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DESIGN AND FABRICATION OF HARDWARE PROTOTYPE OF SINGLE PHASE QUASI SINE PULSE WIDTH MODULATION INVERTER

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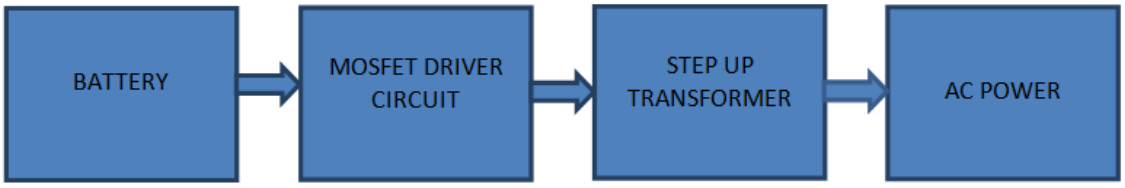
ABSTRACT

This research is based on Design and prototype of single phase Quasi Sine Pulse with Modulation Inverter. Many high voltage applications require single-phase inverters. The central test in inverter arranging is the control of consonant turning (HD) to achieve greater switching execution. Usually, sinusoidal pulse width modulation (SPWM) is widely used to trigger the inverting switches for controlling the total harmonic distortion performance in the Inverters To Give the option of multiple operating ranges the multi-level inverters are designed for higher voltage operations. This paper contributes in two passes, first, an improved SPWM modulation is generated for designing the three levels of Inverters. Then in the second pass, the performance of the THD is evaluated under the Various load conditions using V-I measurement. In the system, THD is present due to the Switches. Therefore, the paper has evaluated the performance of the proposed improved Sine PWM-based multilevel inverter for analysis. To improve the performance, the modulation index of the Sine PWM block is varied. The presentation of the part report is likewise introduced in the short, the result waveform of the line current and the voltage are thought about. The FFT examination is done to assess the relation of THD execution. It is concluded that improving the Sine PWM performance and the loading conditions may improve the Total Harmonics Distortion performance also.

Keywords: Analysis, Single Phase Inverter, Three-Level Inverter, FFT Analysis, THD, SPWM, Modulation Index.

I. INTRODUCTION

In this day and age most apparatuses and machines like a fan, AC deals with AC power. Without a trace of AC power, there ought to be an acceptable method for changing over DC capacity to AC power. This change is finished by the power electronic circuit called the Inverter. The fundamental capacity of a power inverter is to change DC input voltage to deviated AC yield voltage of the ideal extent, and recurrence Sinusoidal PWM is a common place PWM procedure.



In this PWM method, the sinusoidal AC voltage reference is contrasted and the high-recurrence three-sided transporter wave progressively decides to exchange states for each shaft in the inverter. Inverters are broadly utilized in modern applications e.g., variable speed AC engines, enlistment warming, backup power supplies and uninterruptible power supplies. Inverters are extensively characterized into two sorts, single-stage inverters and three-stage inverters. Each type can utilize controlled turn on and switch off gadgets. These inverters by and large use beat width balance control signs to give an AC yield signal.

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II. METHODOLOGY

ATMEGA328P– 8 Bit Microcontroller

Figure 1: Microcontroller

[ATMEGA328P] is a microcontroller from the 'ARDUINO(ATMEGA328P)16F' family and is made by MICROCHIP TECHNOLOGY. It is an 8-Bit CMOS Microcontroller with nano-Watt Technology. This microcontroller is well known among specialists and designers due to its highlights and costLike some other microcontrollers, ATMEGA328P should have been modified prior to getting the chip working. So for working on ATMEGA328P (ARDUINO), first we want to save the suitable program record in the regulator FLASH memory. Whenever power is given, the regulator executes this code saved in FLASH memory to make the reaction

