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Conventional Power Generator (12V DC to 220V AC Inverter)

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***Abstract:** An inverter is a device that converts DC battery power to AC electrical power. The converted AC can be used at any required application. The Inverter performs the opposite function of a Rectifier. The aim of this work is to explain about a 12V-DC/220V-AC inverter. This circuit consists of three parts which include the Oscillator, Amplifier and Transformer. The Oscillator is implemented by using the 2N2222 Transistors, amplifier is implemented by MOSFET's IRF630, and finally we require 12V to 220V center tapped step up transformer. The reason for naming the project as Conventional Power Generator is that because of adding some advancement to the circuit such as adding of solar plate to the circuit which will conveniently charge the battery basing on the solar energy available during the day. And remaining portion of the circuit does the job of generating power on the capacity of circuit requirement.*
***Keywords:** Inverter, Oscillator, 12V DC to 220V AC Inverter.*

I. INTRODUCTION

Now in India, we have 140 Crore people are alive, where as 400 million people are not having Electricity access. Although India has less than a fifth of the world's population, which is close to 40 percent of the world's population without access to electricity. Consider the example of Fateh Nagla Village which is located in Uttar Pradesh (one of the most India's populated state).In Fateh Nagla, having total population of 963 people, 150 homes are Available. In this premises,only 15 Houses having electricity access, probably connected to the power grid. And remaining 135 Houses, people are suffering with the Non-accessible electric supply.

Fig–1: A night view of the 'electrified village of Fateh Nagla, where only 15 homes are connected to the power Grid.

Fig-2: A Boy studying under the light of a kerosene lamp in Fateh Nagla.

In this way so many people are struggling with this problem. These people live in darkness during nights. By the consideration of all these issues, there is one better solution for providing electricity access for small domestic appliances at home, which is "the Conventional Power Generator."

Here mainly, this power generator is suitable for the low voltage applications i.e. 40-45W rating appliances. By the way, increasing the range of this power generator is possible by adding more no. of MOSFETs' to the circuit.

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II. INVERTER

An inverter is an apparatus that changes direct current (DC) to alternating current (AC).
Direct current is supplied by devices such as batteries. When connected, an inverter allows these devices to provide AC electrical power for small household devices. The inverter does this through a complex process of electrical adjustment. From this process, AC electric power is produced. This form of electricity can be used to power an electric light, a microwave oven, or some other electric machine. An inverter usually also increases the voltage. In order to increase the voltage, the current must be decreased. So, an inverter will use a lot of current on the DC side when only a small amount is being used on the AC side.
By the way, this Small size inverter will invert the signal of 12V DC to 220V AC signal. This inverted current will be helpful for the small rating appliances in home. This Inverter will be constructed using less no. of components and it is very compact .i.e., it occupies less space for its implementation.

III. OSCILLATOR

An oscillator is a circuit which produces a continuous, repeated, alternating waveform without any input. Oscillators basically convert unidirectional current flow from a DC source into an alternating waveform which is of the desired frequency, as decided by its circuit components. Practically, the oscillators are nothing but the amplifier circuits which are provided with a positive or regenerative feedback where in, a part of the output signal is fed back to the input. The amplifier consists of an amplifying active element which can be a transistor or an Op-Amp and the back-fed in-phase signal is held responsible to keep-up (sustain) the oscillations by making-up for the losses in the circuit. This Oscillator is built up by using the 2N2222 transistors. Each transistor produces an inverting square wave, which means that it produces some sustained oscillations to the circuit.

IV. 12V DC TO 220V AC INVERTER

Inverters are often needed at places where it is not possible to get AC supply from the Mains. An inverter circuit is used to convert the DC power to AC power. Inverters can be of two types true/pure sine wave inverters and quasi or modified inverters. These true /pure sine wave inverters are costly, while modified or quasi inverters are inexpensive. These modified inverters produce a square wave and these are not used to power delicate electronic equipment. Here, a simple voltage driven inverter circuit using power transistors as switching devices is build, which converts 12V DC signal to single phase 220V AC.

A. Principle Behind this Circuit

The basic idea behind every inverter circuit is to produce oscillations using the given DC and apply these oscillations across the primary of the transformer by amplifying the current. This primary voltage is then stepped up to a higher voltage depending upon the number of turns in primary and secondary coils.

