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Design and Analysis of DC To DC Buck-Boost Converter System with Inter Phase of Micro Controller

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Abstract: **In recent times, many existing and developing electrical and electronic fields require voltages of different levels supplied from a singular existing source voltage such as a battery. Basically DC converters are devices designed for the purpose of changing DC voltage levels. The converters are electronic devices, it has an output voltage magnitude that is either greater than or less than the input voltage magnitude. Rising energy has a higher cost of delivering power and low power density. Meanwhile, the demand for compact power supplies rises significantly. It requires power supplies with high efficiency, low cost and smaller size. In order to control the output voltage of the converter, the controller is designed to change the duty cycle of the converter. In this converter IGBT switch is digitally controlled by microcontroller. In this work simulation and then hardware implementation is done with analysis of the results. The converter is mainly used, where load is very sensitive (battery - powered products), it provides variation of 1% only.**

Keywords: **Micro Controller, Switch Voltage, Power Factor, PWM Pulses.**

I. INTRODUCTION

Basically DC - DC converters are electronic devices which used whenever we want to change DC electrical power efficiently from one voltage level to another. In High frequency switching converters, semiconductor devices switch at a rate that is fast compared to the variation of the input and output waveforms basically. High frequency switching converters are used most often as interfaces between DC systems of different voltage levels according to the requirement of particular application. These converters are known as high-frequency DC - DC converters. They can be used in the power supplies and other electronic equipment for various analysis. And also high frequency switching converters can also be used as an interface between DC and AC systems. In the fields of electrical engineering and applied physics, high voltage DC is required for several applications.

Such as electron microscopes, X-ray units require high DC voltages of the order of 100 kV or more, electrostatic precipitator, particle accelerators in nuclear physics and plasma research, railway coaches, drives, UPS system applications.

Basically the converter is able to deliver output voltages both higher as well as lower than (or even equal to) the input voltage, this is why it is referred to as a buck-boost power converter. In many applications the input voltage can vary widely, starting at full charge and gradually decreasing as the battery charge is used up. At full charge, where the battery voltage may be higher than actually needed by the circuit being powered, a buck mode would be ideal to keep the supply voltage steady at that time. However as the charge diminishes the input voltage falls below the level required by the circuit, and either the battery must be discarded or recharged so for particular at this point the ideal alternative would be the boost mode.

II. SYSTEM MODEL AND ASSUMPTIONS

If we consider the system as 5.5 kW converter, flyback switched mode power supply is used with multiple secondary for supply of microcontroller and driver card operated at 25 kHz. IGBT is used as switch, operating at 6.4 kHz switching frequency.

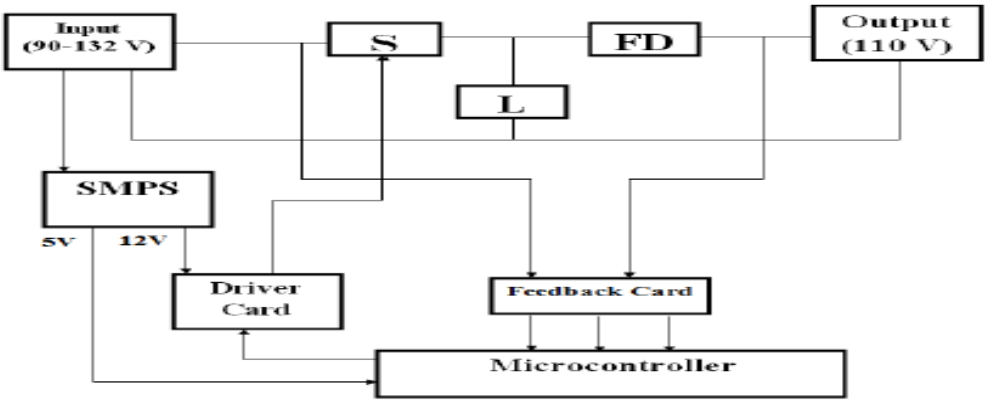

Fig.1: Block Diagram of Converter

IGBT switch is used in converter which is digitally controlled by microcontroller. This micro controller adjust duty ratio and provides proper output. It is a RISC (Reduced Instruction Set Computer) design, only thirty seven instructions to remember. Its code is extremely efficient, allowing the PIC to run with typically less program memory than its larger competitors with low cost, high clock speed.

