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DesignandAnalysis of 230V Inverter

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ABSTRACT
An inverter is an electrical device that converts direct current (DC) to alternatingcurrent (AC). The converted AC can be at any required voltage and frequencywith the use of appropriate transformers, switching and control circuits. Aninverter is essentially the opposite of a rectifier. In this research work, a 500Wpower inverter system was designed, and simulated. The values ofthe various components were determined before the simulations wereembarked upon using electronic workbench: Multisim software. The inverter circuit in this research work is based on the operationof the U_1CD4047 and U_2ULN2004. 12V AC which is stepped up to 230V AC by using a step uptransformer. The assemble composite unitworked well. The oscilloscopemeasurement was tallied with the set frequency of 50Hz and the square waveoscillator output.

KEYWORDS: Inverter, electricity generation, Multisim, Simulation & oscillator.

I. INTRODUCTION

Due to today total dependence on electricity and because of frequent electrical power outage,back up power is becoming a necessity. Emergency back-up power system can provide electricalpower to critical loads or the whole house during power outages. All type of electronic devices requires power supply from electricpower sources for their operation. This source can be either generator or a battery(Richard, 2000).In our societytoday, the need for power supply can not be over emphasize, because the provision of good andservices could be completely cut off without electricity power supply. For one to fully enjoy thebetterment of living in this new dispensation there should be an adequate stable source of powersupply (Tharaja, 2007).

There are currently two forms of electrical transmission, Direct Current (DC)and Alternating Current (AC), each with its own advantages and disadvantages. DC power issimply the application of a steady constant voltage across a circuit resulting in a constant current.A battery is the most common source of DC transmission as current flows from one end of a circuitto the other (Bo*et al.*,2015).

The aim of this research work is to design and evaluate 230V inverter while the main objective of this research work is to convert 12V DC supply to 230V AC using both simulation and calculation method.Most digital circuitry today is run off of DC power as it carries theability to provide either a constant high or constant low voltage, enabling digital logic to processcode executions. Historically, electricity was first commercially transmitted and was a DC power line. However, this electricity was low voltage, due to the inability to step upDC voltage at the time, and thus it was not capable of transmitting power over long distances(Paul *et al.*,2015).Electrical transmission has therefore been mainly based upon AC power, supplying mostNigerian homes with a 220 volt AC source. It should be noted that since 1954 there have beenmany high voltage DC transmission systems implemented around the globe with the advent ofDC/DC converters, allowing the easy stepping up and down of DC voltages (Ali*et al*, 1992).

Over the years electricity has been generated through energy conversion from one place to another.Some of these energy sources are; Solar, Thermal, Wind and Electric generators etc. These sourceshave proved to be quite reliable and efficient but, due to inadequate sources ofenergy to run the engines or a fault in the system as a result of poor maintenance, they have failedthe users at one time or the other (Mukund, 2006). As such the need for a reliable standby powersupply is essential which brought into existence an alternative means called *inverter*.Inverters are electronic circuits that convert DC to AC. We can easily say that inverters transferpower from a dc source to an ac load. The objective is to create an ac voltage when only a DCvoltage source is available. A variable output voltage can be obtained by varying the input DCvoltage and maintaining the gain of the inverter constant(Harry *et al*.,2008). The inverter gain can be defined as the ratio of the ac output voltage to dcinput voltage. This proposalwill presents the design and construction of 500VA square wave power inverter systemusing multisim software for the simulation. The simulation is mearnt to createa better understanding of the output wave form.

CATEGORIES OF INVERTERS

The inverter are extensively used, not only because of their universal function of converting DC power toAC power, but also because of their high efficiency, reduced power costs and versatileapplications(Alexander, 2016).These days, they are being used extensively in applications where there is a frequent power cutoff, because in case of power failures, inverters are a very good and efficient power remedies. Forevery classification, we form some basis first, depending upon which we can further categorizeour results for easier understanding and a better approach (John.,2001). This is done in order topromote better understanding and a more extensive classification of different things.Inverters are primarily classified on the basis of their output characteristics. So there are threedifferent types of outputs we get from inverters, and hence we classify inverters into three primaryclasses, which are: (i) Square Wave inverter. A square wave inverter is one of the simplest invertertypes, which convert a straight DC signal to a phase shifting AC signal. But the output is not pureAC, i.e. in the form of a pure sine wave, but it is a square wave. At the same time they are cheaperas well. The simplest construction of a square wave inverter can be achieved by using an on-offswitch, before a typical voltage amplifying circuitry like that of a transformer. (ii)Modified Sine wave inverter or quasi sine wave inverter(Simon*etal*., 2005). The construction of this type of inverteris a bit more complex than a simple square wave inverter, but still it is a lot simpler than a puresine wave inverter. A modified sine wave shows some pauses before the phase shifting of thewave, i.e. unlike a square it does not shift its phase abruptly from positive to negative, or unlike asine wave, does not make a smooth transition from positive to negative, but takes brief pauses andthen shifts its phase. (iii) Pure sine wave inverter (Anil, 2007). The electrical circuit of a pure sinewave inverter is far more complex than a square wave or modified sine wave inverter. Anotherway to obtain a sine output is to obtain a square wave output from a square wave inverter and thenmodify this output to achieve a pure sine wave (Sen, 2002).

