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LM555 Timer-Based Inverter Low Power Pure Sinusoidal AC Output

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Abstract: The demand of highly efficient and stable DC to AC inverters used in renewable energy systems to convert DC output from green energy sources into purely sinusoidal unwavering AC is on rise, due to low cost energy generation and conversion, less complexity and environmental factors. Later this converter energy can be feed in to grid or utility supply for load sharing purpose also (can be work as Distributed Generation System (DGS)). This paper represents a duty cycle-based configuration of LM555 timer to generate an AC output of 50Hz. Two BJT transistors (NPN and PNP) are used to convert the 12V DC into 12V AC cycle. Also the low pass filter design is tested to transform distorted square wave into pure sinusoidal wave with minimum ripples on no load condition. The results shown are simulation based, showing a proper shape of 220V AC output with very less harmonics surges and noise effects.

Key words: Inverters · Low pass filter · Sinusoidal waveform

INTRODUCTION

The demand for the use of electric power in today's society is increasing as society advances in living standard going up around the world. Due to heavy power losses in long transmission lines, the impact on public and awareness about environmental safety is increasing day by day [1]. By addition of new power plants, the power transmission and distribution system over long distances coupled with the concerns of safety is becoming highly sensitive when looked at from view point of safety concerns by intellectuals [2-4]. Also the aging of existing power system structure, the issues stemming from environmental calamities in the form of storms and hurricanes are all kind of challenging tasks lying before the electric utilities to combat with. The traditional power systems with power stations remotely located from load centers generating power to be transported via long transmission lines is being supported by energy generation from green sources referred to as Distributed Generation (DG) [5]. Simultaneously, other avenues of clean energy sources such as wind and solar are already considered to be serious contenders due their current cost-affordability values for such generating units. This is supported by the drastic reduction in cost of the interfacing modules required integrating these units into the system.

A concurrent and significant consequence of this situation is a shift of the electric power system from the existing style of centralized generation to a newer one highly marked by Distributed Generation (DG). In this DG style of power systems, a relatively small number of very high power AC power generators is to be supported by an extremely large number of small–medium power generators (DC and AC) run by energy from renewable sources. Among such sources are those from solar panel and wind turbine are drawing the most attention worldwide [6].

The energy generated by these renewable energy generation plants is in raw direct current form. Which is, then, converted into alternative current (AC) by using power inverters such that the resulting output AC is synchronized for being fed to electrical grid systems [7-9]. Integration of these renewable energy power generation systems to grid supply system needs to meet required levels of power quality in the form of reduced harmonics and higher power transfer efficiency under varying load conditions-all such activities make up new areas of research pursuits.

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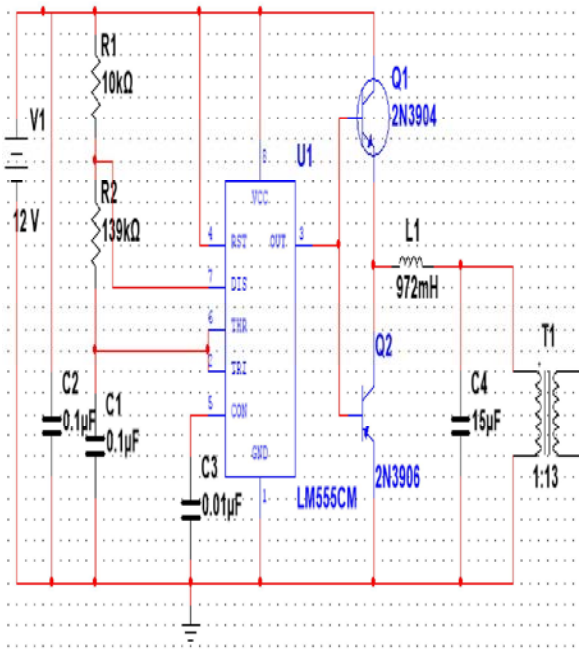