III. DC-DC CONVERTER SYSTEM

Basically, two inductors are used for feeding the load by two independent switches. One inductor charges up by load voltages and another inductor discharges its energy into load during this time. The output power is almost like doubled where the ripple voltage is reduced by factor of two when compared to the conventional DC to DC converter. If the supply side matter is concern for application purpose then it includes Switched mode power supply and flyback converter with KA3524 SMPS controller. And according to the design parameters and results, simulation is done for getting reference values for the hardware implement with Micro Controller.

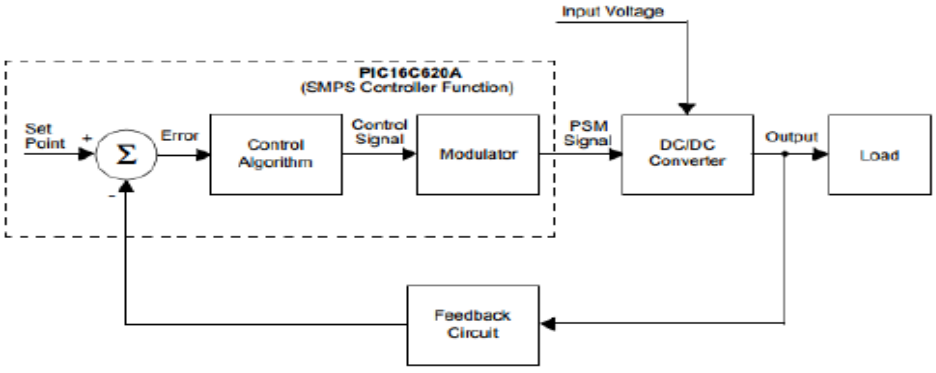

Fig.2: DC-DC Converter System

IV. SIMULATION RESULTS

Basically Simulation results are carried out considering parameters like switch voltage, primary voltage, output current, output voltage and secondary voltage of Buck Boost Converter. Here in Figures, Simulation results are shown and according to this simulation result, reference values are being obtained and according to this values hardware results can be obtained.