II. METHODOLOGY

This research work was undertaken on the net and other source to ascertain the basic operatingprinciple of inverters in general. The block diagram which reflects the basic units of the desiresystem will be develope using MULTISIM Software toascertain the output wave form before the actual hardware design.

III. RESULTS AND DISCUSSION

This section deals with the design stages of the complete circuit diagram of the electrical inverter.Design Specification

Output power = 500W, Frequency = 50Hz, Input voltage = 12Vdc, Output voltage = 230Vac

Transformer Rating: Required output voltage (V_2) =15V, Input voltage (V_1) = 230v

Primary turns (N_1) = 300

$$\text{Secondary turns } N_2 = \frac{N_1V_2}{V_1} = \frac{300*15}{230} = 19.56turn$$

Transformer output current = 2A

Output power = 15x 2A =15 $* 2 = 30w$

Transformer Design

$$A = \frac{\sqrt{P}}{5.58} = 4.58 * 10^{-4}m^2 \text{ where P = 500w and 5.58 is constant}$$

$$\Phi_m = B_m * A$$

$$B_m = flux\ density\ in\ tesla = 1.531tesla$$

$$A = Area\ in\ square\ meter = 4.58 * 10^{-4}m^2$$

$$\Phi_m = B_m * A = 1.531 * 4.58 * 10^{-4} = 7.01198 * 10^{-4}w$$

$$E_1 = 4.44 * F * \Phi_m = 4.44 * 50 * 7.01198 * 10^{-4} = 0.1557V/turn$$

Primary Turn$N_1 = \frac{V_1}{E_1} = \frac{12}{0.1557} = 77turns$

Secondary Turns$N_2 = \frac{N_1V_2}{V_1} = \frac{77*230}{12} = 1476turns$

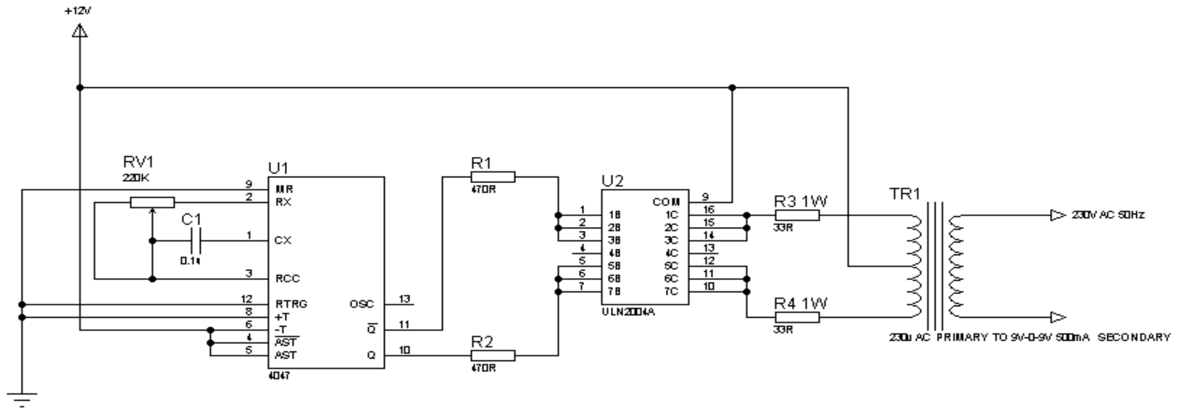

Figure 1.0 Inverter circuit diagram

Using this circuit you can convert the 12V dc in to the 230V Ac. In this circuit $U_1$4047 and U_2 ULN2004 is use togenerate the square wave of 50Hz and amplify the current and then amplify the voltage by usingthe step up transformer.

Table1.0:Simulation of Inverter System Results

Simulation Parameters	Specified value	Achieved value
Output voltage	230V	230V
Output power	500W	498.5W
Frequency	50Hz	50Hz
Waveform	Square wave	Square wave

IV. CONCLUSION

The design of the electrical inverter was achieved and successfully designed despite a lot ofassumptions and approximations made in the design. The circuit design was able to convert the12V DC supply from the deep cycle batteries to 230V alternating current. It is to be noted that theefficiency of this research depends on the power rating of the connected batteries and on the totalload rating. Thus, the inverter could deliver constant power for a calculated number of hours.We believe to the best of our knowledge that this design had expose some technical content ofdesigning an electrical inverter, if desired, the same approach can be applied in designing inverterwith a better output like the pure sine wave 5KV inverter system.

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