B. Inverter circuit using Transistors

A 12V DC to 220 V AC converter can also be designed using simple transistors. It can be used to power lamps up to 35W but can be made to drive more powerful loads by adding more MOSFETS.
The inverter implemented in this circuit is a square wave inverter and works with devices that do not require pure sine wave AC.

C. Components required

1) *Bread Board:* The purpose of the breadboard is to make quick electrical connections between components like resistors, LEDs, capacitors, etc- so that you can test your circuit before permanently soldering it together. Breadboards have many small sockets on them, and some groups of sockets are electrically connected to each other. Here this whole circuit implementation can be done by the bread board or else we can use PCB also.

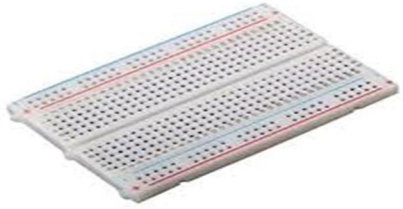

Fig-3: Bread Board

2) *12V Battery:* A 12 volt battery is an irregular battery used in specific electronic applications. Of all the types of batteries, the 12 volt battery is one that looks very different depending on its use. In some ways, it is one of the most diverse of all batteries. It can be large or small, heavy or light. In some cases, they may look nearly like regular AA batteries. One of the most common uses of a 12 volt battery is for transportation applications, such as in cars and boats. The sizes of 12 volt batteries vary widely based on the amp hours they are designed to produce. They can be very heavy and large, such as those found in cars.

Fig-4: 12V Battery

3) *MOSFET:* IRF630 is an N channel MOSFET manufactured in TO-220 and other packages. The transistor is designed for applications which require high speed switching and it is capable of delivering switching speed of the order nano seconds. The transistor is also capable to drive load of upto 200V with upto 9A current and in pulse mode it can drive load of upto 36A for a time period of 300 microseconds with duty cycle of 2%. Moreover the transistor also has low ON state resistance between drain and source which results in low power loss. Besides, its use as a switch, it can also be used as an amplifier to build high power amplifiers. IRF630 can be used in applications in which high switching speed is required. Other than that it can also be used in any general application that falls under its specifications. It is also suitable for audio amplification and can be used to build high power audio amplifiers. The procedure of using this transistor in circuit is same as you use any other MOSFET.

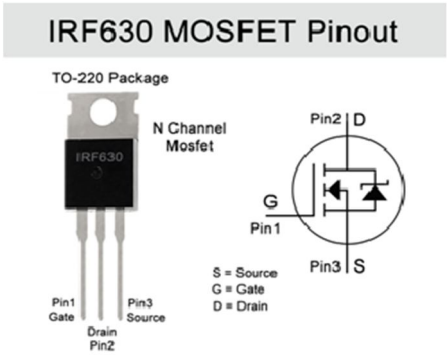

Fig-5: MOSFET IRF 630

4) *2N2222 Transistors:* The 2N2222 is a common NPN bipolar junction transistor (BJT) used for general purpose low-power amplifying or switching applications. It is designed for low to medium current, low power, medium voltage, and can operate at moderately high speeds. The 2N2222 is considered a very common transistor, and is used as an exemplar of an NPN transistor. It is frequently used as a small-signal transistor, and it remains a small general purpose transistor of enduring popularity. The 2N2222 was part of a family of devices described by Motorola at a 1962 IRE convention. Since then it has been made by many semiconductor companies, for example, Texas Instruments.

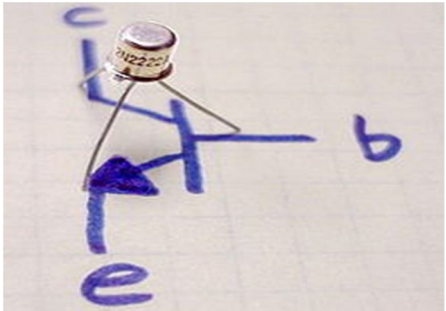

Fig-6: 2N2222 Transistor

5) *2.2uF (Micro Farads) Capacitors:* (Electrolytic decoupling capacitors 2.2uF / 63V). These capacitors are great transient/surge suppressors and work well in high-voltage and audio applications. High quality radial electrolytic capacitors.

Fig-7: 2.2uF Capacitor

6) *Resistors:* A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages. High-power resistors can dissipate many watts of electrical power as heat. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Fig-8: 680 ohms Resistor

7) *12V to 220V centre tapped Step-up Transformer:* We require this transformer for combining the inverting signals and together it will be stepped up to 220V AC source voltage.

