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Fuzzy Logic based Hysteresis Controller for Buck-Boost Converter

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Abstract: A new method of controller design for boost type dc-dc converter is proposed. A feedback controller for DC-DC boost converter is designed to obtain constant output voltage of 24v.The converter operates in repeated Conduction Mode, with gentle changes between the buck and the boost operations across a line-cycle. To implement the Power Factor Correction (PFC) functionality, the controller computes the buck and the boost duty cycles based on the sensed inductor current and output voltage. The control of static converters has been the subject of an important research activity over the past decades. This interest is mainly due to the emergence of embedded electronics in everyday life, increasing thereby the need for more efficient converters. The input voltage for boost converters is 12 volts. The output voltage across the load 6Ω is maintained constant at 48 volts.
Keyword: DC-DC, Feedback Controller, Power Factor Correction (PFC)

I. INTRODUCTION

The main target of power electronics is to convert electrical energy from one form to another. To make the electrical energy to reach the load with the highest efficiency is the target to be achieved. Power electronics also targets to reduce the size of the device which aims to reduce cost, size and high availability. In this project, the power electronic device is DC–DC boost converter. Sometimes, it is necessary to increases dc voltage. Boost converter is a DC–DC converter in which the output voltage is always greater than the input voltage which depends on switching frequency[1]. From the energy point of view. From the energy point of view, output voltage regulation in the DC–DC converter is achieved. a novel method of controller design for boost type dc-dc converter is proposed. DC/DC converters are widely used in photovoltaic generating systems as an interface between the photovoltaic panel and the load. Therefore, a better possible control technique is required in order to control the variation in output voltage of DC/DC converter due to the variation occurring in the external static input parameters such as radiation, temperature and internal impedance of the photovoltaic (PV) module.

A. DC-DC Boost Converter

The dc-dc boost converters are used to convert the unregulated dc input to a controlled dc output at a desired voltage level. They generally perform the conversion by applying a dc voltage across an inductor or transformer for a period of time (usually in the 20 kHz to 5 MHz range) which causes current to flow through it and store energy magnetically, then switching this voltage off and causing the stored energy to be transferred to the voltage output in a controlled manner. The output voltage is regulated by adjusting the ratio of on/off time. This
is achieved using *switched-mode*, or *chopper*, circuits whose elements dissipate negligible power. *Pulse-width modulation* (PWM) allows control and regulation of the total output voltage. It is considered as the heart of thepower supply, thus it will affect the overall performance of the power supply system. The ideal converter exhibits 100% efficiency; in practice, efficiencies of 70% to 95% are typically obtained.

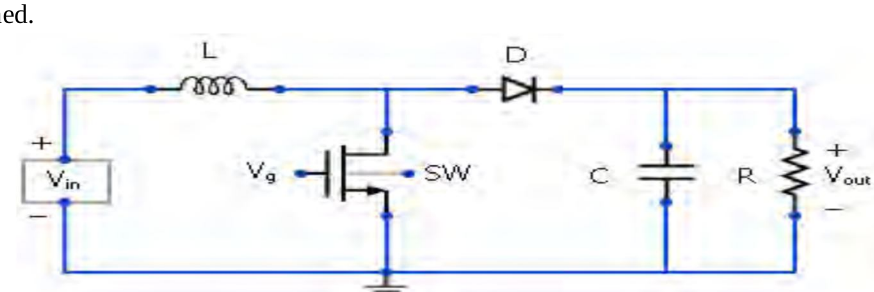

Fig. 1 Schematic of Boost converter

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II. LITERATURE REVIEW

A boost converter is designed to step up a fluctuating or variable input voltage to a constant output voltage of24 volts with input range of 6-23volts in [1]. To produce a constant output voltage feedback loop is used. The output voltage is compared with a reference voltage and a PWM wave is generated, here PIC16F877 microcontroller is used to generate PWM signal to control switching action. A DC to DC converter is used to step up from 12V to 24V in [2]. The 12V input voltage is from the battery storage equipment and the 24V output voltage serves as the input of the inverter in solar electric system. In designing process, the switching frequency, *f* is set at 20 kHz and the duty cycle, *D* is 50%.