REGULATOR IC 7805

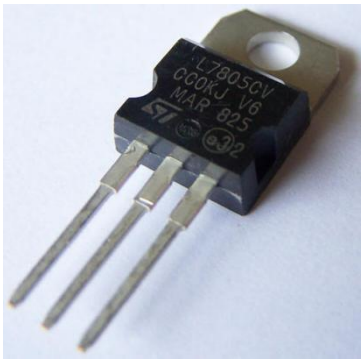

Figure 2: Regulator IC

Voltage regulators are very common in electronic circuits. They give a steady result voltage to a fluctuated input voltage. For our situation, the 7805 IC is a famous controller IC that tracks down its application in a large portion of the undertakings. The name 7805 implies two signifying, "78" implies that it is a positive voltage controller and "05" implies that it gives 5V as result. So our 7805 will give a +5V yield voltage The result current of this IC can go up to 1.5A. However, the IC experiences weighty hotness misfortune, thus a Heat sink is suggested for projects that consume more current. For instance, on the off chance that the information voltage is 12V, and you are consuming 1A, (12-5) * 1 = 7W. These 7 Watts will be scattered as hotness.

Features

- 5V Positive Voltage- Regulator.
- 7.1v Minimum Input Voltage.
- 24 vMaximum Input Voltage
- Operating current is 5 mA.
- Internal Thermal Overload and Short circuit current limiting protection is available.
- Junction Temperature maximum 125 C degree Celsius.
- Available in O-220 and KTE package.

IRFZ44N N-Channel Power MOSFET

Dissimilar to semiconductors, MOS-FETs are voltage-controlled gadgets. This means they can be turned on or switched off by providing the necessary Gate edge voltage (VGS). IRFZ44N is an N-channel MOS FET, so the Drain and Source pins will be left open when there is no voltage applied to the entryway pin. At the point when an entryway voltage is applied, these pins get closed. If it is expected to be exchanged with Arduino, then a straightforward drive circuit utilizing a semiconductor will attempt to give the necessary door voltage to set off the MOS-FET to completely open. For other exchanging and intensifying applications, a committed MOS-FET Driver IC is required.

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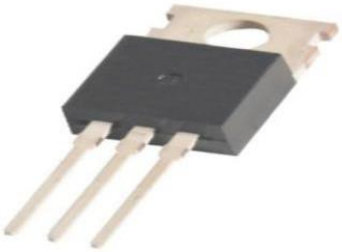

Figure 3: Mosfet

Features

- Small signal N-Channel MOSFET
- Continuous Drain Current is 45A at 27°C
- Pulsed Drain Current (ID-peak) is 170A
- Minimum Gate(threshold voltage) is 2.1V
- Maximum Gate threshold voltage is 5V.
- Gate-Source Voltage is (VGS) is ±20V Max.
- Maximum Drain-Source Voltage (VDS) is 45V.
- Rise time and fall time is about 60ns and 48Ns respectively.
- It is commonly used with Arduino, due to its low threshold current.

Applications

- Switching high power devices
- Control speed of motors
- Light emmting Diode dimmers or flasher.
- High Speed switching applications,
- Converters or Inverter circuit.s

TRANSFORMER (CENTER TAPPED)

A Centre tapped transformer, otherwise called a two-stage three-wire transformer is typically utilized for rectifier circuits. At the point when an advanced venture needs to work with AC mains, a Transformer is utilized to move forward the voltage for our situation, to 220vAC from 12-0-12V

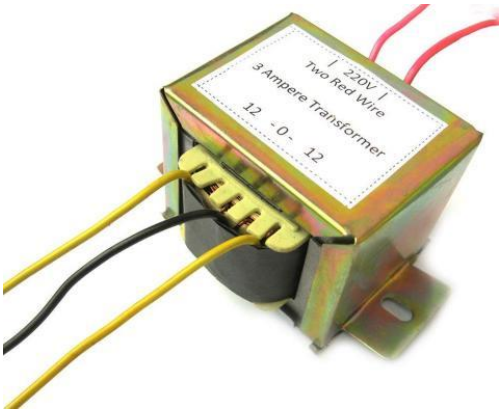

Figure 4: Transformer

Specifications

I/P Voltage: 12- 0 -12 AC on 50Hz.