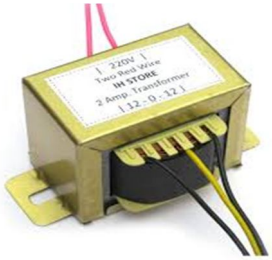

Fig-9: Centre tapped step-up transformer (12V-220V)

V. CIRCUIT DIAGRAM

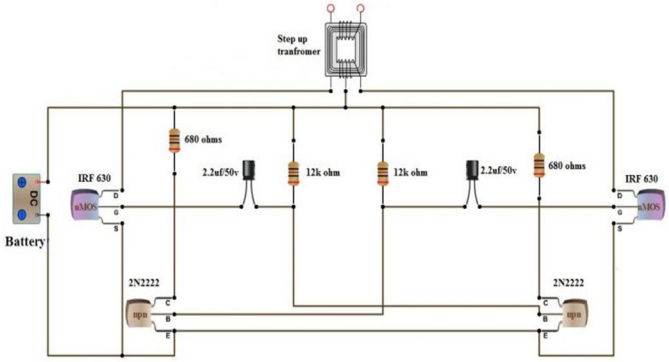

Fig-10: Circuit diagram of 12VDC to 220V AC inverter

A. Working

The circuit can be divided into three parts: oscillator, amplifier and transformer. A 50Hz oscillator is required as the frequency of AC supply is 50Hz.

This can be achieved by constructing an Astable multivibrator which produces a square wave at 50Hz. In the circuit, resistors R1, R2, R3, R4, capacitors C1, C2, transistors T2 and T3 form the oscillator.

Each transistor produces inverting square waves. The values of R1, R2 and C1 (R4, R3 and C2 are identical) will decide the frequency. The formula for the frequency of square wave generated by the astable multivibrator is

f = 1/ (1.38*R2*C1) Hz

The inverting signals from the oscillator are amplified by the Power MOSFETS T1 and T4. These amplified signals are given to the step-up transformer with its center tap connected to 12V DC.

The turns ratio of the transformer must be 1:19 in order to convert 12V to 220V. The transformer combines both the inverting signals to generate a 220V alternating square wave output.

By using a 24V battery, loads up to 85W can be powered, but the design is inefficient. In order to increase the capacity of the inverter, the number of MOSFETS must be increased.

VI. ADVANCEMENTS IN INVERTER CIRCUIT

A. By this inverter circuit, power can be generated by one's self in some different locations and areas.

B. Solar equipment can be connected to this inverter circuit. The solar plate will produce some energy, and that energy will be stored in batteries while rest of the portion of the circuit remains the same.

C. The inverter circuit does the job of producing electricity from the energy obtained by the solar power.

D. This whole thing is implemented on a single pole of equipment and then placed at different consumer areas, where the electricity access is required.

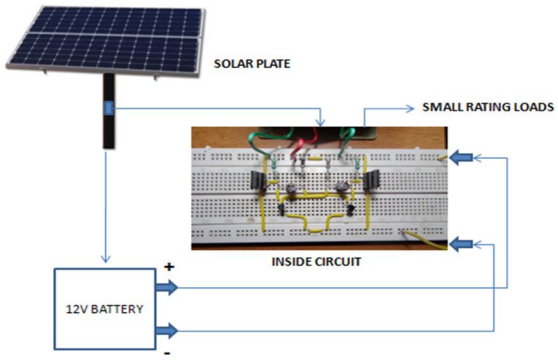

Fig-11: Inverter circuit along with solar equipment

VII. ADVANTAGES OF CONVENTIONAL POWER GENERATOR:

A. From construction point of view, it's a slightly simple circuit.i.e., It requires fewer components.

B. By using this, people can generate electrical energy by their own self.

C. It's portable, and easily movable and transportable to any required location.

D. It's economical.

VIII. LIMITATIONS OF CONVENTIONAL POWER GENERATOR

A. It cannot generate high voltage levels.

B. It is not suitable for high watt rating appliances at home.

C. It cannot generate electrical power in all weather conditions such as in rainy season, as we get less amount of solar energy. So, the battery is not charged sufficiently by the solar plate. Electricity is generated until the solar energy is available in the period of day.

D. Use of transistors reduces the efficiency of the circuit.

E. Use of switching transistors has the possibility of causing cross over distortion in the output signal. However this limitation has been reduced to some extent by the use of biasing diodes.

