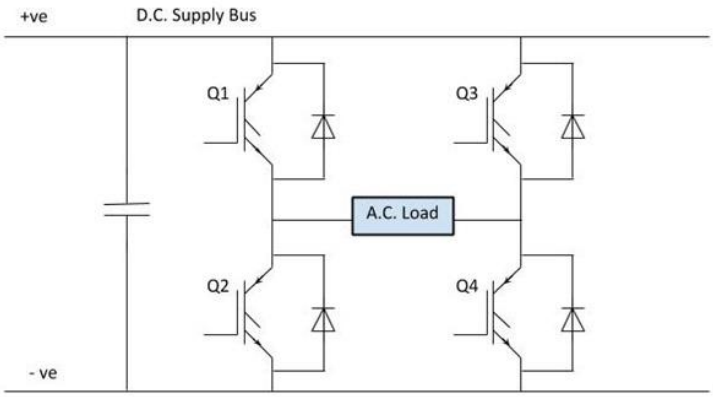

Figure 5

PWM (Pulse width modulation)

The most used technique in inverters is called Pulse Width Modulation (PWM). PWM is used to turn the DC voltage on and off with a certain pulse. The width of each pulse is varied so that the overall electrical result is similar to that of a sine wave.

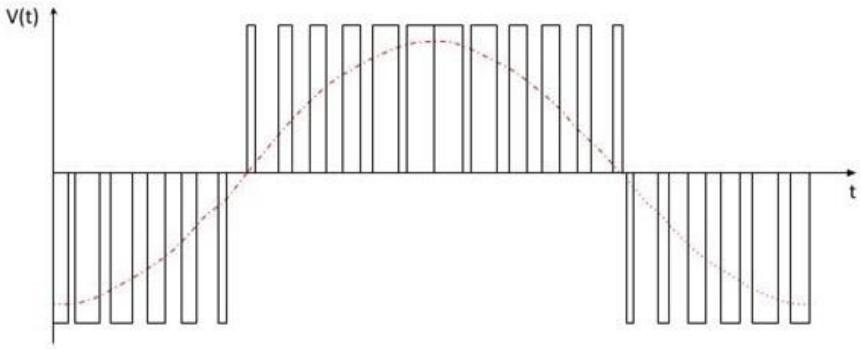

Figure 6

2. Inverter Errors Finding

12V is supplied to the inverter circuit using a lead-acid battery, but it is not producing the AC (230V) power output. As shown in Figure 7, the multimeter displays a value of 13V, and two MOSFETs are missing from the circuit. Additionally, the fault indicators and power-on LED are not working.

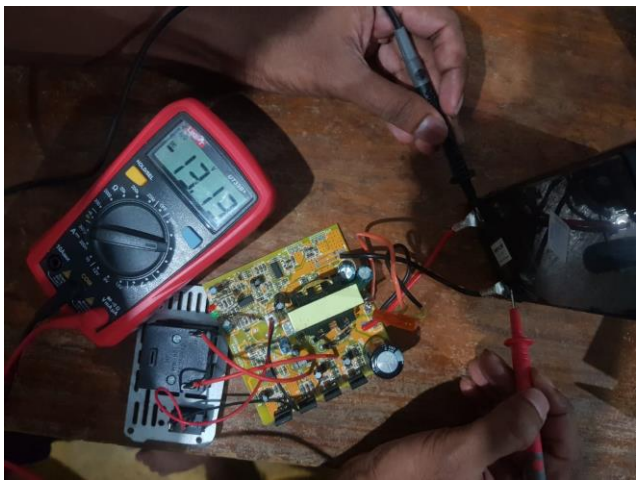

Figure 7

A problem with a circuit where the fuse in the DC section has blown, indicating that there may be excess current flowing into the circuit. This is a safety mechanism designed to prevent damage to the circuit and potential hazards. After checking the circuit, it was noticed that several MOSFETs used for the H Bridge circuit are not functioning correctly. Specifically, they are shorted, which means that there is a direct connection between their source and drain terminals, resulting in an electrical short circuit. This issue will need to be addressed before the circuit can function properly.

