

ANALYSIS OF CHB CONVERTER WITH INTEGRATED SPLIT BATTERY ENERGY STORAGE FOR EV CHARGING STATIONS

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Abstract:

The aim of this project is to develop a high-efficiency single-input multiple-output (SIMO) dc–dc converter to have the power flow in both directions. The proposed converter can produce output power source to a controllable dc bus and middle-voltage output terminals. The dc bus can take as the main power for a high-voltage dc load or the front terminal of a dc–ac inverter. Moreover, middle-voltage output terminals can supply powers for individual middle-voltage dc loads or for charging auxiliary power sources (e.g., battery modules). Environmental awareness and related concerns have given rise to a high interest toward electrical mobility based on battery energy storage during the recent years. Such an action aims mainly at the significant reduction of CO₂ and other pollutant emission. In order to ensure the wide spread utilization of such electric vehicles (EVs), however, significant effort is still needed regarding their competitive Market launching over conventional combustion engine vehicles.

Keywords – SIMO, Battery module, EV.

1. INTRODUCTION

An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. There are two main types of inverter. The output of a modified sine wave inverter is similar to a square wave output except that the output goes to zero volts for a time before switching positive or negative. It is simple and low cost (~\$0.10USD/Watt) and is compatible with most electronic devices, except for sensitive or specialized equipment, for example certain laser printers. A pure sine wave inverter produces a nearly perfect sine wave output (<3% total harmonic distortion) that is essentially the same as utility-supplied grid power. Thus it is compatible with all AC electronic devices. This is the type used in grid-tie inverters. Its design is more complex, and costs 5 or 10 times more per unit power (~\$0.50 to \$1.00USD/Watt). The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converters was made to work in reverse, and thus was "inverted", to convert DC to AC. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term *diode* and the

term *rectifier* is merely one of usage, i.e., the term *rectifier* describes a *diode* that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

2. PROPOSED SYSTEM

Linear regulators can only output at lower voltages from the input. They are very inefficient when the voltage drop is large and the current is high as they dissipate heat equal to the product of the output current and the voltage drop; consequently they are not normally used for large-drop high-current applications. The inefficiency wastes power and requires higher-rated, and consequently more expensive and larger, components. The heat dissipated by high-power supplies is a problem in itself as it must be removed from the circuitry to prevent unacceptable temperature rises.

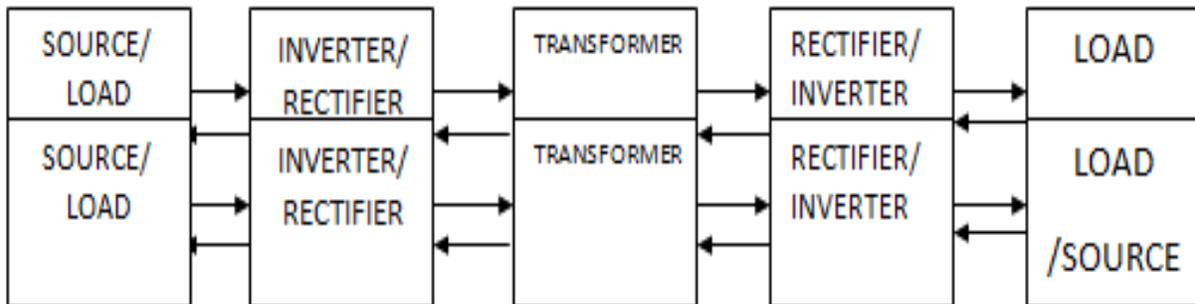


Fig.1. Block diagram of converter

They are practical if the current is low, the power dissipated being small, although it may still be a large fraction of the total power consumed. They are often used as part of a simple regulated power supply for higher currents: a transformer generates a voltage which, when rectified, is a little higher than that needed to bias the linear regulator. The linear regulator drops the excess voltage, reducing hum-generating ripple current and providing a constant output voltage independent of normal fluctuations of the unregulated input voltage from the transformer / bridge rectifier circuit and of the load current.

3. CONTROLLER

A microcontroller (sometimes abbreviated μC , uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

