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An Overview on Mini Inverter for Small Rating Appliances

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Abstract

A power electronics device called an inverter transforms DC electricity into AC power at the appropriate output voltage and frequency. This project's main goal is to use a transformer to increase the voltage from a 12V DC power source to a 240V AC output. Furthermore, the system may provide up to 1000 watts of output power. In order to convert DC energy into AC and make it appropriate for usage in domestic electrical equipment, the inverter circuit is essential. The circuit operates between 220V and 240V AC and is intended to provide a sine wave output with little noise. In order to further advance the technology, we offer ideas and recommendations for possible future developments in the last portion of this study.

Introduction

Using the right transformers, switching, and control circuits, an inverter is an electrical device that changes direct current (DC) into alternating current (AC) at any desired voltage and frequency. In essence, an inverter is the rectifier's opposite.

With no moving parts, static inverters are employed in a variety of settings, ranging from big electric utility high-voltage direct current applications that transmit bulk power to tiny switching power supply in computers. Inverters are frequently used to convert DC sources, like solar panels or batteries, into AC electricity. An electronic oscillator with high power is the electrical inverter. The term "inverted" refers to the fact that early mechanical AC to DC converters were designed to operate in reverse, converting DC to AC.

This paper is particularly beneficial for compact spaces, camping sites, and remote locations where AC power is not readily accessible. The main objective of this project is to develop a DC-to-AC power inverter that efficiently converts DC power into high-voltage AC power, similar to the electricity supplied by a standard wall outlet. Inverters play a crucial role in situations where low-voltage DC sources, such as batteries, solar panels, or fuel cells, need to be converted into AC power for operating household and industrial appliances. For instance, an inverter can transform power from a car battery to run devices like laptops, televisions, or mobile phones.

AC power is essential for operating most electronic devices, but power outages can make their use challenging. This issue can be resolved with an inverter, which converts direct current (DC) into alternating current (AC). The primary

function of an inverter is to convert a DC input voltage into a symmetrical AC output voltage with the required magnitude and frequency.

Inverters are available in different wattage capacities, determined by the formula $P=VI$ = $VIP=VI$, where power (watts) is dependent on voltage and current. The wattage output is influenced by key components such as transformers and coil wires, which are designed based on the required amperage.

There are various types of inverters, categorized based on factors such as the number of phases, power semiconductor devices used, communication principles, and output waveforms. This paper first examines single-phase inverters, followed by discussions on voltage source inverters (VSI) and current source inverters (CSI).

Inverters have diverse industrial applications, including speed control of induction and synchronous motors, induction heating, aircraft power supplies, uninterruptible power supplies (UPS), and high-voltage DC transmission. They are particularly essential in areas with unreliable electricity, making them a vital technology for enhancing daily life. Understanding inverters contributes to a deeper knowledge of electrical and electronic systems.

BLOCK DAIGRAM

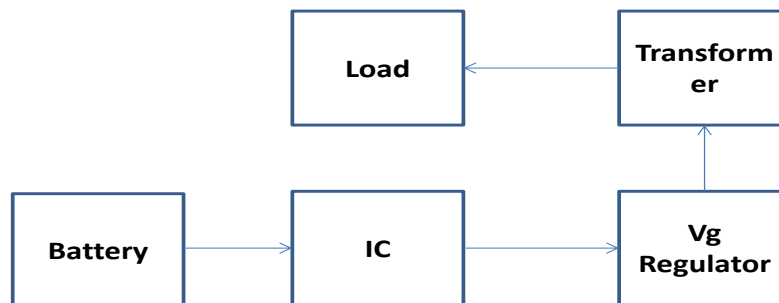


Fig. 1 Block Diagram

In this block diagram, a 12V power supply is used to power a complementary MOS astable/bistable multivibrator. This circuit generates two output signals: one in-phase (180°) and the other out-of-phase (180° out of phase). These signals are then fed into the base of a switching transistor (TIP122). The collector supply is connected to a high-power transistor

OBJECTIVE

This project's main objective is to offer power continuously in the event of an emergency. The specific objectives of this initiative were as follows:

- Backup power sources for emergencies: During emergencies or power outages, power-efficient small inverters can be utilized as backup power sources to run vital appliances like lights, refrigerators, and medical equipment.
- Automobile power systems: Small electronic gadgets like computers, tablets, and smartphones can be powered by mini inverters installed in cars.
- Camping or outdoor activities: Portable fridge, fans, and lights are just a few of the tiny appliances that can be powered by power-efficient miniinverters when camping or engaging in outdoor activities.
- Home automation systems: Security cameras, smart thermostats, and lighting controls are just a few of the small electronic devices that can be powered and managed by mini inverters.
- Remote or off-grid areas: Cabins, boats, and RVs are examples of remote or off-grid areas with restricted access to energy that can benefit from mini inverters.

