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DESIGN & CONSTRUCTION OF SINE WAVE INVERTER

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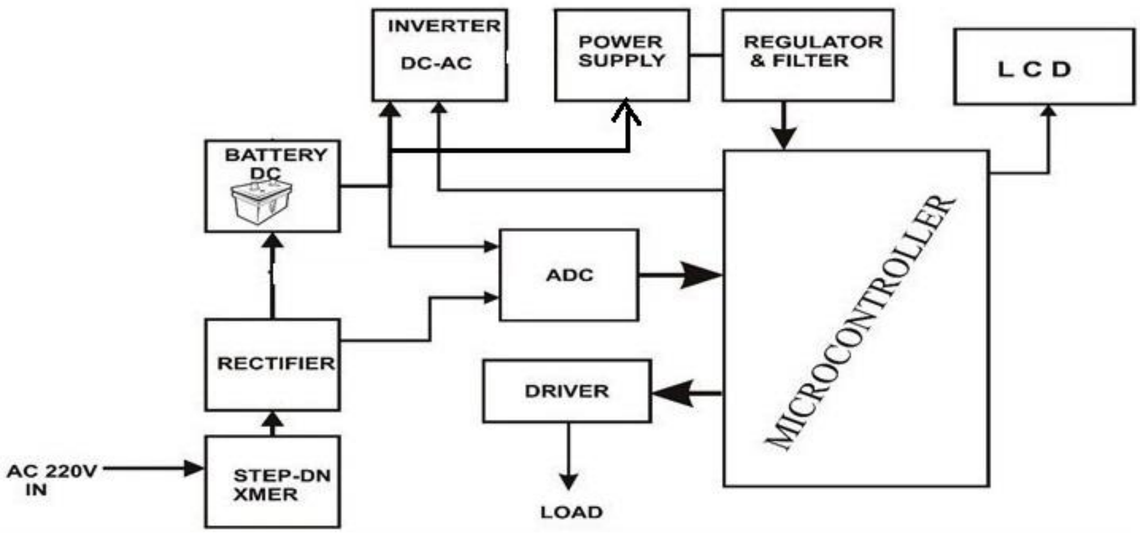
Abstract: - Where it is not practicable to gate the AC supply from the main and power backup, inverters are frequently required. To convert DC power to AC power, an inverter circuit is utilized. There are two types of inverters: quasi-or modified inverters and true/pure sine wave inverters. Modified or quasi-inverters are less expensive than these True/pure sine wave inverters. These altered inverters generate a sine wave, which is utilized to supply power to sensitive electronic devices. Here, a straightforward voltage-driven inverter circuit is constructed using power IGBT switching devices. With the aid of a step-up transformer, the circuit converts a 12V DC signal to a single phase 220V AC. The fundamental idea of any inverter circuit is to apply oscillations across the transformer primary by amplifying the current and creating oscillations with the supplied DC. Depending on how many turns the primary and secondary coils have, this primary voltage is then increased to a greater voltage.

Keywords: PIC16F886 Microcontroller, Center-Tapped Transformer, Relay, IGBT, LCD.