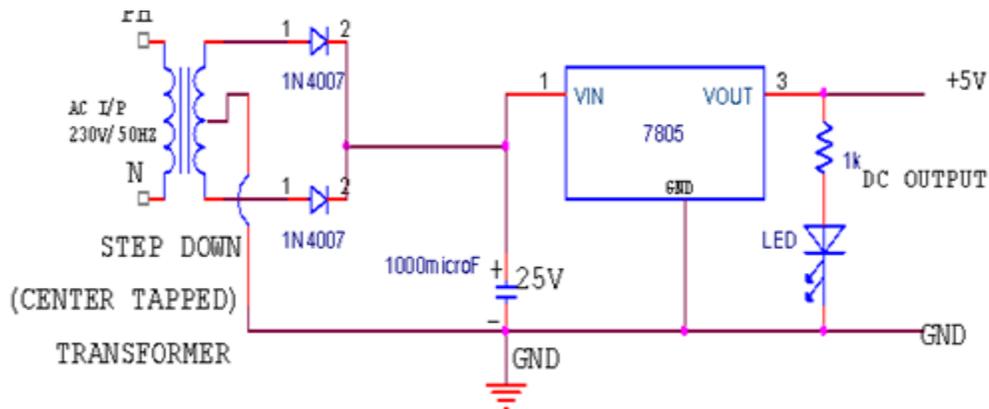


Fig.2.Power supply

Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. XTAL1 and XTAL2 are the input and output respectively of an inverting amplifier which is intended for use as a crystal oscillator in the pierce configuration, in the frequency range of 1.2 MHz to 18 Mhz. XTAL2 also the input to the internal clock generator. To drive the chip with an internal oscillator, one would ground XTAL1 and XTAL2. Since the input to the clock generator is divide by two flip flop there are no requirements on the duty cycle of the external oscillator signal. However, minimum high and low times must be observed.

4. SIMULATION RESULTS

As can be observed from the current waveforms for the types of dc-dc converters described earlier, the current changes between the maximum and minimum values, if it (current) is continuous. In the current limit control strategy, the switch in dc-dc converter (chopper) is turned ON and OFF, so that the current is maintained between two (upper and lower) limits. When the current exceed upper (maximum) limit, the

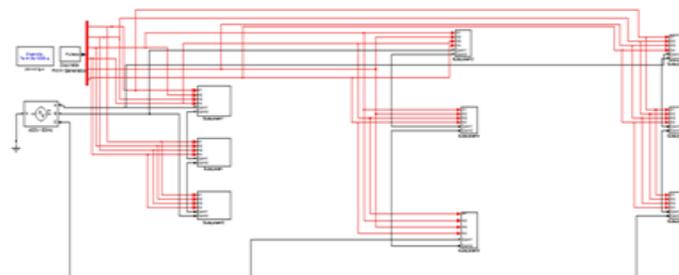


Fig.3.Matlab Simulation

switch is turned OFF. During OFF period, the current freewheels in say, buck converter (dc-dc) through the diode, D_F , and decreases exponentially. When it reaches lower (minimum) limit, the switch is turned ON. This type of control is possible, either with constant frequency, or constant ON time, T_{ON} . This is used only, when the load has energy storage elements, i.e. inductance, L. The reference values are load current or load voltage. In this case, the current is continuous, varying between I_{max} and I_{min} , which decides the frequency used for switching. The ripple in the load current can be reduced, if the difference between the upper and lower limits is reduced, thereby making it minimum. This in turn increases the frequency, thereby increasing the switching losses.

