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DESIGN OF INTEGRATED ZVS SINGLE-INDUCTOR MULTIPLE -OUTPUT USING SYNCHRONOUS BUCK CONVERTER FOR MULTI-LOAD APPLICATIONS

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Abstract:

The fast market growth of battery-operated portable applications such as digital cameras, personal digital assistants, cellular phones, MP3 players, medical diagnosis systems, etc. demands for more and more efficient power management systems. In this area, DC-DC converters play a critical role in keeping long battery life while still providing stable supply voltage together with the required driving capability. In these devices, an inductor stores magnetic energy and transfers part of it to a load while another part is converted into electrostatic energy stored in a capacitor. The result is high power efficiency, low cost, and small size. Often, in portable applications, the reduction of power is obtained by using multiple supply voltages for different functional blocks. A dynamic regulation of the supply following the performance requests optimizes the use of power.

Keywords – Digital, Dynamic, Electrostatic.

1. INTRODUCTION

However, since having in the system one inductor per DC-DC converters is expensive and not practical, the strategy is viable only if two or more converters share the same inductor as proposed in recent implementations (single inductor multiple output boost converter and boost or buck converters with double output. Since the regulation of each output requires its loop control, a multiple-output system must foresee a multi feedback loop with the request of suitable processing of signals. Moreover, it is necessary to use extra power switches that must be properly driven. This paper studies the above mentioned design problems and applies the identified solutions to a study case: a four output single inductor buck converter able to independently regulate the output voltages in the range 0 V - 1 V below the power supply voltage and able of an overall driving capability of 0.8 A.

The switching frequency is 3 MHz and the external inductor is 1 µH. Transistor level simulations show that a power efficiency as high as 86% can be achieved.Multiple output converters are widely used in the industrial applications. Designing multi-output converters presents a remarkable challenge for the power supply designer. Converters utilizing a single primary power stage and generating more than one isolated output voltage are called multi-output converters. The basic requirements are small size and high efficiency. High switching frequency is necessary for achievement of small size. If the switching frequency is increased then the switching loss will increase. A new generation of single input multiple output (SIMO) dc–dc converters has been developed based on boost and inverted topologies. However, in these configurations, loads are independently constructed except the negative output. In the proposed SIMO converter, the techniques of soft switching and voltage clamping are adopted to reduce the switching and conduction losses via the utilization of a low voltage rated power switch with a small Rds (on). This project presents a newly designed SIMO dc–dc converter based on boost and inverted derived topologies with a coupled inductor. The motivation of this project is to design a single input multiple output converter for increasing the conversion efficiency, voltage gain, reducing the complex control and saving the cost of manufacturing.

2. PROPOSED SYSTEM

A rectifier is an electrical device that converts alternating current which periodically reverses direction to direct current which flows in only one direction. The process is known as rectification. Rectifiers have many uses, but are often found serving as components of DC power supplies and high voltage direct current power transmission system. Many application of rectifier such as supplies for radio, television and computer equipment, require a steady constant DC current.