(TIP3055), which serves as a replacement for the 2N3055 complementary high-power transistor. The output is then regulated through a voltage stabilizer consisting of a Zener diode and a capacitor. Finally, a step-up transformer converts the 12V DC into 240V AC, which is then supplied to the connected load.

A. Battery



A 12V, 1.2Ah lithium-ion cell is a compact and versatile battery solution commonly used in small electronics, portable power banks, emergency lighting, and backup power supplies. Below is an overview of its key characteristics and considerations:

This battery is ideal for:

- **Portable Electronics:** Such as radios, mini power tools, and small appliances.
- **Backup Power:** Suitable for small emergency lighting systems and devices needing reliable power.
- **DIY Projects:** A great choice for projects requiring a compact, rechargeable power source.

B. IC



Integrated circuits are made up of several components such as R, C, L, diodes and transistors. They are built on a small single block or chip of a semiconductor known as an integrated circuit (IC). All of them work together

to perform a particular task. The IC is easily breakable, so to be attached to a circuit board, it is often housed in a plastic package with metal pins.

C. Voltage Regulator



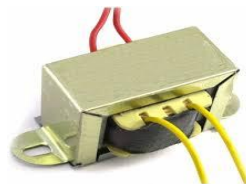
A power supply IC that maintains a constant output voltage regardless of variations in input voltage, output current, and load resistance is known as a voltage regulator. This section focuses on linear voltage regulators, which operate without switching functions.

Voltage regulators are referred to by various names, including linear regulators, series regulators, voltage regulators (VR), and low dropout (LDO) regulators.

By using a voltage regulator, a stable output voltage can be achieved from different input sources with varying voltages, such as a 12V power supply, dry cell batteries, or lithium secondary batteries.

Additionally, a voltage regulator ensures a consistent output voltage even when the output current fluctuates. This feature helps create stable power supply lines, making voltage regulators one of the most widely used components in power management.

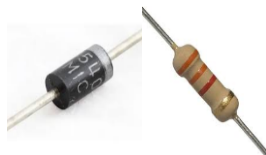
D. Transformer



A transformer is an electrical device that transfers energy between two or more circuits using electromagnetic induction. This process generates an electromotive force within a

conductor when it is exposed to a time-varying magnetic field. Transformers play a crucial role in electric power applications by either increasing or decreasing alternating voltages.

E. Diodes And Resistor



The Diode (IN4007) is used to minimize the power supply flowing through it. We use it in our charging model for the battery protection and safety purpose. This is a better alternative of BMS Module. The resistor of 1K is used with the transistor.

Results

The proposed model will be tested to 220V AC. When this DC supply was fed into the transformer through a transistor, it began generating AC signals. The inverter operates by converting DC from the battery into AC through the transistor. The circuit draws 12V DC from the battery and efficiently converts it into 220V AC. To verify the circuit's output, an LED bulb was connected, which illuminated successfully, confirming the functionality of the inverter.

Conclusion

To initiate this project, we conducted research on existing inverter systems worldwide. An inverter is an electrical device that converts direct current (DC) into alternating current (AC). The resulting AC output can be tailored to a specific voltage and frequency using suitable transformers, switching mechanisms, and control circuits. Solid-state inverters, which have no moving parts, are widely used in various applications, from small power supplies in computers to large-scale high-voltage DC transmission systems for bulk power distribution. Inverters are commonly employed to convert DC power from sources such as solar panels and batteries into usable AC power, essentially functioning as the reverse of a rectifier. Through this project, we have acquired valuable technical skills, including an understanding of inverter operation, output generation, and voltage regulation. Additionally, we have gained hands-on experience in electronic soldering, wiring, single-phase circuit connections, and selecting appropriate cable sizes for efficient power transmission.

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