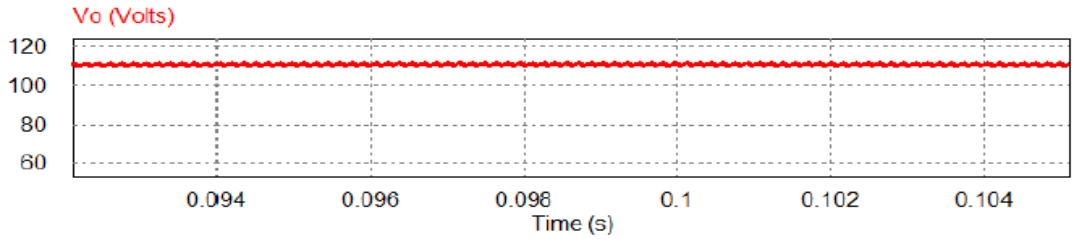

Fig.3: Voltage Waveform of Buck Boost Converter

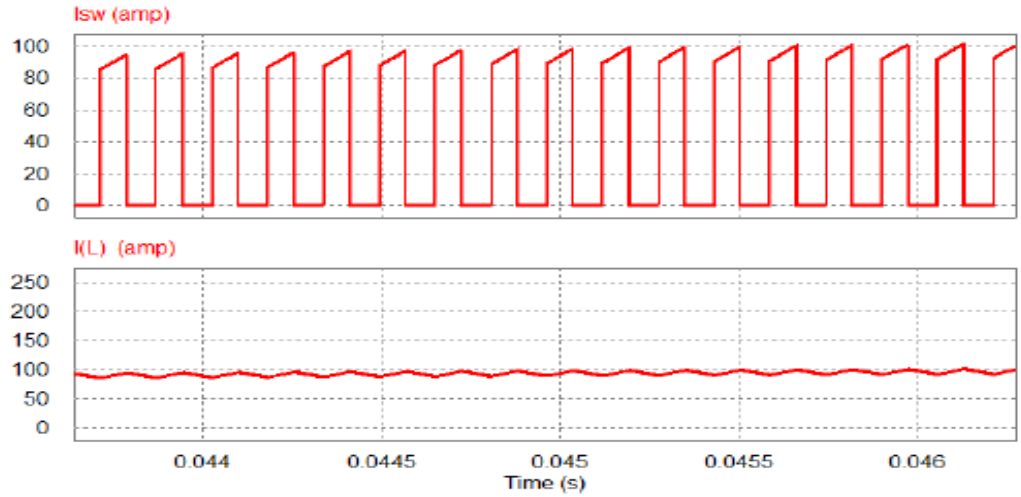

Fig.4: Current Across Switch And Current Through Load Waveforms Of Buck Boost Converter

