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DESIGNING AND MANUFACTURING OF PSEUDO-SINUSOIDAL PWM INVERTER BY USING SMART FEEDBACK TO STABILIZE VOLTAGE PARAMETERS FOR TYPICAL APPLICATIONS

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ABSTRACT

Developing an inverter with high efficiency and with the ability of starting with inductive, capacitive, and resistive loads along with output voltage stability is a challenging problem. Considering higher reliability and convenient maintenance, this paper focuses on the use of analog circuits. In this regard, this paper uses pulse width modulation techniques, intelligent feedback, and peak as well as effective voltage supply are employed. Results indicated that this designed inverter with a power of 700 W can be started with ohmic loads (100% quality), inductive loads (97% quality), and capacitive loads (83% quality).

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KEY WORDS

Inverter, pulse width modulation, intelligent feedback, peak and effective voltage.

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INTRODUCTION

Worldwide ever-increasing energy demand from one side and inefficiency of the conventional power generation systems from the other side have led the involved authorities to use reliable and efficient technologies in power production without the use of fossil fuels. In recent decades, with the advancement of power production and energy consumption efficiency, high quality energies such as alternative electricity replaces low quality counterparts such as coal. Electricity as one of the main entities in economic part is greatly important. Thus, consumption forecast and immediate supply of power demand can accelerate economic growth [1]. Excessive growth of energy consumption in Iran is high such that prior to the time horizon 2020, its role as an energy exporter will change to a country of energy importer. To counter this threat, implementing optimization strategies in generation, distribution and consumption of energy, along with modifying consumption patterns and the use of renewable energy are essential [2]. Therefore, the use of converters with high efficiency and power can be greatly useful in solving this problem [3]. P. Sponic et al. and YazdanPanah et al. studied in the field of designing and manufacturing a high frequency inverter controlled by PWM with soft switching characteristics for use in induction heating systems. Soft switching range for the proposed half-bridge inverter is significantly increased compared to conventional half-bridge inverter. Among the applications of the circuit are cook stoves that operate with high thermal efficiency and in constant frequencies around 20 kHz [4, 5]. Ridge studied foundations of power MOSFETs. Discrete power MOSFETs are semiconductor processing techniques that operating similar to today's VLSI circuits. The study consists of a wide variety of MOSFET behaviors; however, here only V-I curve of transistor is examined. When MOSFET is used as a switch, its primary function is to control the discharge current by the gate voltage [6].

Mr. Barati et al. conducted a research in an article entitled "reducing the amplitude of voltage harmonics of the three-phase PWM inverter with parallel processing" and concluded that this technique is highly efficient. In this paper, using power transistors as switches, a three-phase inverter is proposed by PWM method. The experimental results obtained from a laboratory-built plan entirely validated the theoretical results [7].

MATERIALS AND METHODS

1. Voltage supply

Two basic points are exist regarding the start of consumers with ohmic, inductive, and capacitive loads. First, effective voltage for starting these consumers is 220 V. Second, peak voltage required in starting instant in inductive and capacitive loads is 310 V. In most of the square wave inverters, inductive and capacitive loads cannot be started due to focus on stability of peak voltage of 220 V. On the other hand, this issue is resolved appropriately and high quality by the use of pulse width modulation technique and intelligent feedback.

2. Pulse width modulation technique

PWM is a proper method to stabilize peak and effective voltage of the inverter. Based on the equation below, one can verify that by the use of intelligent feedback to convey load variations, peak voltage and effective voltage are fixed on 310 and 220 V.

$$V_{rms} = \int V_{peack} dt$$

[Figure- 1] depicts PWM technique performance in three modes: normal mode, voltage drop (due to consumer connection), and voltage rise (due to disconnection of the consumer).

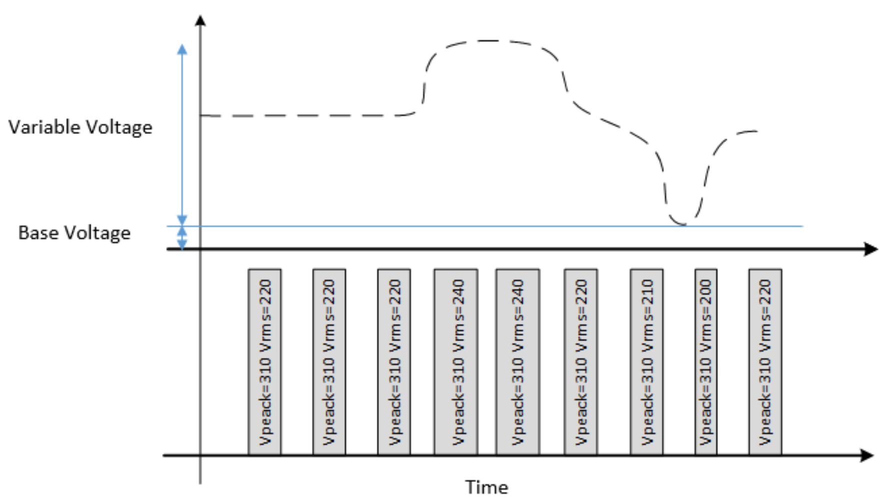

Fig: 1. Performance of PWM technique (dashed line shows load value and square wave shows system output).