Figure 9

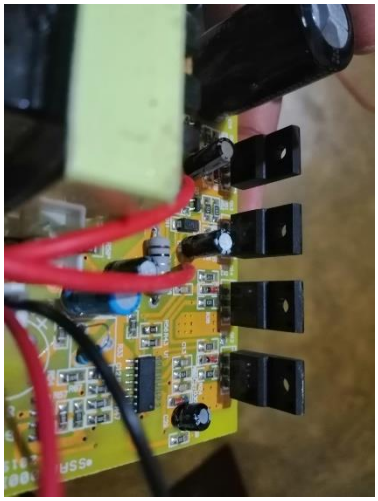

Figure 8

3. PCB Design

The inverter circuit shown above is located on a double-sided complex PCB. Using EasyEDA, a PCB was designed using the same technique used in the inverter circuit. The PCB design and pictures that were taken during the process are attached below.

1. Schematic diagram

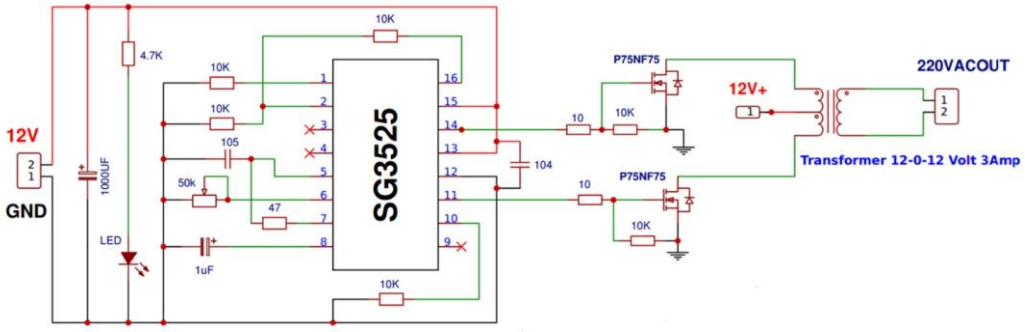

Figure 10

2. PCB Layout

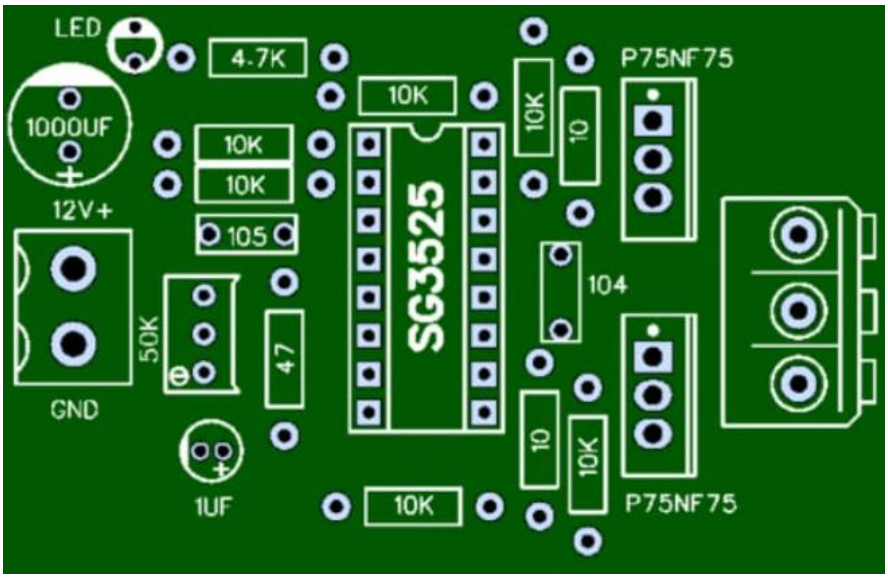

Figure 11

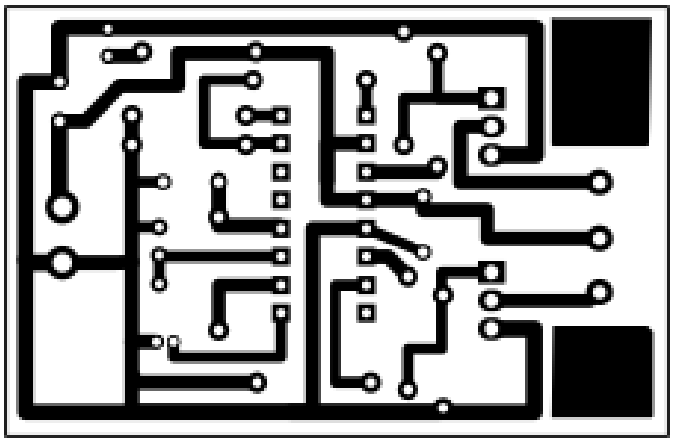

Figure 12

The board is then placed into a solution of ferric chloride. This solution eats away at the unprotected copper and leaves only the desired circuitry intact. The etching process can take several minutes, but the timing can vary depending on factors such as the size of the board and the concentration of the ferric chloride solution. Once the etching is complete, the PCB is removed from the solution and rinsed with tap water to remove any remaining traces of the etchant. The board is then dried and ready for use.