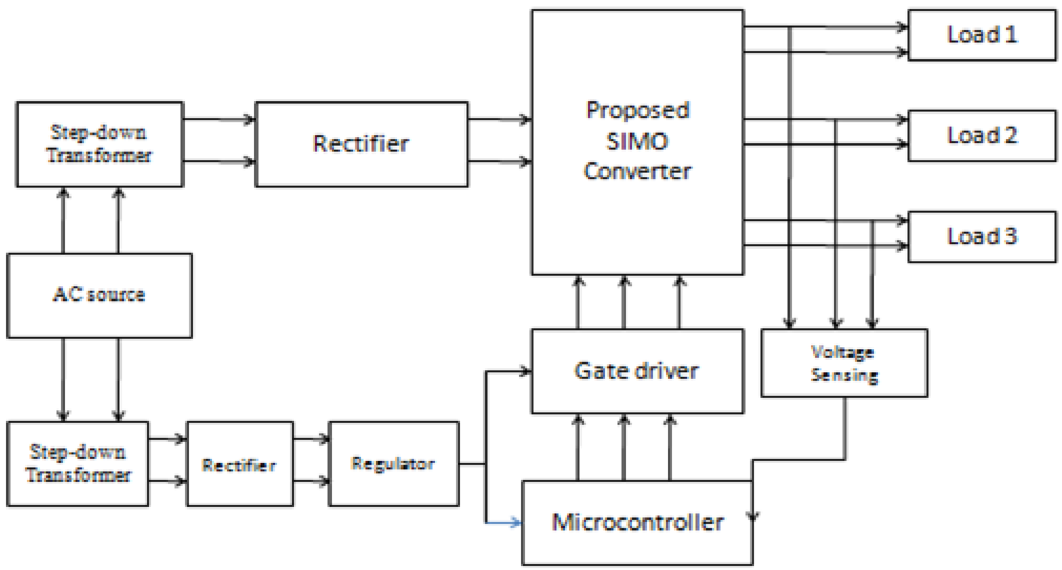

Fig.1.Block diagram

A voltage regulator is a circuit which makes the rectifier-filter output voltage constant regardless of the variations in the input voltage load. It is a simple forward design. It may include negative feedback control loop increasing the open loop gain tends to increase the regulator accuracy. It is designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism or electronic component depending on the design; it may be used to regulate one or more AC or DC voltage. A DC -to -DC converter is a device that accepts a DC input voltage and produces a DC output voltage. Typically the output produced is at a different voltage level then the input. In addition, DC-to-DC converters are used to produce noise isolation, power bus regulation, etc.

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3. CONVERTER

The conceptual model of the buck converter is best understood in terms of the relation between current and voltage of the inductor. Beginning with the switch open (off-state), the current in the circuit is zero. When the switch is first closed (on-state), the current will begin to increase, and the inductor will produce an opposing voltage across its terminals in response to the changing current. This voltage drop counteracts the voltage of the source and therefore reduces the net voltage across the load.

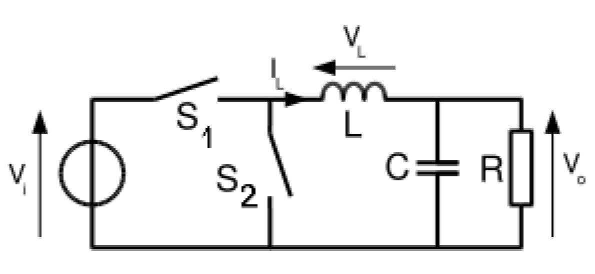

Fig.2.Converter

Over time, the rate of change of current decreases, and the voltage across the inductor also then decreases, increasing the voltage at the load. During this time, the inductor stores energy in the form of a magnetic field. If the switch is opened while the current is still changing, then there will always be a voltage drop across the inductor, so the net voltage at the load will always be less than the input voltage source. When the switch is opened again (off-state), the voltage source will be removed from the circuit, and the current will decrease. The changing current will produce a change in voltage across the inductor, now aiding the source voltage. The stored energy in the inductor's magnetic field supports current flow through the load. During this time, the inductor is discharging its stored energy into the rest of the circuit.

4. SIMULATION RESULT

A Microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports, and a timer all on a single chip. In other words, the processors, RAM, ROM, I/O ports, and timer are all

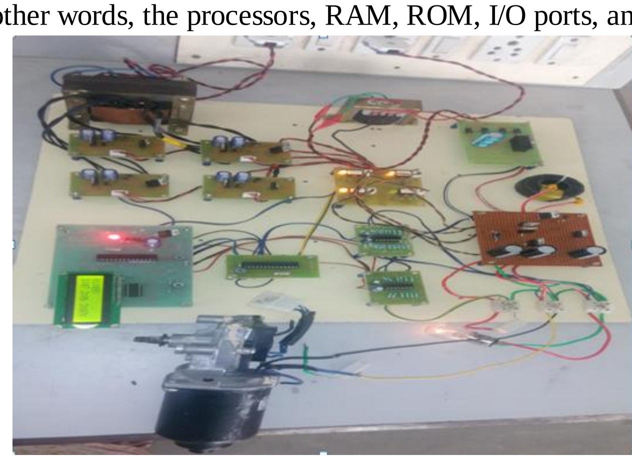

Fig.3.Hardware structure

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embedded together on one chip; therefore, the designer cannot add any external memory, I/O, or timer to it. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical. In many applications,