INTRODUCTION

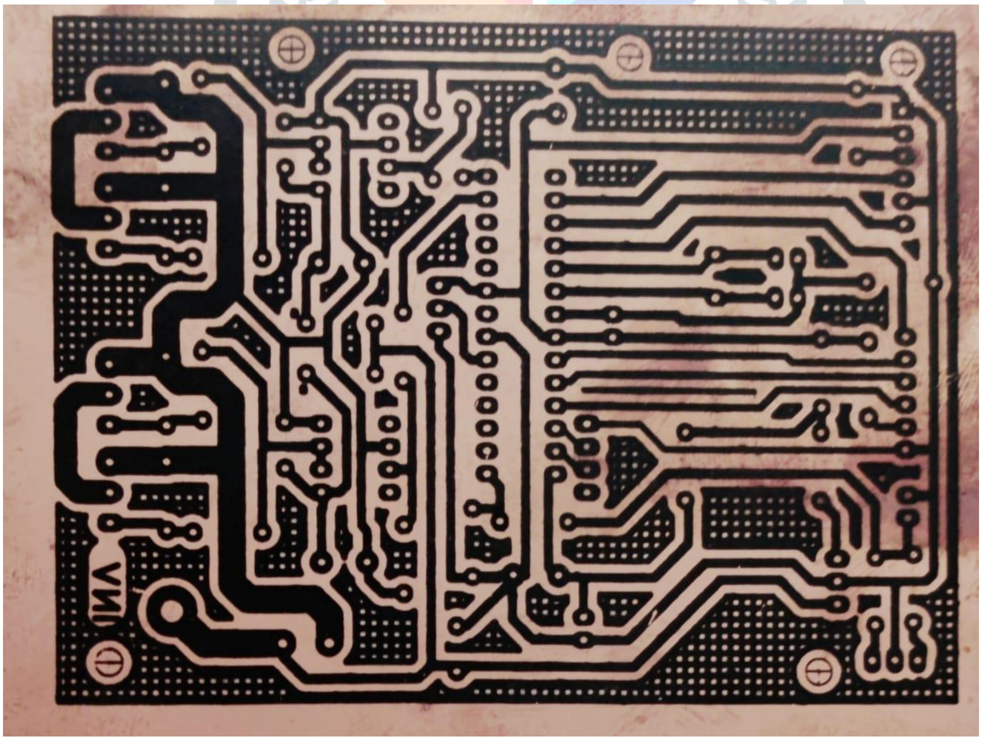
The goal of this paper is to provide an in-depth analysis of DC to AC power inverters, which effectively convert DC power sources into high-voltage AC sources that resemble the electricity found at a wall outlet. In situations where low voltage DC sources, such batteries, solar panels, or fuel cells, need to be converted so that devices can run on AC power, inverters are employed for a variety of purposes. A situation like this would be using a car battery's electricity to power a laptop, TV, or cell phone. There are two processes involved in the process of inverting low voltage DC power. The first involves converting low-voltage DC power into a high-voltage DC source, and the second involves employing pulse width modulation to convert the high-voltage DC source into an AC waveform. An alternative way to achieve the desired result would be to use a transformer to raise the voltage to 220V after converting the low voltage DC electricity to AC. This project concentrated on the conversion of a high voltage DC source into an AC output, which is the first approach mentioned. Among the several DC- AC There are basically two types of AC output produced by AC inverters on the market today: modified sine wave and pure sine wave. A modified sine wave is more akin to a square wave than a sine wave because it maintains the same average power and root mean square voltage by passing a high DC voltage for a predetermined period of time. These inverters are appealing substitutes since they are significantly less expensive than pure sine wave inverters.

BLOCK DIAGRAM



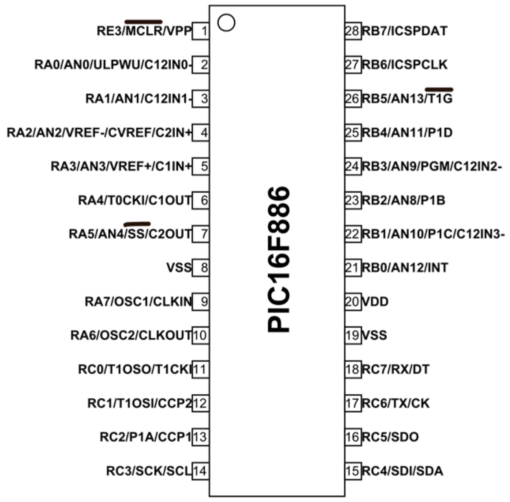
3.1 PRINTED CIRCUIT BOARD

To design a PCB layout, we used Dip Trace. In this initially a schematic capture is to be designed further, from this schematic capture we can directly (automatically) designed a PCB layout. After completion of PCB layout a printout will be taken on photo paper & finally by using electric iron paper we transfer photo paper print on copper clad (PCB) plate. There after a plate will be etching is a feels (ferric chloride) solution to remove unwanted copper from the board . After that holes will be drilled with 1mm drill bit. Then soldering process & drilling process. The mounting HUB process is used for to easily connect and removed microcontroller & IGBT driver, separation due to mounting process. The PCB are use to inter connections of the components as the circuit diagram.



3.2 PIC16F886 – 8 BIT MICROCONTROLLER

The PICI16F886 microcontroller boasts a high flash memory rewrite cycle, making it an excellent choice for experimentation and application development. In addition, there are a ton of online guides and resources. The control features 24 programmable input/output pins that can withstand 20mA of current, meaning it has ample flash memory (16K bytes) for a wide range of applications (direct LED driving capability) Many peripherals can be simply interfaced with the system. The controller can be used to design applications for permanent installation since it has a watchdog timer that resets immediately in the event of an error. The PICI16F886 microcontroller required programming in order to function, just like any other microcontroller. Therefore, in order for PICI16F886 to function, the relevant program file must first be saved in the controller's FLASH memory. The controller runs this FLASH-memory-stored code as soon as power is applied to generate the answer.



3.3 DC-AC INVERSION

The DC-AC inverter design is the most integral part of this thesis as its functionality determined the success of the design of the entire system. A similar design to that used by Crowley and Leung (2001) was adopted for the design. Some modifications were made to this design such as adjusting the sine wave frequency to 50 Hz and the entire pulse width modulation design was changed. Microcontroller send the PWM signal to IGBT then output will be the inversion is sine wave

3.4 PULSE WIDTH MODULATION

Pulse width modulation is a digital modulation technique whereby the width of a pulse carrier is made to vary in accordance with the modulation voltage. This output is then sent into the IGBT driver IC ULN2003 to drive the IGBTs.