O/P Voltage: 220V AC.

O/P Current: 0.4A

Vertical mount type,

Low cost and small package.

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III. MODELING AND ANALYSIS

This is a quasi-sine wave inverter that we made since it was more demanding than the sine at the time. we have a project with a quasi-sine wave as well with an ARDUINO(ATMEGA328P) microcontroller The design here uses IRFP55 x- 4 on each leg for 100W. We can use other MOSFETs as well. There are 2 resistances for driving the MOSFETs, on the control board. ATMEGA328 requires 5v to operate, hence a regulator IC -7805 is used with an input filter capacitor of 1000uF and an Output storage Capacitor of 470uF. Output volt is adjusted to achieve 230V or 220V as required with the help of variable resistance(POT) connected to the AD0 pin of ATMEGA328. The transformer we have is 12-0-12 primary, doesn't need to be accurate, since you can adjust the output voltage using the pot. What meant said you wanted a 12-0-12 transformer, but you got some error, then you can just adjust the preset/pot to set output at 230v. No separate winding, feedback is done onboard using diode/cap/resistor and micro. IGBT can be added for a nice design, but we omitted it, as it is costlier than MOSFET. Availability of MOS-FET is easy also we can replace it in case of burning. The transformer is rated at 100W power and is a standard transformer used for 100W inverters over here. The primary voltage is 12-0-12, and the secondary voltage is 0-240. The inverter has short circuit protection. It uses the fact that during a short circuit, DC bus voltage significantly decreases. The microcontroller senses that and indicates a short circuit. Reverse voltage protection isn't provided as it's connected to the battery 24/7.

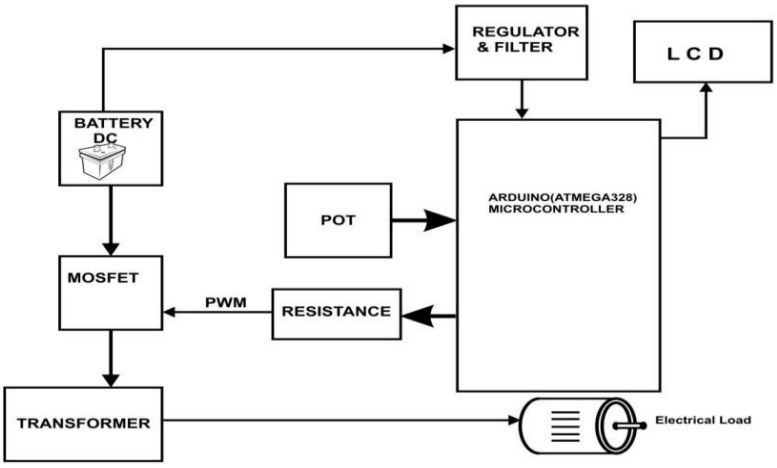

Figure 5: Block Diagram

Drawing the schematic

There are numerous software accessible on the Internet that assists you in withdrawing the schematic of the circuit Diagram. Plunge Trace programming is an excellent choice since it is freeware. here will utilize Diptrace SCH to draw the schematic. Diptrace PCB which incorporates Diptrace SCH is accessible on the Internet free of charge to Draw a circuit. Figure 6 Designing of Circuit