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3. Intelligent feedback

The output voltage is one of the best examples to adjust employed pulse widths. However, since it is not easily achievable due to higher voltage amplitude and transformation, a 12-V coil with low current mounted on the same transformer is used to get the best and accurate sample. This voltage which is changing with the output voltage and with a similar ratio is the best sampling source. Feedback input, after converting to DC state, is adjusted in two maximum transfer of variations and base voltage value modes by two potentiometer RV1 and RV2 **[Figure- 3].**

4. Analog design

Due to higher reliability and convenient maintenance, this paper focuses on the use of analog circuits. Thus, a powerful IC id SG3526 used within its central part. This IC with higher performance is a pulse width modulator which is designed and fabricated for fixed frequency and other power control applications. Among the performances of this IC, one can mention temperature control, sawtooth oscillator, pulse width modulator, pulse frequency measurement, having two high current output which is ideal for starting MOSFET transistors, phase difference of 180 degrees and non-overlapping of two outputs and power in high speeds.

RESULTS

Its protection features are soft starting, voltage clamp, current limiter, and adjustable dead time. Adjustability leads this device to connect mid- point transformer. **Figure- 2** shows block diagram of the IC.

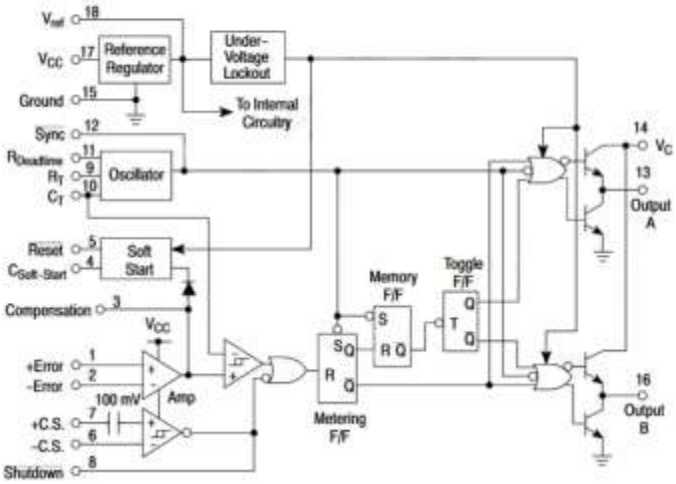

Fig: 2. Block diagram of SG3526

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Designed circuit

In order to maximally utilization of this powerful IC, circuit shown in **[Figure- 2]** is designed.

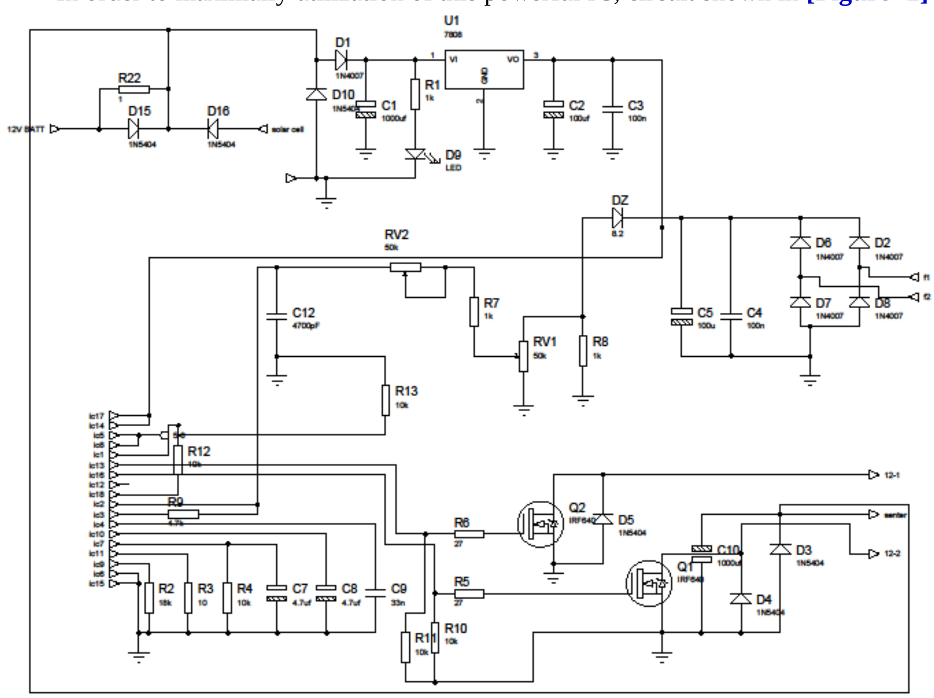

Fig: 3. Designed circuit

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CONCLUSION

Inverters are one of the most important parts of renewable energy systems which can supply required energy demand of customers by DC voltage transform of batteries into AC one. Several aspects such as high efficiency, the ability to start various consumers such as inductive, capacitive, and ohmic loads, and fixing output voltage are important in design and development of inverters. In this paper, the design and development of square-wave inverters are addressed where it was tried to best solve the required parameters.

In order to measure the quality of various loads starters, three incandescent lamps as ohmic loads, drill as an inductive load, and refrigerator as capacitive load are used. Measurement of power produced is done once by a load with nominal voltage and by the designed inverter.

Results showed that the designed inverter with a power of 700 W can start ohmic loads (100% quality), inductive loads (97% quality), and capacitive loads (83% quality).

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CONFLICT OF INTEREST

Authors declare no conflict of interest

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None

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