IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 10 | April 2016
ISSN (online): 2349-784X

Non-Isolated High Gain Buck Boost DC-DC Converters Adopting Switched Capacitor Cell for WSN Applications

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Abstract

This paper presents a high step up DC-DC converter to boost low voltage PV system voltage. The switched capacitor converter can obtain a high voltage gain but the line and load regulation is poor and the output voltage is not regulated. The output regulation of the non - isolated switching mode DC-DC converter is excellent but the voltage gain cannot be too high.A combination method of the SC converter and the switching mode DC-DC converter is proposed. Thus, the voltage gain is increased and decreased by varying the duty cycle of wireless sensor network applications.
Keywords: DC-DC, WSN

I. Introduction

Many applications call for high step-up dc–dc converters that do not require isolation. Some dc–dc converters can provide high step-up voltage gain, but with the penalty of either an extreme duty ratio or a large amount of circulating energy. the high step-up dc–dc converters for the applications have the High step-up voltage gain, High efficiency, No isolation is required, but The leakage energy induces high voltage stress, large switching losses and severe EMI problems[11]. Fuel cells are electrochemical devices that convert chemical energy to electricity and thermal energy. Promising applications for fuel cells include portable power, transportation, building cogeneration, and distributed power for utilities. For portable power, a fuel cell coupled with a fuel container can offer a higher energy storage density and more convenience than conventional battery systems. In transportation applications, fuel cells offer higher efficiency and better part-load performance than conventional engines. In stationary power applications, low emissions permit fuel cells to be located in high power density areas where they can supplement the existing utility grid. With the help of type of electrolyte the Fuel cells are characterized. Some of the fuel cell types are PEMFC, DMFC, PAFC, MCFC and SOFC, but the PEMFC have low operating temperature, DMFC have low power density, and PAFC also have low operating temperature[1].

A novel high step-up dc–dc converter for distributed generation systems is proposed. Two capacitors and one coupled inductor are used here. The two capacitors are charged in parallel during the ON condition and are discharged in series during the OFF condition by the energy stored in the coupled inductor to achieve a high step-up voltage gain[3].

A conventional voltage- doubler -rectifier boost-integrated half bridge converter, which make it suitable for high step-up applications. A high step-up voltage gain can be achieved by the use of the switched-capacitor and voltage lift techniques. Because of simple structures and continuous current the boost converter is used in the non-isolated applications. Because of parasitic resistances in the boost converters it is very difficult to achieve high efficiency and high voltage conversion ratio its become the disadvantage [8].

A boost converter with coupled inductors for reduce the voltage stress operated at high voltage ratio is obtained by the active switch. But the presence of leakage inductor in the coupled inductors would results in high component stress, low conversion efficiency and high noise level[10].

The different types of electronic equipment uses the DC-DC converters with a high voltage ratio are used. A single switch three diode DC-DC pulse width modulator are used in this paper. This converter is also used to drive the voltage multiplier to boost the voltage gain. It have some advantages, they are reduced size and weight, simple structure and control and automatic power factor correction capability[4].

The provided static and dynamic performance of the PI control is compared with the PID controller. To describe the positive output elementary super lift

luo converter was achieved by state space average method[7].

In this paper combination method of the SC converter and Switching mode DC-DC converter with the MIESC-SCs is presented. The basic approach is introducing multiple capacitors into the switching mode DC-DC converters. MATLAB is used for Simulation result.

II. CIRCUIT DIAGRAM AND OPERATION

Fig 1shows Capacitors C1 and C2 are connected in series through switch Q.The series connected capacitors are connected to the output filter Cf and load resistor Rld and Do. when the inductor current is continuous, there exist two operating modes for a high step-up converter with SIESC-SCs derived from the boost converter.

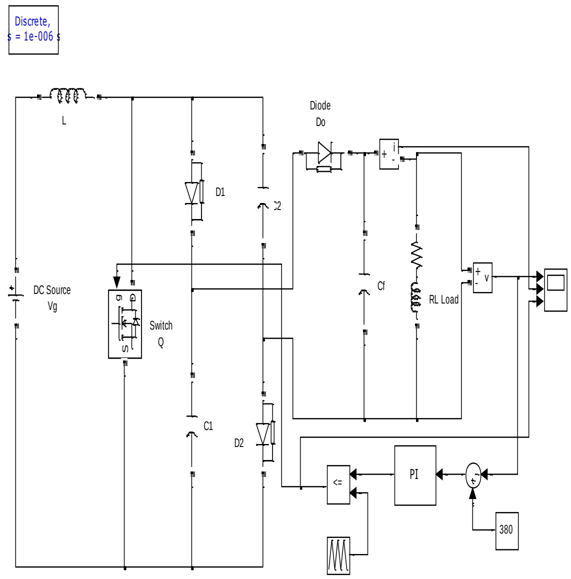

Fig 1:High step-up DC-DC converters with SIECS-SCs derived from boost converter with closed loop.