A. *Proposed System*

1) *Feedback Control System:* Initially the PWM is tested to evaluate the PWM signal generated by the unit. Next, the controller is tested by varying the input voltage and controlling the output voltage.

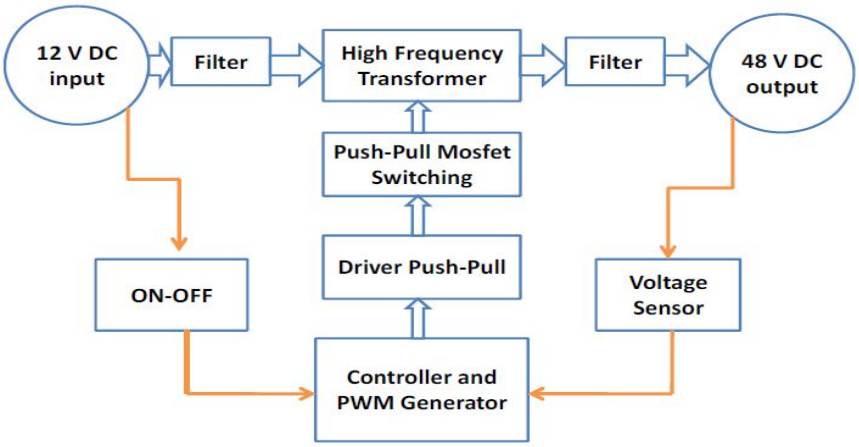

Fig. 2 DC to DC converter static output

Many industrial, scientific, medical,
Communication and defense equipment's require 32 or 48 volt power supply. These equipment's can be operated in a fixed placed as well as in a mobile unit. Unfortunately, many power supply, especially in a mobile unit, available only in 12 volts. These 12 volt power may come from car battery or solar cell. In this research, a 12 volt DC to 48 volt DC converter is designed, implemented and tested. The power supply is designed as a switching mode power supply (SMPS) with feedback regulator for efficiency and operational flexibility. This way, the output voltage can be adjusted by the user to meet their need. The performance of the power supply is obtained by varying the input voltage and varying the output voltage. The power supply is also tested by applying the converter using car battery as its input and loading the power supply. Test results show that the power supply could deliver power from 26.6 to 55 volt DC for input voltage of 9.8 to 12volt. For output of 48 volt, the converter yields an efficiency of 85% with ripple voltage of 50 millivolt peak to peak.
The experimental result shows that the controller is capable of maintaining the output voltage at 48V DC when the input voltage is 9.8V or higher. When the input voltage is 12V, the controller is capable of controlling the output between 26.6V to 55V DC.