Fig. 1: Timer-based inverter circuit

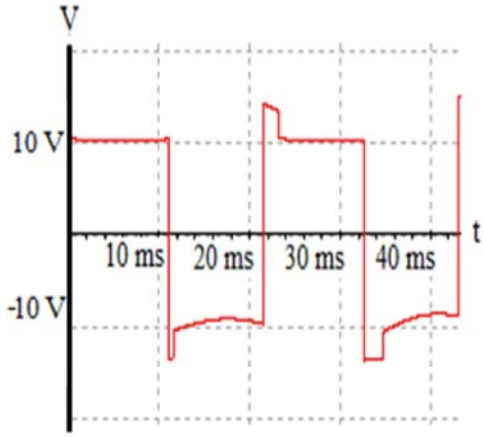

Fig. 2: Output waveform at transistor terminals

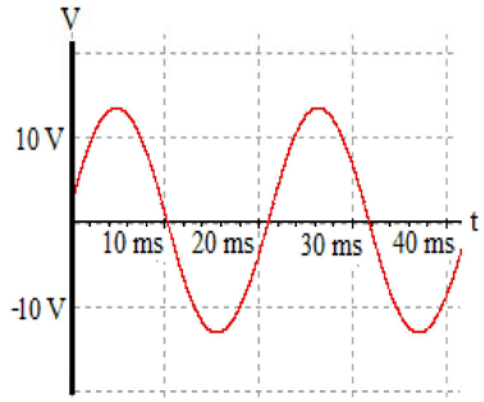

Fig. 3: Output waveform after low pass filter

This paper gives an overall architecture of a system for converting DC into AC of a transformer based inverter using simple 555 timer IC. The results are related to output in response to timed (RC) generation of a digital output with appropriate frequency.

Circuit Schematic: The template is used to format your paper and style the text. All margins, column widths, line spaces and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings and not as an independent document. Please do not revise any of the current designations. In Figure 1 is shown a transformer and LM555 IC based inverter circuit with configuration capable of giving a 50 Hz 220 V output. Where, V1 is a 12V DC input voltage supply which can be from any renewable energy generator (such as solar panel or wind turbine), resistors R1, R2 and capacitor C1 are acting as a time constant (τ), the transistor Q1 is NPN and while transistor Q2 is PNP, both make up a pair of switching devices to generate AC cycle, while inductor L1 and capacitor C4 are acting as a low pass filter to convert square wave output from the transistor-pair into sinusoidal wave.

Wave Shaping: The output from NPN and PNP transistor pair is in square wave which also contains harmonics and wave form disorder properties as shown in Figure 2.

After amplification by the transistors, the proposed low pass filter configuration for 50Hz frequency the harmonics are reduced and the output waveform is in proper sinusoidal shape ascan be observed in Figure 3.

RESULTS AND DISCUSSION

The output from the low pass filter is passed through to a transformer to step it up to 220 V AC.

Figure 4 shows the results for R1=10kΩ and R2= 150kΩ with frequency of 54Hz and The output waveform shown in Figure. 5 is 50Hz, 220V AC pure sinusoidal wave with R1 and R2 values of 10kΩ and 139kΩ respectively with no load attached.

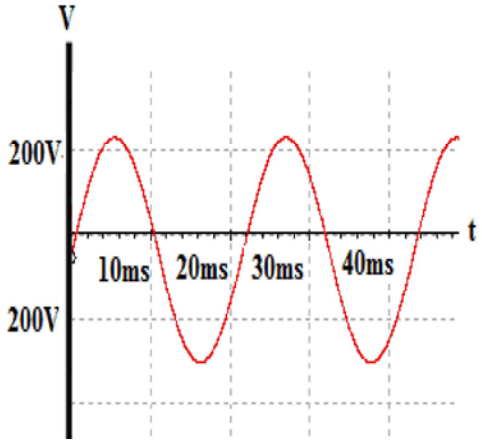

Fig. 4: Inverter 220V 54Hz AC output

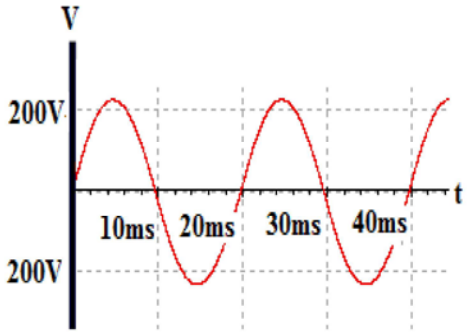

Fig. 5: Inverter 220V 54Hz AC output

CONCLUSION

This paper represents a duty cycle configuration of LM555 timer to generate 50Hz AC output. Also the low pass filter design is tested to transform distorted square wave into pure sinusoidal wave form. The results shown are simulation based which shows a proper shape 220 V AC output with reduced harmonics and noise effect as compare to transistor 5V output

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