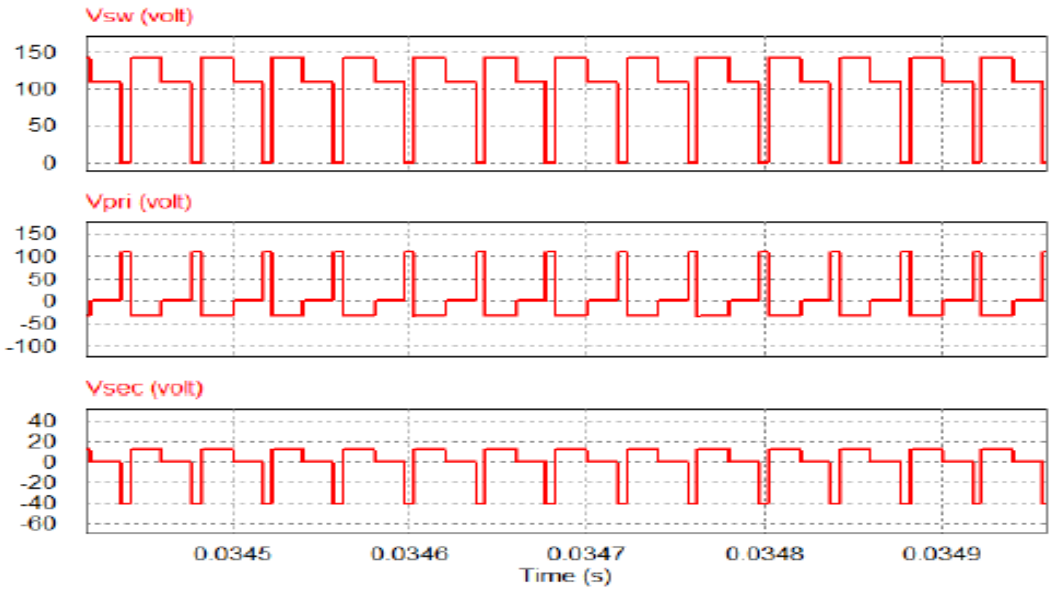

Fig.5: Waveforms of Switch Voltage, Primary Voltage And Secondary Voltage

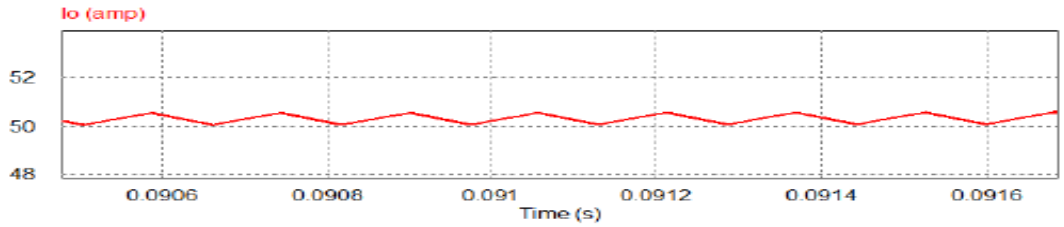

Fig.6: Output Current Waveform Of Buck Boost Converter

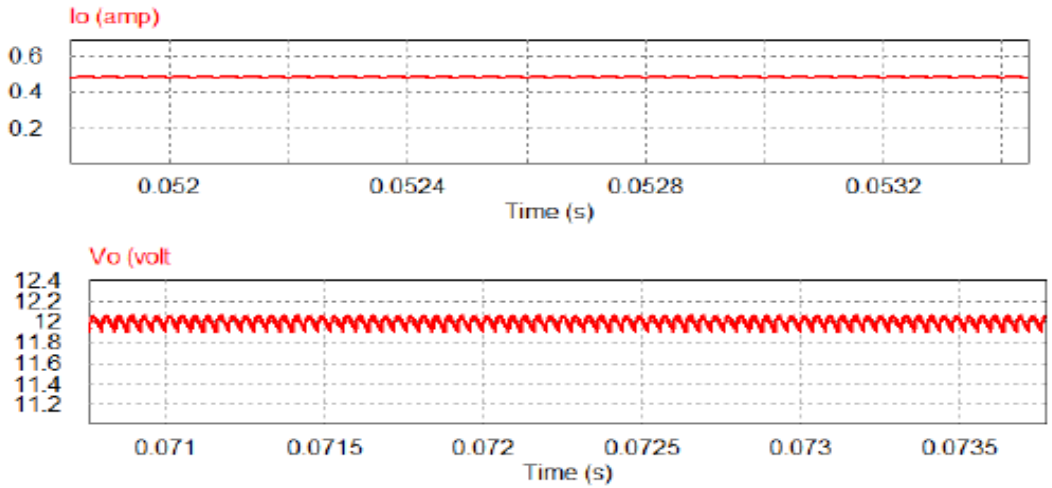

Fig.7: Waveforms of Output Current And Output Voltage

Basically in DC to DC Buck Boost Converter system, Fly back SMPS is used to for power supply at certain frequency to supply voltage to control circuitry and driver circuitry respectively. Input voltage range can be varied between 90V-132V, with switching frequency around 6.4khz.

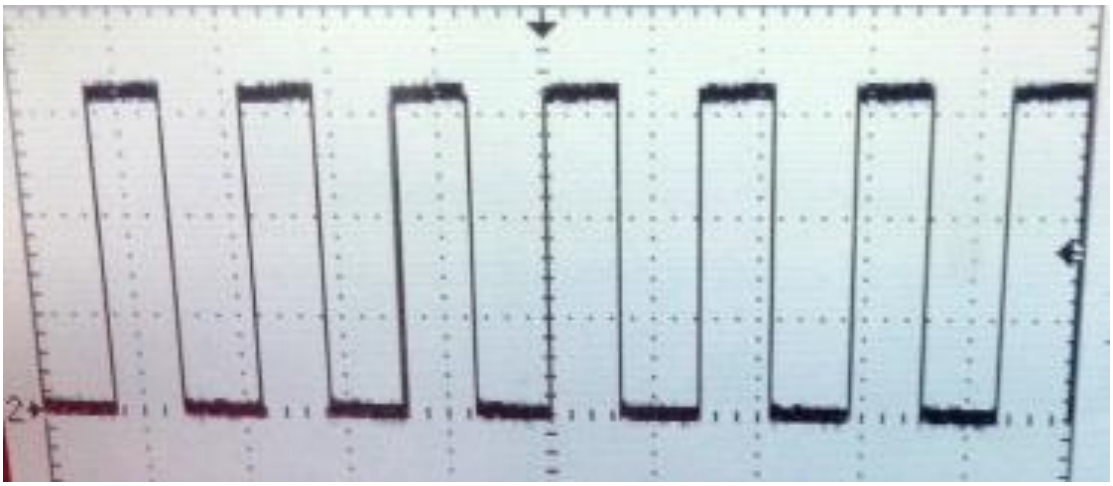

Fig.8: Output Waveform Of PWM Pulses [Scale X:Axis 100us/div, Y:Axis 1V/div]

Here in Figure 8, Output voltage waveform of PWM pulses is shown which is being obtained by Micro Controller for the analysis of Buck Boost converter system basically.