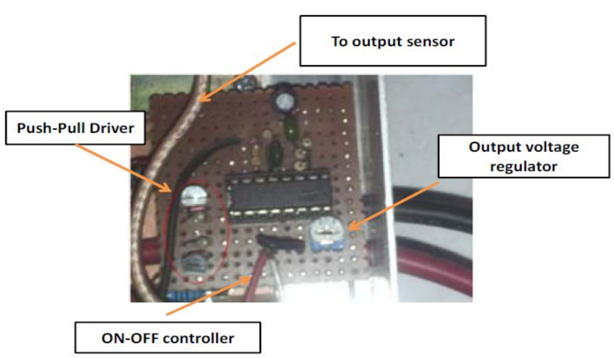

Fig. 3 The control system

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III. RESULT AND DISCUSSION

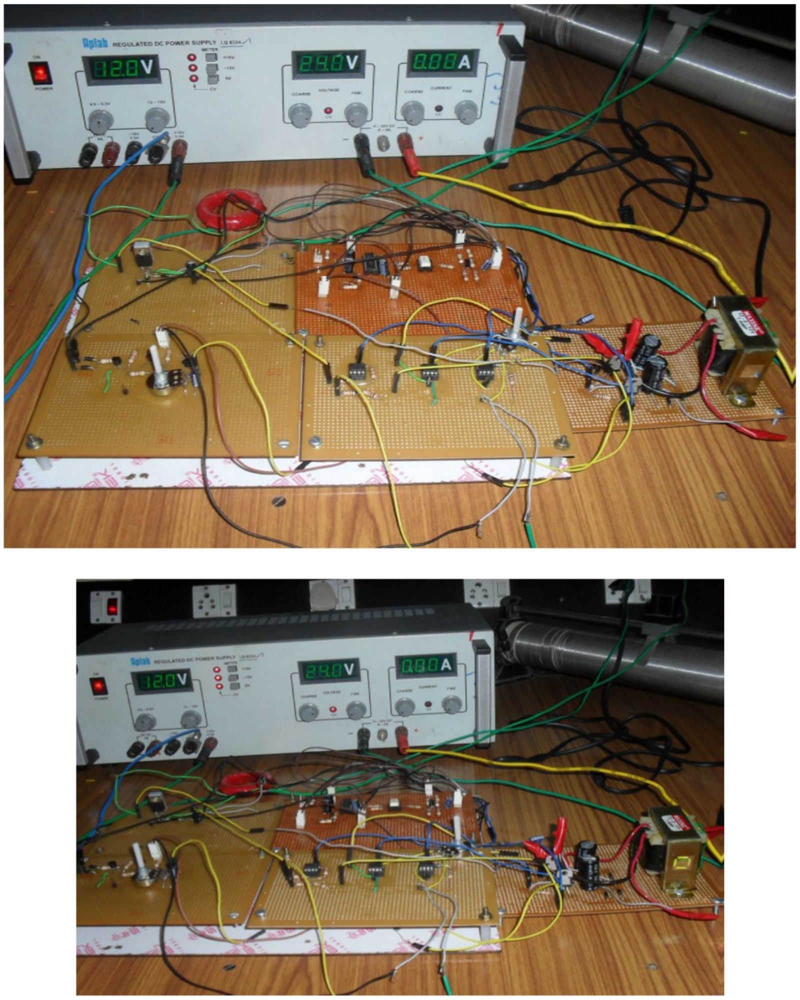

Fig.4 Hardware setup for closed loop boost converter.

The performance of the power supply is obtained by varying the input voltage and varying the output voltage. The power supply is also tested by applying the converter using car battery as its input and loading the power supply. Test results show that the power supply could deliver power from 26.6 to 55 volt DC for input voltage of 9.8 to 12volt. For output of 48 volt static, the converter yields an efficiency of85% with ripple voltage of 50 milli volt peak to peak.

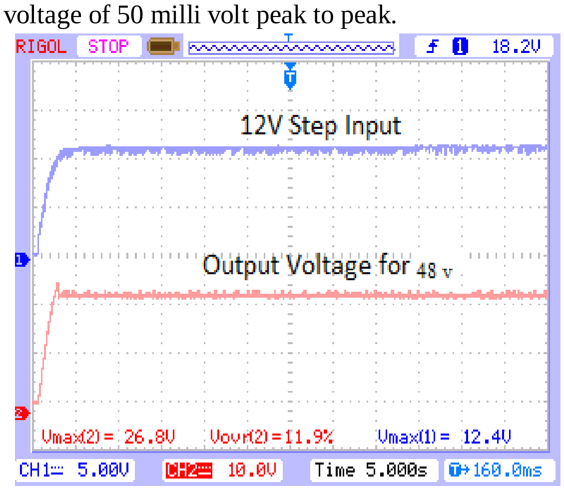

Fig .5 12v to 48v static output

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IV. CONCLUSION

A DC – DC converter has been successfully developed and tested. The converter is capable of maintaining output voltage at 48v static volt When input voltage is maintained at 12 volt, the DC – DC converter is capable of delivering output voltage from 26.6 volt to 55 volt. The feedback controller module is intended to control andstabilize output voltage of the converter.