When the inductor current is continuous, there exist two operating modes for a high step-up converter with SIESC-SCs derived from the boost converter. When switch *Q* is conducting, the input voltage source charges the inductor. Meanwhile, *C*2 is in series with *C*1 to supply the load through switch *Q*. When switch *Q* is turned off, the inductor charges *C*1 and *C*2 in parallel, and the load is powered by *C*f . The output voltage taken as feedback, which is compared with reference voltage, if output voltage varies from reference voltage then error value will be produced. This error value is given to the PI controller. The contoller will tune the error value untill it reach the output votage to the reference voltage. The output of the PI controller is given to pulse width modulator to generate pulse. In this the pulse will produced by comparing the reference signal with the carrier signal. Here sawtooth wave is used as carrier signal.

Fig 2 shows Capacitors c1 and c2 are connected in series through switch Q. The series connected capacitors are connected to the output filter Cf and load resistor Rld and Do . when the inductor current is continuous, there exist two operating modes for a high step-up converter with SIESC-SCs derived from the buck-boost converter.

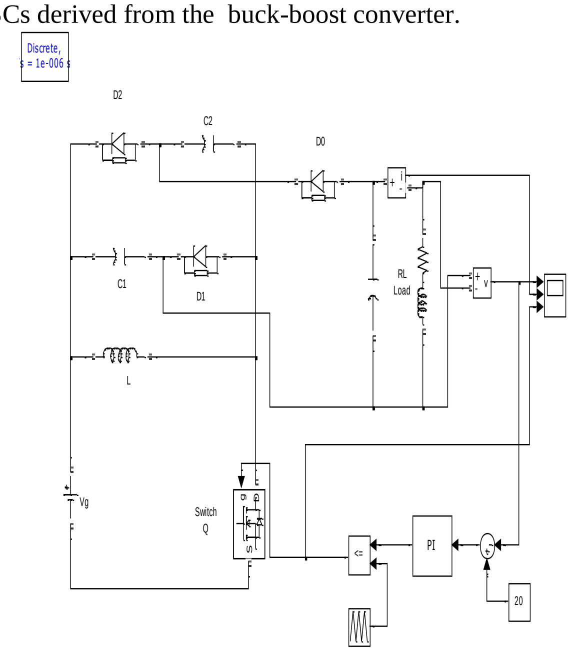

Fig. 2: High step-up DC-DC converters with SIESC-SCs derived from buck boost converter with closed loop

When the inductor current is continuous, there exist two operating modes for a high step-up converter with SIESC-SCs derived from the buck-boost converter. when switch *Q* is turned on, the input voltage source charges the inductor. Meanwhile, *C*4 is in series with the voltage source and *C*3 to supply the load through switch *Q*. When switch *Q* is turned off, the inductor charges *C*3 and *C*4 in parallel, and the load is powered by *C*f . In this converter, both the SCs are the buck–boost capacitors, and the two capacitors are in series with the voltage source to supply the load. The output voltage taken as feedback, which is compared with reference voltage, if output voltage varies from reference voltage then error value will be produced. This error value is given to the PI controller. The contoller will tune the error value untill it reach the output votage to the reference voltage. The output of the PI controller is given to pulse width modulator to generate pulse. In this the pulse will produced by comparing the reference signal with the carrier signal. Here sawtooth wave is used as carrier signal.

Fig 3 Shows Capacitors are connected in series through switch Q. The series connected capacitors are connected to the output filter Cf and load resistor Rld and Do. when the inductor current is continuous, there exist two operating modes for a high step-up converter with MIESC-SCs derived from the buck-boost converter.

