Study of Modified Sine Wave Inverter

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Abstract - *The following project deals with the simulation and generation of Modified Sine Wave from 12V Battery of 7Ah capacity. The whole circuit is being divided into two parts i.e., Gate Driver Circuit and Inverter Circuit. Here Gate Driver Circuit is obtained using two methods. First method deals with the use of IC 555 Timer and IC CD4017 which provides gate pulses to the Inverter Circuit. Second method deals with the use of Arduino UNO as a gate pulse generator which is provided to the Inverter Circuit. Using any of the two methods, output of 230V, 50Hz, 500W can be obtained from the secondary of the centre tapped transformer.*

Key Words: AC Power, Arduino UNO, Centre Tap Transformer, Clock Pulse, DC Source, Gate Driver, Inverter, MOSFET

1. INTRODUCTION

Most of the domestic electrical loads operate with an AC power supply of 230V, 50Hz frequency in India. It is normally available from plug point/power point in our houses. But in case of power cut-off due to fault or any other reason AC power can be obtained from stored DC power in Batteries. Hence as AC power can't be stored it has to be converted from DC. The converter that converts DC to AC is known as an Inverter. The Inverter does not produce any power; the power is provided by the DC source.

1.1 Types of Inverter

Inverter can be broadly classified into three categories which are:-

- ➢ Square Wave Inverter
- ➢ Modified Sine Wave Inverter
- ➢ Pure Sine Wave Inverter

THD value of Pure Sine Wave Inverter is least as compared to above two Inverters, but most of the UPS power backup systems are indeed Modified sine Wave Inverters. Moreover all equipments that have Universal Motors such as vacuum cleaners, roof fans and drilling machines operate well from it.

2. OBTAINING MODIFIED SINE WAVE USING IC-CD4017

Here 12V battery with 7Ah capacity is used to obtain Modified Sine Wave. IC CD4017 is a Decade Counter that gives 10 consecutive output from Q0 to Q9 when clock pulses are available on it's pin14. Clock pulses are provided from IC 555 Timer. If we want 50Hz output, then timer output frequency must be equal to 4*50=200Hz which is obtained by varying 50k variable pot.

Output from 555 timer (pin3) is connected to pin14 (clk) of CD4017. Now output from Q1 and Q3 of CD4017 is used to trigger MOSFETs STP55NF06L alternately. If we see output waveform from Q1 and Q3 of CD4017 in DSO i.e., connecting Q1 and Q3 to channel1 of DSO, then it will appear as a modified sine wave with peak of 5V. Hence output obtained from step-up transformer (centre tapped) 10-0-10 to 240V is also a modified sine wave.
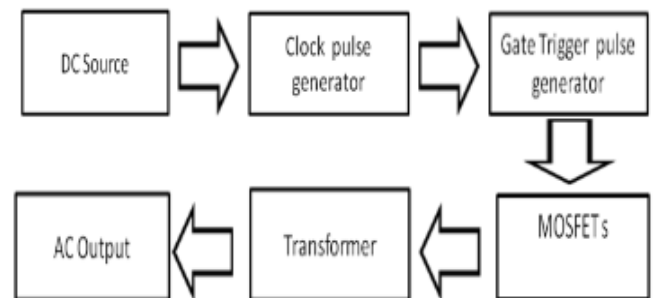

Fig -1: Block Diagram of modified sine wave inverter

It can be inferred from above block diagram that clock pulse generator (IC 555) and gate trigger pulse generator(IC-CD4017) forms the "Gate Driver Circuit" while MOSFETs and Transformer makes "Inverter Circuit".
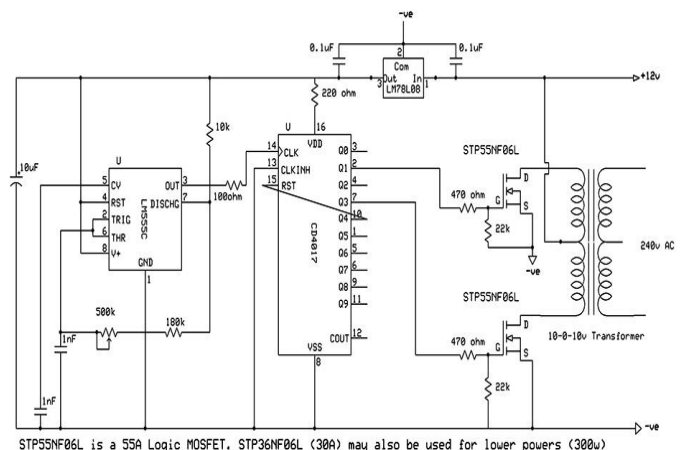

STP55NF06L is a 55A Logic MOSFET. STP36NF06L (30A) may also be used for lower powers (300w)