Figure 14

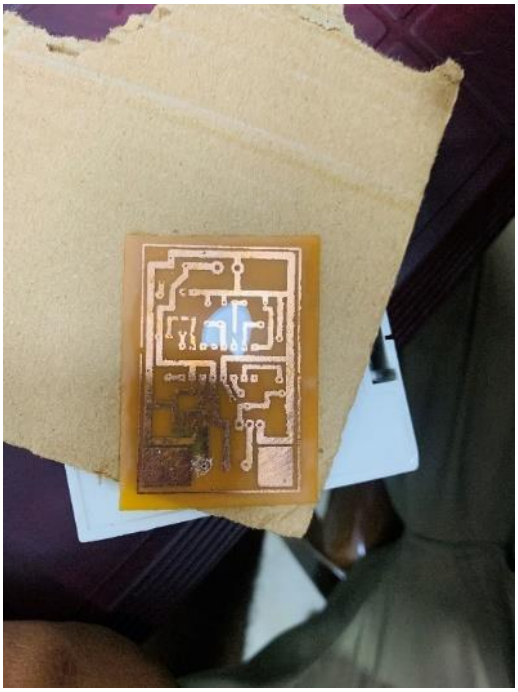

Figure 13

4. Hardware Assembling and Connect the Transformer

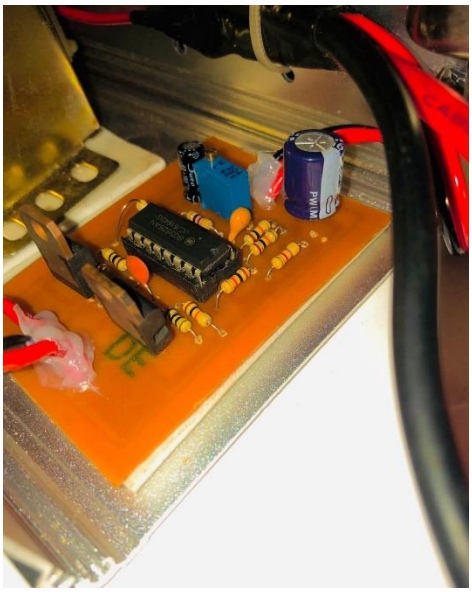

Figure 15

Components that use to assembling

SG3525 IC
Resistors
Capacitors
MOSFETS (75NF75)
Transformer (Center Tap)

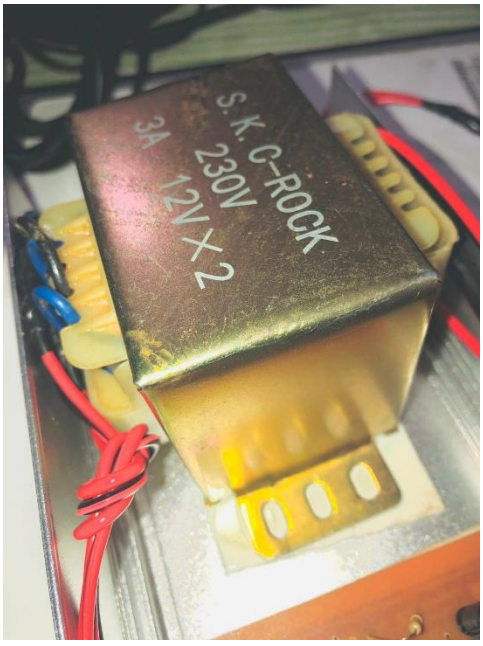

Figure 16

A 12-0-12 transformer is a type of step-down transformer that reduces voltage from 220-230v input to dual 12v output. It has three terminals on the secondary side, which makes it a center-tap transformer. The middle wire terminal is considered the 0v reference point, and each side terminal from 0v is 12v. With a power output of nearly 300W, it can deliver up to 3A of current. This transformer can also be used to provide a 24v supply.