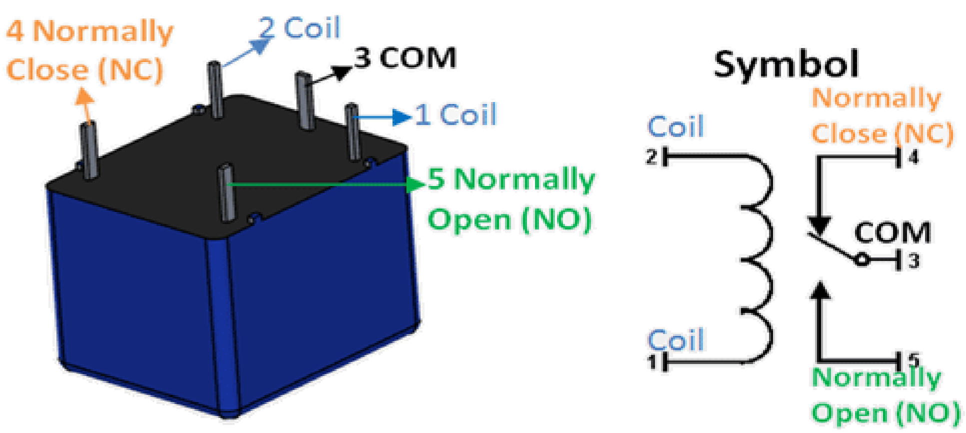
3.5 LIQUID CRYSTAL DISPLAY(LCD)

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical.

16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots.

3.6 RELAY

Relays are most commonly used switching device in electronics. There are two important parameters of relay, first is the Trigger Voltage, this is the voltage required to turn on the relay that is to change the contact from Common → NC to Common → NO. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range. To change the power supply mains to inverter



3.6 THE MAINS

The main is the direct power supply which is 220 volts and is the power supply to the inverter where theirs is no main the inverter switch power supply to the battery this is all control by microcontroller PIC 16f886.

3.7 WORKING

check battery level
-If battery level < 13.5v (this voltage is set using a pot, so can be easily adjusted), charge at the set current (set with a pot).
-If battery level > 13.5v, stop charging
-While battery > 13.2v, stop charging
-If battery voltage drops instantly start charging again
-initialize Timer and start PWM
-Check battery voltage, stop PWM and indicate on LED when battery falls below 10.8v (this is also set with a pot), response time is fast so a short circuit that produces an instant voltage drop is detected
-Check load level, check against preset level (set with pot) and if too high, shut down and indicate
-Check output voltage, adjust as required
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 quasi-sine wave as well with a PIC microcontroller
The design here uses IGBT x 2 on each leg for 100W. We can use other IGBTs as well. There are 2 transistors for driving the IGBTs, on the control board - 2xc547.
For upto 5V, we need to change the 7805 with an auxiliary supply, that's the only change.
Output volt is adjusted to achieve 230V or 220V as required, that is for feedback voltage setting or output voltage setting when running in inverter mode. Battery max is for battery high cut voltage, to cut off charging when battery reaches a specific voltage. I set mine at around 13.5v.
Charging current is for setting the current at which battery is to be charged. In our 1Amp is set to charge the battery.
Low battery is for setting battery low cut voltage. in our project will be for 10.5v
The transformer we have is 9-0-9 primary, doesn't need to be accurate, since you can adjust the output voltage using the pot. What I meant is, say you wanted a 9-0-9 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 on board using diode/cap/resistor and micro. Charging is done using the same IGBT board, no special capacitor or inductor, just a snubber on the board. Transformer primary is not strict. IGBT can be added for a nice design, but I omitted it as it was more demanding to have the IGBT board separate, in case the IGBTs burnt. Haven't had a situation till now, but it can easily be made into one nice PCB.
The transformer is rated at 500W power and is a standard transformer used for 500W inverters over here. The primary voltage is 9-0-9, secondary voltage is 0-240.This 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 short circuit. Reverse voltage protection isn't provided as it's connected to the battery 24/7.

IV. CONCLUSION

Sine wave inverters serve as critical components in converting DC power to AC power with high precision and efficiency. Their importance extends across various sectors, including residential, commercial, and industrial applications. With their ability to provide clean and stable power, sine wave inverters ensure the smooth operation of sensitive electronics equipment. As technology evolves, we can anticipate further enhancements in efficiency, integration with renewable energy sources, and the addition of smart features. Overall, sine wave inverters are poised to remain essential in meeting the growing demand for reliable and high-quality power supply solutions.

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