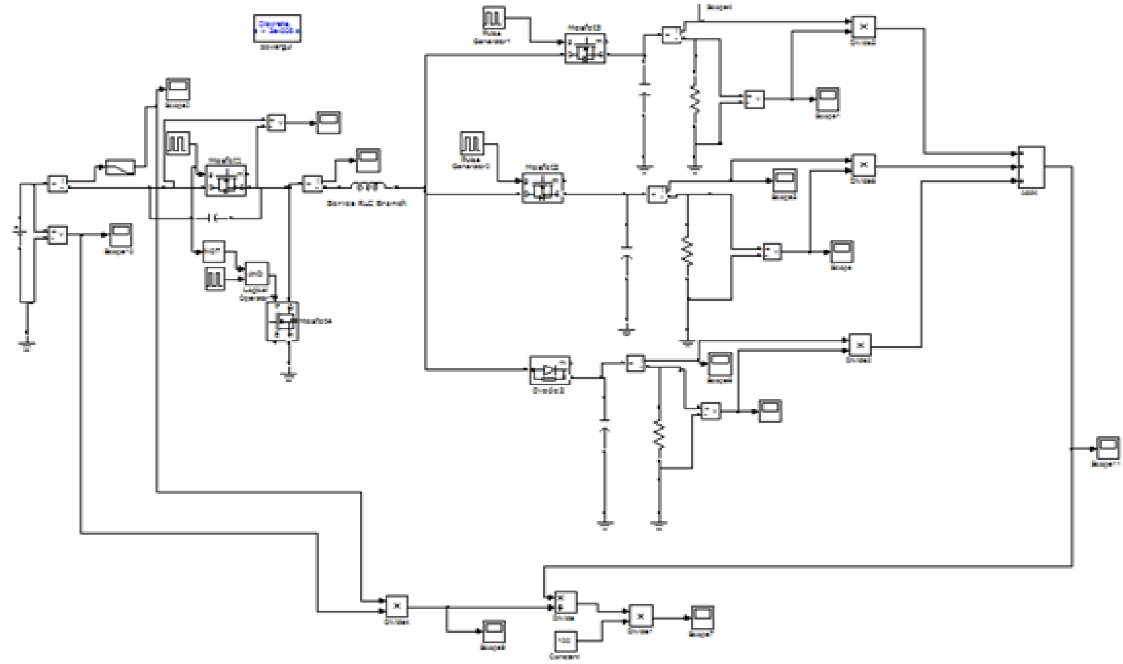

Fig.4.Simulation system

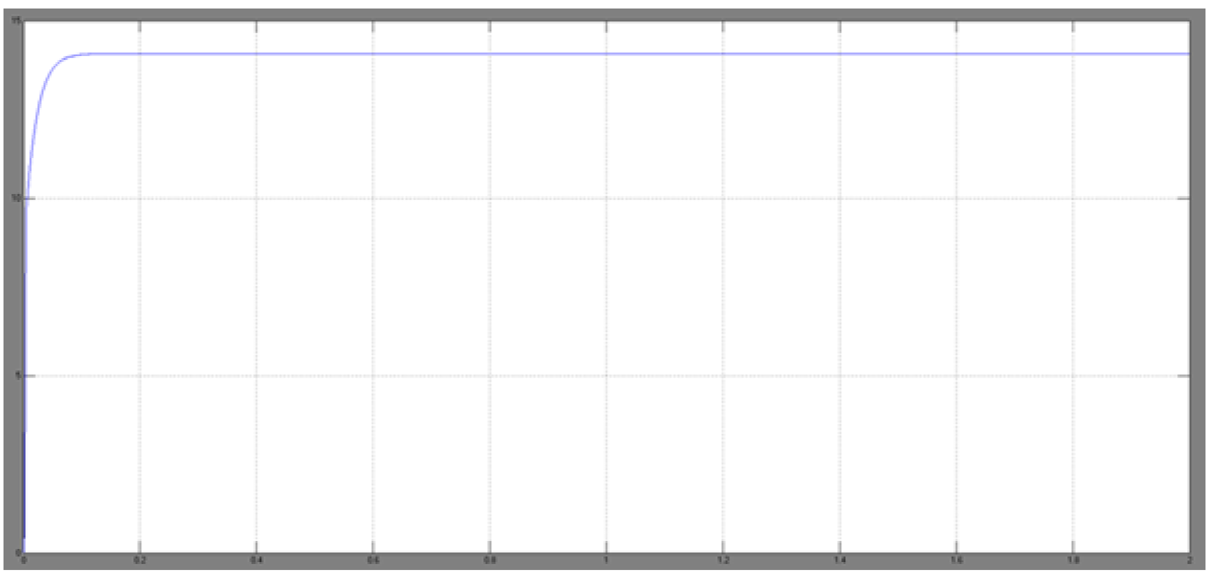

Fig.5.Output voltage waveform

for example a TV remote control, there is no need for the computing power of a 486 or even an 8086 microprocessor. Resonant frequency of RC oscillator depends on supply voltage rate, resistance R, capacity C and working temperature. It should be mentioned here that resonant frequency is also influenced by normal variations in process parameters, by tolerance of external R and C components, etc.

EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make PIC16F84 applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).

CONCLUSION

Thus an integrated ZVS Single-Inductor Multiple-Output Synchronous Buck Converter was designed. Thus the outputs are controlled individually and applied for multiform applications. A new generation of single input multiple output (SIMO) dc–dc converters has been developed based on boost and inverted topologies. However, in these configurations, loads are independently constructed except the negative output. In the proposed SIMO converter, the techniques of soft switching and voltage clamping are adopted to reduce the switching and conduction losses via the utilization of a low voltage rated power switch with a small Rds (on). This project presents a newly designed SIMO dc–dc converter based on boost and inverted derived topologies with a coupled inductor. The motivation of this project is to design a single input multiple output converter for increasing the conversion efficiency, voltage gain, reducing the complex control and saving the cost of manufacturing.Transistor level simulations show that a power efficiency as high as 90% can be achieved.