5. Checking and Finalizing

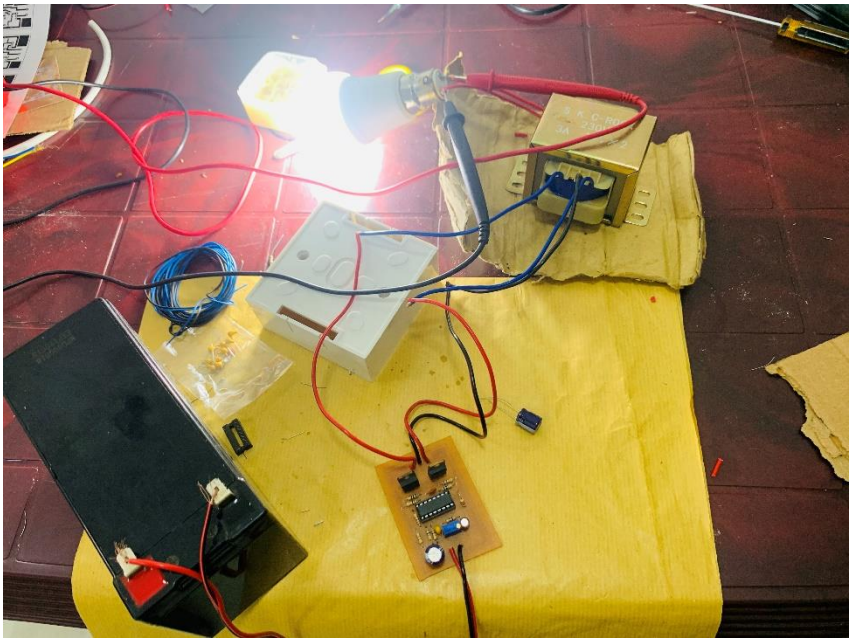

Figure 17

The DC to AC converting circuit is a type of inverter that is designed to convert direct current (DC) into alternating current (AC). The circuit is typically connected to a battery and a center tap transformer to produce the desired AC output voltage. In this case, a 230V bulb was connected to the output of the circuit to test its functionality.

The inverter circuit generates an AC waveform that is typically a modified sine wave or a pure sine wave, depending on the design of the circuit. In this case, the inverter produced a modified sine wave with a frequency of 50Hz.

When the circuit was connected to the 230V bulb, it was able to provide the necessary AC voltage and current to power the bulb, indicating that the circuit was functioning properly. This type of inverter is commonly used in applications where an AC power source is not available, such as in remote locations or for emergency backup power.

6. Conclusion

An inverter is an electronic device that converts direct current (DC) electricity into alternating current (AC) electricity. The basic operation of an inverter involves taking the DC power input and converting it into AC power using a variety of electronic components, including MOSFET or IGBT, Resistors, capacitors, and transformers. The output of an inverter is typically characterized by its frequency, voltage, and waveform, with most inverters producing a sine wave. Using the SG3525 is a pulse width modulation (PWM) control integrated circuit (IC) used in switching power supplies and inverters. It is designed to control the output voltage and frequency of a DC-AC converter. 50/60 Hz Inverter using IC SG3525 with PWM Inverter Circuit. The circuit will take a 12V DC power supply from a 12V battery and converts it into 220V, PWM output. They are the outputs of the SG3525 internal driver stage and can be used to directly drive MOSFETs and IGBTs.

7. References

Admin (2023) *12V DC to 220V AC Inverter Circuit & PCB, How To Electronics*. Available at: https://how2electronics.com/12v-dc-to-220v-ac-inverter-circuit (Accessed: February 28, 2023).

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12-0-12 transformer connection: How to get 24V from 12-0-12 (2022) *circuitspedia.com*. Available at: https://circuitspedia.com/center-tapped-transformer-connection-diagram (Accessed: February 28, 2023).