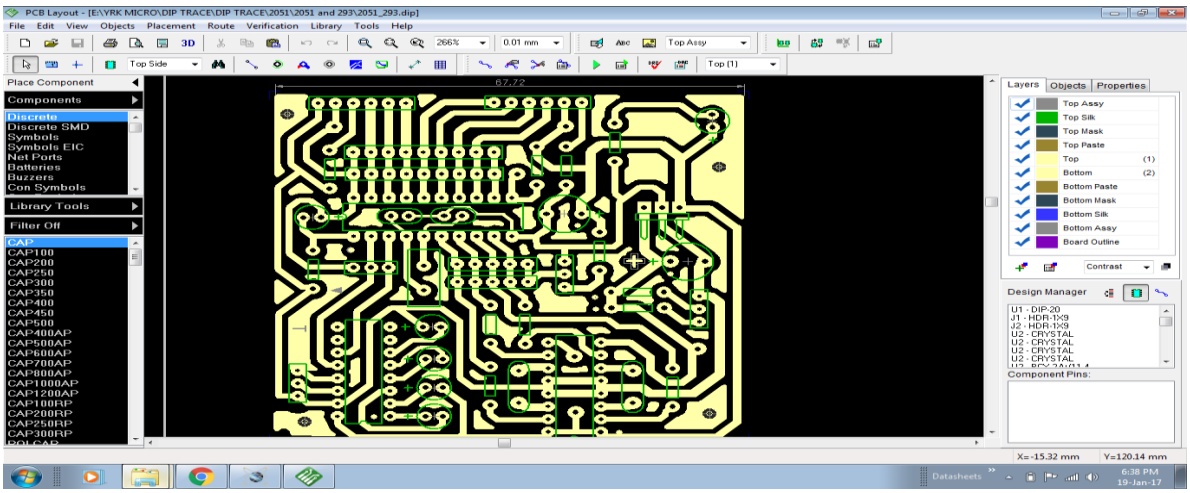

Figure 6: making PCB Layout

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Designing the PCB:

While designing a Printed Circuit Board try to make it as compact as possible. Fig. shows the PCB of the circuit designed in DipTrace PCB. Green lines show the silkscreen layer component layouts, and Yellow lines show the bottom copper layer.

IV. RESULTS AND DISCUSSION

When testing the Inverter with an oscilloscope produced a 50 Hz sine wave signal at the output as shown in CRO figure 7. Also, a 60 watts bulb was connected to the output. After hours of running the system, the 60 watts bulb went OFF. when the battery voltage dropped below 4-5 VDC which is the low battery set point.

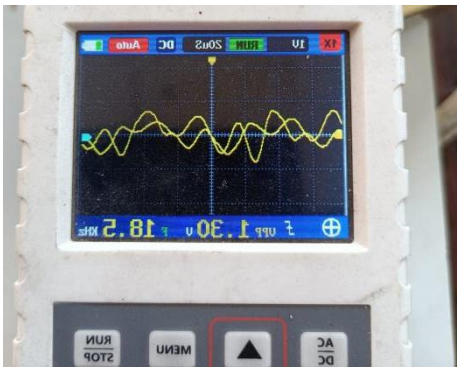

Figure 7: Display Waveform

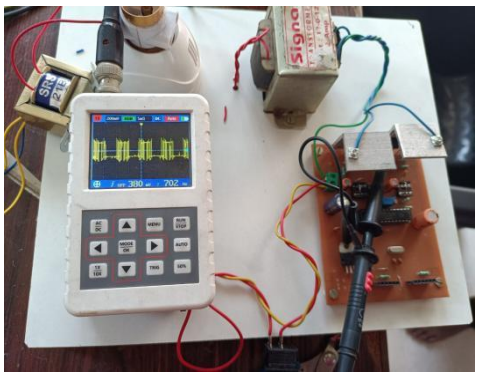

Figure 8: Testing of Hardware Model

OUTPUT TABLE

S/N	Battery Voltage (Volts)	AC Output (Volts)	Output State
1	12V	230	ON
2	11.8	227	ON
3	10.7	225	ON
4	10.1	220	ON
5	9.5	215	ON
6	85	209	ON
7	7.4	190	OFF
8	5.2	160	OFF
9	4.5	150	OFF

V. CONCLUSION

There is no one circuit to make a 100W inverter, different applications of electrical/electronic components in a circuit can determine how efficient an inverter is, the power stored in the batteries, and the capacity of the transformer watt. This paper is discussed available techniques and tried to come up with a solution for low power applications which is carry to implement, cost efficient and compact size , reliable for consumers.

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