REFERENCES

1. D. Kwon and G. A. Rincon-Mora, “Single-inductor multiple-output switching dc-dc converters,” IEEE Trans. Circuits Syst. II, Exp. Briefs, vol. 56, no. 8, pp. 614–618, Aug. 2009.
2. H.-P. Le, C.-S. Chae, K.-C. Lee, S.-W. Wang, G.-H. Cho, and G.-H. Cho, “A single-inductor switching dc-dc converter with five outputs and ordered power-distributive control,” IEEE J. Solid-State Circuits, vol. 42, no. 12, pp. 2706–2714, Dec. 2007.
3 M.-H. Huang and K.-H. Chen, “Single-inductor multi-output (SIMO) dc-dc converters with high light-load efficiency and minimized crossregulation for portable devices,” IEEE J. Solid-State Circuits, vol. 44, no. 4, pp. 1099–1111, Apr. 2009.
4. M.-H. Huang, Y.-N. Tsai, and K.-H. Chen, “Sub-1 v input single-inductor dual output (SIDO) dc-dc converter with adaptive load tracking control (ALTC) for single-cell powered systems,” IEEE Trans. Power Electron., vol. 25, no. 7, pp. 1713–1724, Jul. 2010.
5. P. Patra, A. Patra, and N. Misra, “A single-inductor multiple-output switcher with simultaneous buck, boost and inverted outputs,” IEEE Trans. Power Electron., vol. 27, no. 4, pp. 1936–1951, Apr. 2012.
6. Z. Shen, X. Chang, W. Wang, X. Tan, N. Yan, and H. Min, “Predictive digital current control of single-inductor multiple-output converters in CCM with low cross regulation,” IEEE Trans. Power Electron., vol. 27, no. 4, pp. 1917–1925, Apr. 2012.