IX. APPLICATIONS

A. This circuit can be used in cars and other vehicles to charge small batteries.
B. This circuit can be used to drive low power AC motors
C. It can be used in solar power system.

X. CONCLUSION

An inverter is an electrical device that converts direct current (DC) to alternating current (AC). The converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits.

Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries.

If this simple circuit which is discussed in the paper is implemented, then we can obtain 220V AC supply from a 12V DC battery and thereby, we can offer some little help to the people who suffer with non-accessibility of electricity for the homes.

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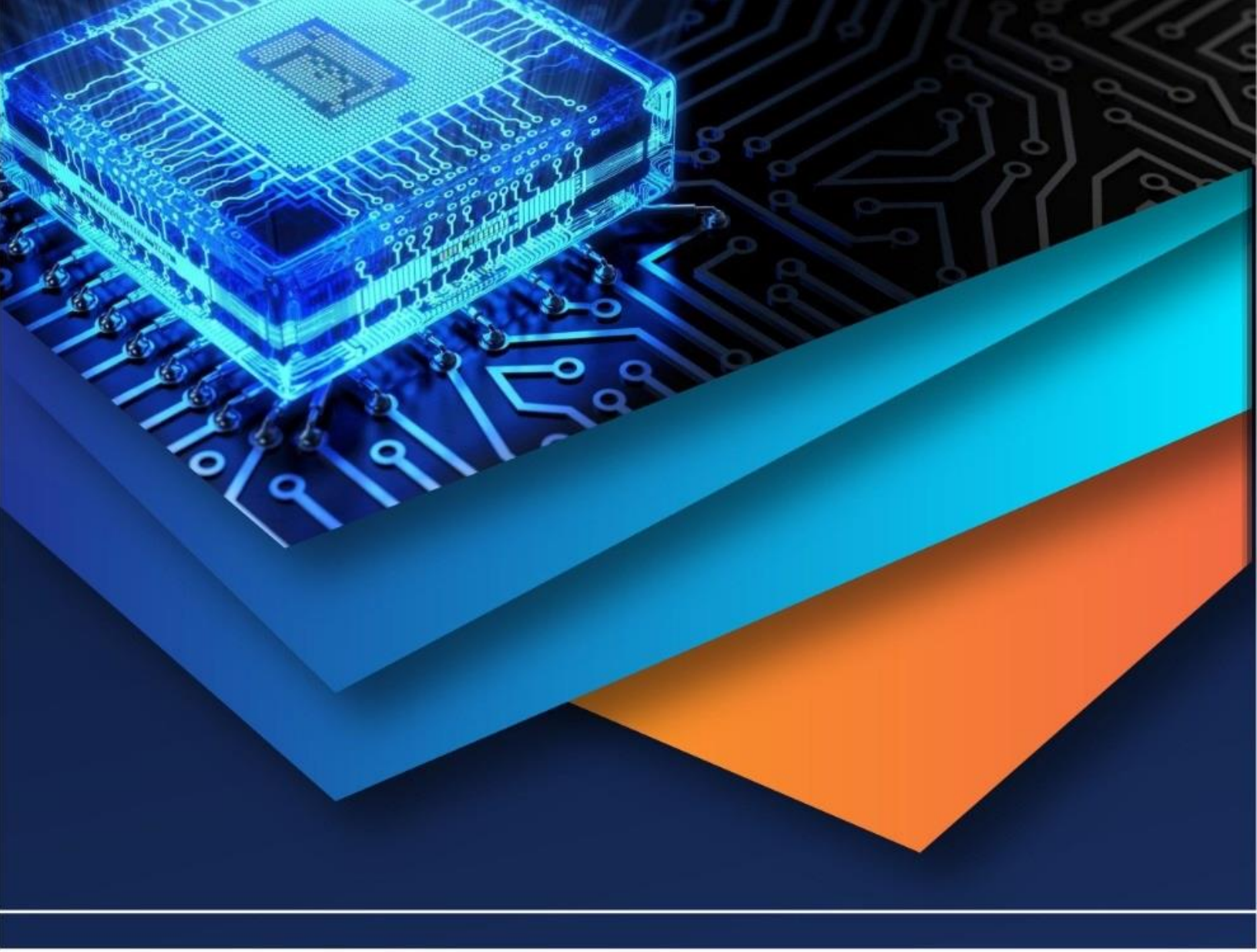

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