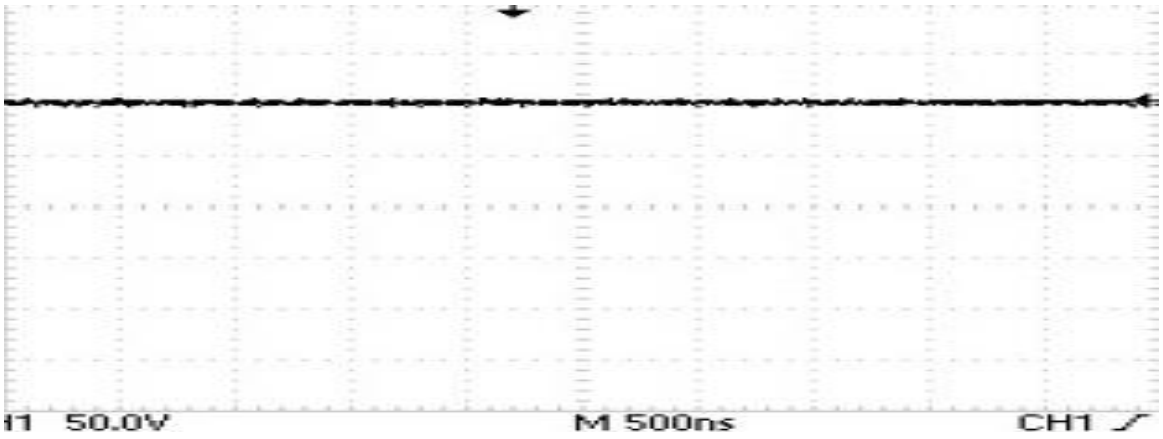

Fig.9 Output Voltage At Boost Voltage Level [Scale X:Axis 500ns/div, Y:Axis 50V/div]

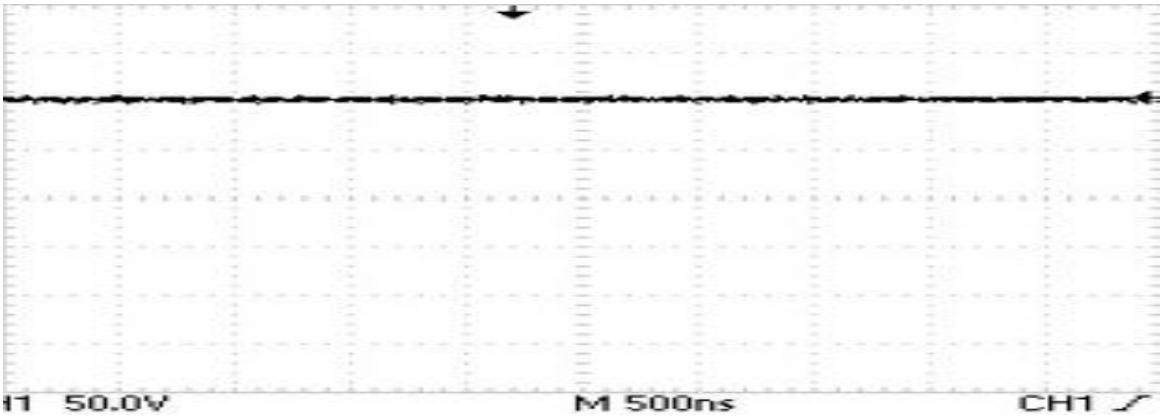

Fig.10 Output Voltage At Buck Voltage Level [Scale X:Axis 500ns/div, Y:Axis 50V/div]

V. CONCLUSION

Basically Rising energy density tends leads to higher cost of delivering power and low power density. This Buck-Boost Converter system is being controlled by Micro controller. High efficiency and low noise around 110V load was obtained. Simulation and hardware implementation can be easily done by interfacing with the Micro controller with ADC and PWM analysis. The high power quality Buck-Boost Converter is proper alternatives for battery powered products.

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