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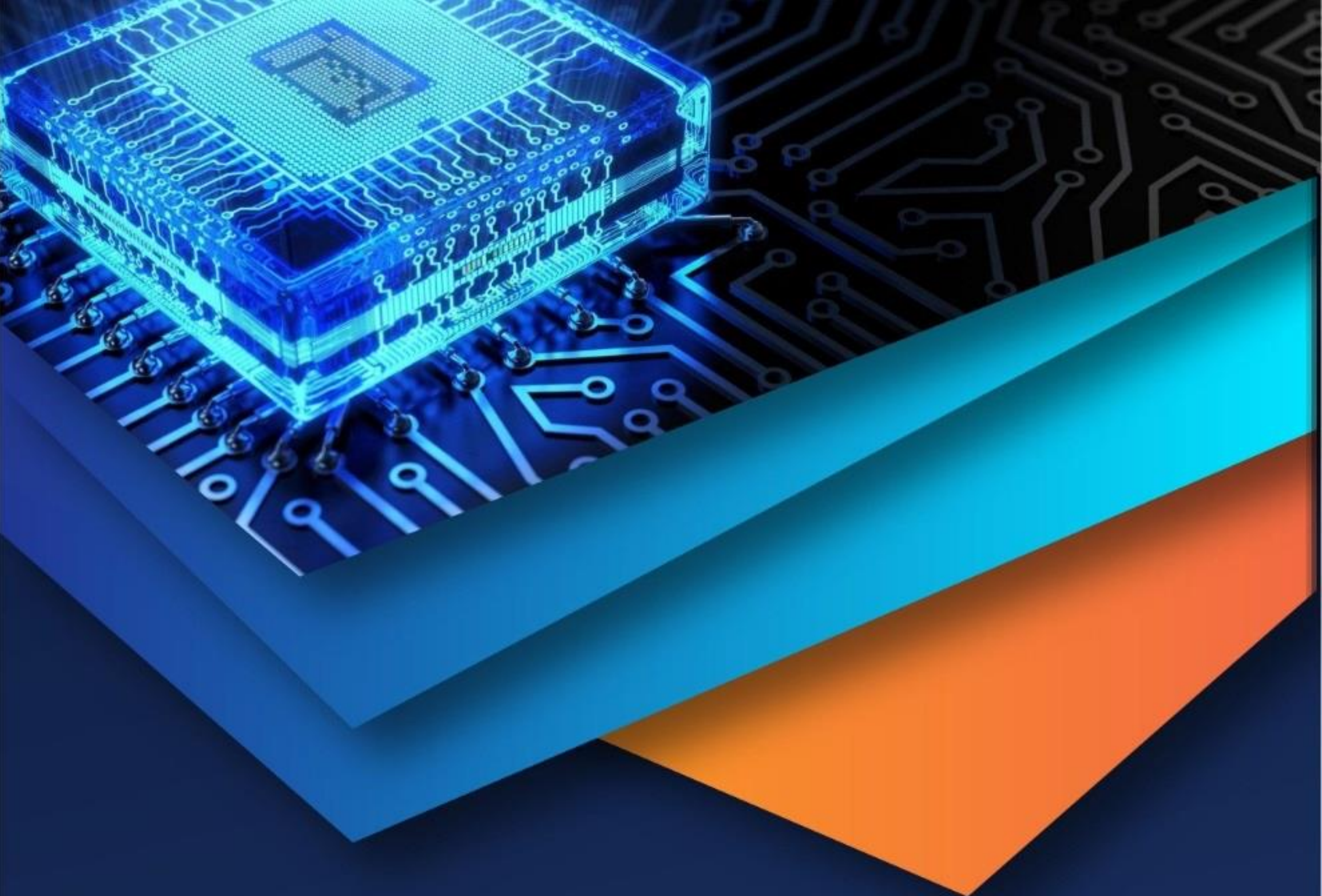

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