Fig-2: Circuit Diagram

STP55NF06L MOSFETs are used for 55A, 500W rating. In case of 30A and for low power rating (300W) STP36NF06L is also used. Both this MOSFETs are of special type that triggers from just 5V. In order to solder the circuit on GPB, Gate Driver Circuit from Fig-2 can be reduced to Fig-3 as shown below:-
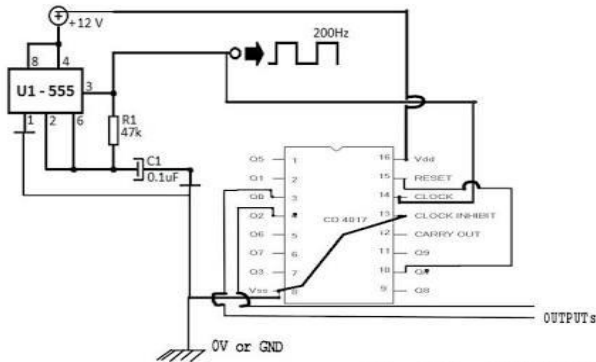

Fig -3: Simplified Gate Driver Circuit

2.1 Simulation of Gate Driver Circuit in Proteus

In order to see the gate triggering pulses, simulation of gate driver circuit (Fig-3) is performed in Proteus simulation software and it's output is seen in oscilloscope.
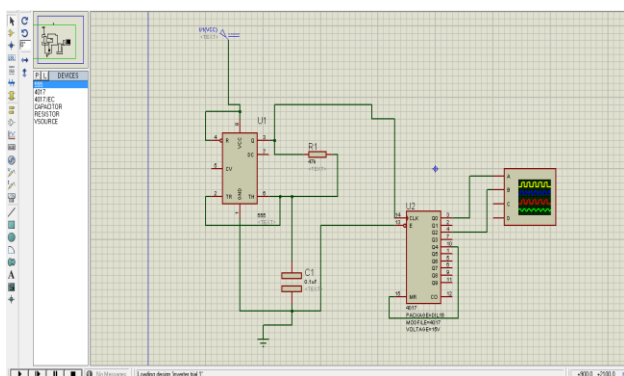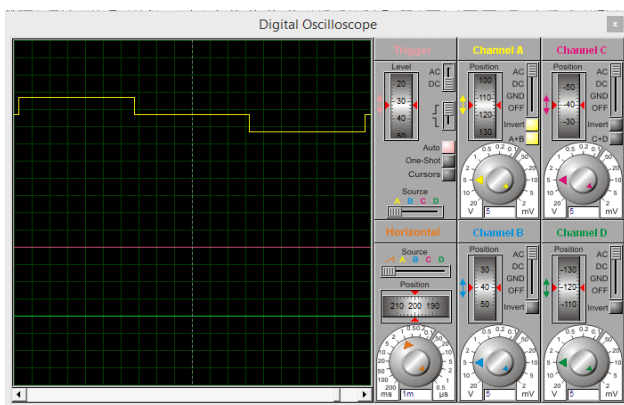

Fig -4: Gate Driver Circuit in Proteus

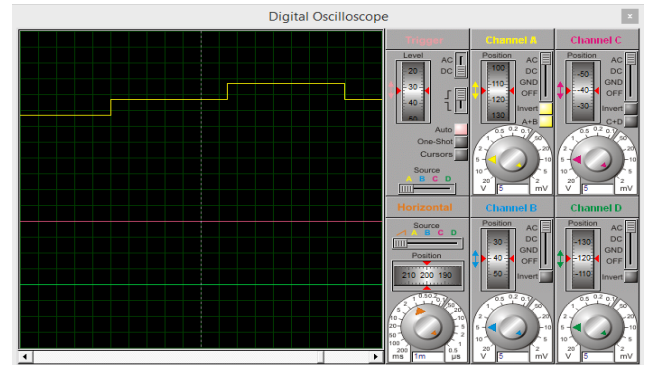**Fig -5(a)**: Gate Driver Circuit output in oscilloscope

Fig -5(b): Gate Driver Circuit output in oscilloscope

3. OBTAINING MODIFIED SINE WAVE USING ARDUINO UNO

Gate Driver Circuit can be obtained more easily by using Arduino by obtaining the gate trigger pulses from any of it's two output pin say pin8 and pin9 of Arduino UNO. Program in Arduino is known as "Sketch". Once the Sketch is uploaded in Arduino and when 12V DC supply is given, Arduino will generate gate trigger pulses from pin8 and pin9 according to the program uploaded.

In other words Arduino UNO simply replaces both IC 555 timer and IC CD4017. Inverter Circuit (MOSFETs and Transformer) remains same and Modified Sine Wave is obtained at transformer secondary with 230V AC is obtained by uploading following program.

```
void setup(){
pinMode(8, OUTPUT);
pinMode(9, OUTPUT);
}
void loop(){
digitalWrite(8, LOW);
delayMicroseconds(3333);
digitalWrite(8, HIGH);
delayMicroseconds(6666);
digitalWrite(8, LOW);
digitalWrite(9, LOW);
delayMicroseconds(3333);
digitalWrite(9, HIGH);
delayMicroseconds(6666);
digitalWrite(9, LOW);
}
```

4. CONCLUSION

The work is defined to develop an Inverter circuit which is not costly to produce and can be used for operating almost all domestic loads upto 500W during power failure using battery of 7Ah capacity.

ACKNOWLEDGEMENT

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