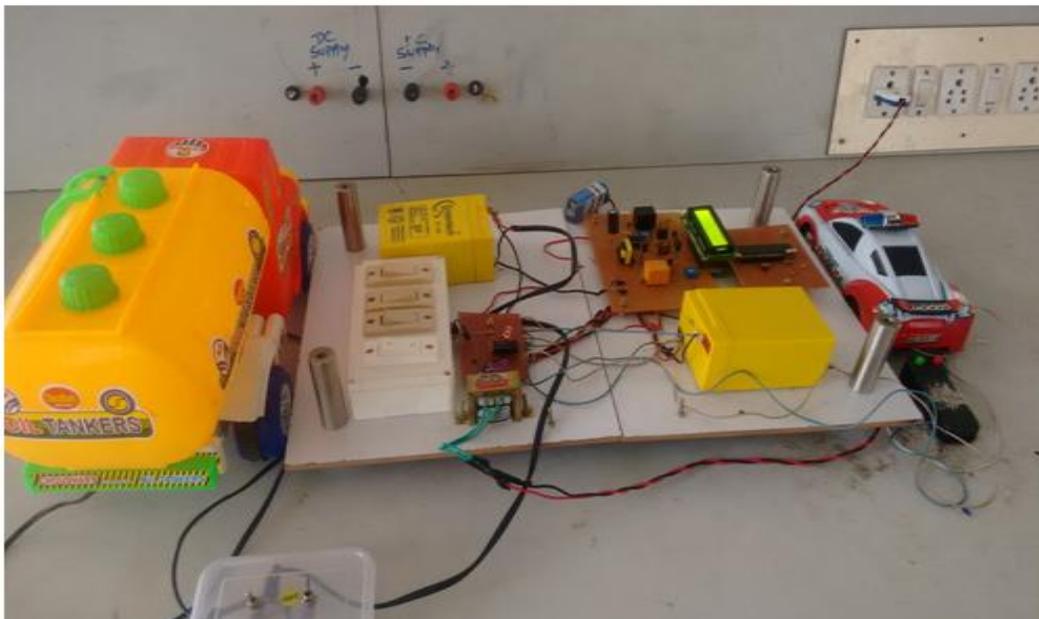


Fig.4. Hardware Components

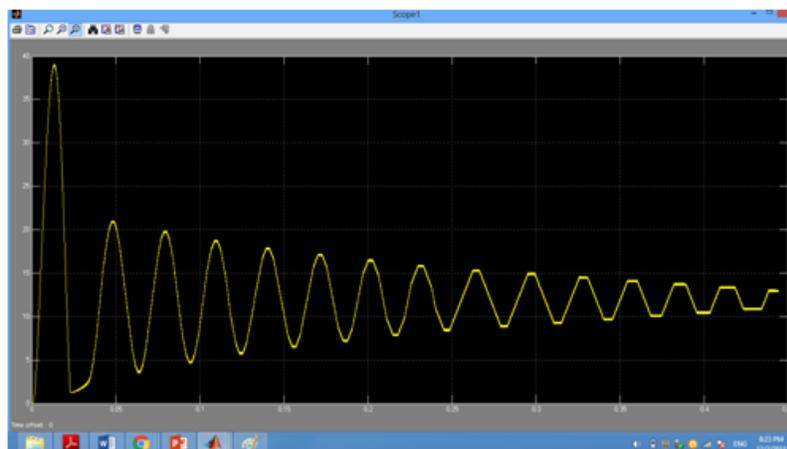


Fig.5. Output waveform

CONCLUSION

This study has successfully developed a high-efficiency isolated single-input multiple-output buck converter with step-down operational states, and this coupled-inductor-based converter was applied well to a single input power source plus two output terminals composed of an auxiliary battery module and a high-voltage dc bus. The experimental results reveal that the maximum efficiencies at the step-up state and the step-down state were measured to be 94% and 97%, respectively. The major contributions of the proposed converter are recited as follows: 1) This topology adopts eight power switches to achieve the objectives of high-efficiency power conversion, electric isolation, bi-directional energy transmission, and various output voltage with different levels. 2) The stray energy can be recycled by a clamped capacitor into the auxiliary battery module or high-voltage dc bus to ensure the property of voltage clamping. 3) An auxiliary inductor is designed for providing the charge power to the auxiliary battery module and assisting the switch turned on under the condition of zero-voltage-switching (ZVS). 4) The switch voltage stress at the step-up state is not related to the input voltage so that it is more suitable for a dc power conversion mechanism with different input voltage levels. 5) The copper loss in the magnetic core can be greatly reduced as a full copper film with lower turns.

REFERENCES

- [1] X. H. Liu, H. Li, and Z. Wang, "A fuel cell power conditioning system with low-frequency ripple-free input current using a control-oriented power pulsation decoupling strategy," *IEEE Trans. Power Electron.*, vol. 29, no. 1, pp. 159-169, 2014.
- [2] A. Urtasun, P. Sanchis, and L. Marroyo, "Adaptive voltage control of the DC/DC boost stage in PV converters with small input capacitor," *IEEE Trans. Power Electron.*, vol. 28, no. 11, pp. 5038-5048, 2013.
- [3] J. Yao, H. Li, Z. Chen, X. F. Xia, X. Y. Chen, Q. Li, and Y. Liao, "Enhanced control of a DFIG-based wind-power generation system with series grid-side converter under unbalanced grid voltage conditions," *IEEE Trans. Power Electron.*, vol. 28, no. 7, pp. 3167-3181, 2013.
- [4] U. R. Prasanna and A. K. Rathore, "A novel single-reference six-pulse-modulation (SRSPM) technique-based interleaved high-frequency three-phase inverter for fuel cell vehicles," *IEEE Trans. Power Electron.*, vol. 28, no. 12, pp. 5547-5556, 2013.
- [5] Z. Amjadi and S. S. Williamson, "Prototype design and controller implementation for a battery-ultracapacitor hybrid electric vehicle energy storage system," *IEEE Trans. Smart Grid*, vol. 3, no. 1, pp. 332-340, 2012.
- [6] J. Cao and A. Emadi, "A new battery/ultracapacitor hybrid energy storage system for electric, hybrid, and plug-in hybrid electric vehicles," *IEEE Trans. Power Electron.*, vol. 27, no. 1, pp. 122-132, 2012.
- [7] C. T. Pan, M. C. Cheng, and C. M. Lai, "A novel integrated dc/ac converter with high voltage gain capability for distributed energy resource systems," *IEEE Trans. Power Electron.*, vol. 27, no. 5, pp. 2385-2395, 2012.