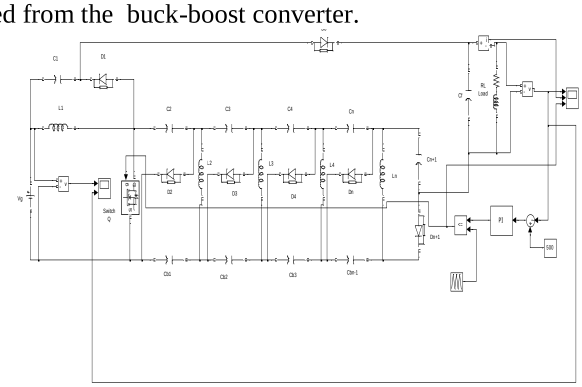

Fig. 3: High step-up DC-DC converters derived from MIESC-SCs derived from buck-boost converter with closed loop

When switch Q is turned on, capacitors c2 and cb are connected in series to charge the inductor L2,capacitors c1,c2,c3,cn+1 and Vg are in series to power the load. when switch Q is turned off, the current of inductor L1 charges the c1 and c2 whereas the current of inductor L2 charges c3,inductor L3 charges Cn, Ln charges Cn+1. The output voltage taken as feedback, which is compared with reference voltage, if output voltage varies from reference voltage then error value will be produced. This error value is given to the PI controller. The contoller will tune the error value untill it reach the output votage to the reference voltage. The output of the PI controller is given to pulse width modulator to generate pulse. In this the pulse will produced by comparing the reference signal with the carrier signal. Here sawtooth wave is used as carrier signal.

III. EXPERIMENTAL RESULTS

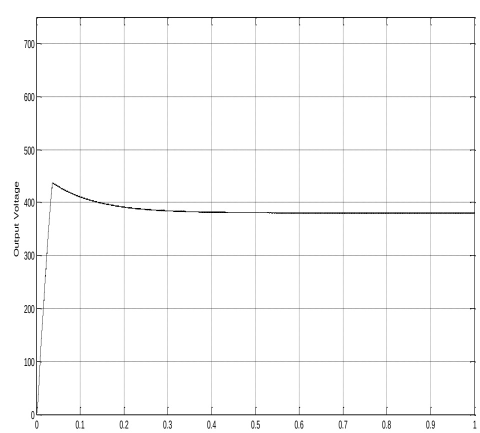

Fig. 4(a): Output voltage for boost converter with SIESC-SCs for closed loop

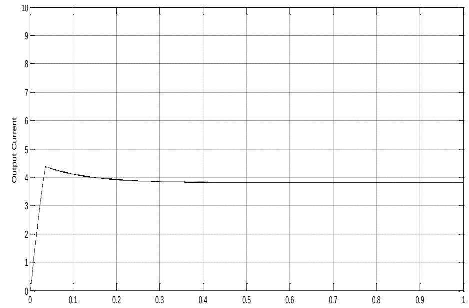

Fig. 4(b): Output current for boost converter with SIESC-SCs for closed loop

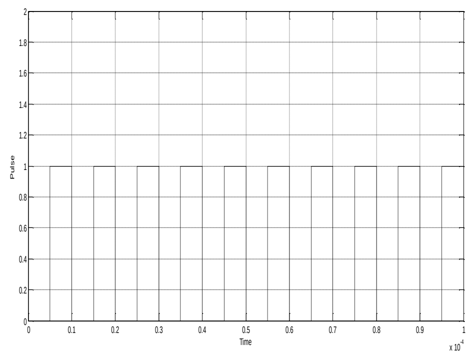

Fig. 4(c): Switching pulse for boost converter with SIESC-SCs for closed loop.

Figures 4(a),4(b) and 4(c) are shows the output voltage, current for buck-boost converter with SIESC-SCs. For a 45v of input voltage the output voltage is obtained as 20v by using the buck-boost converter with SIESC-SCs.This output voltage and output current is obtained by closed loop modification of circuit.The current value also showned for a given input voltage.

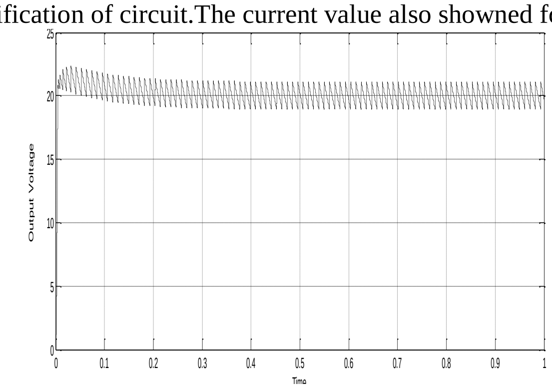

Fig. 5(a): Output voltage for buck-boost converter with SIESC-SCs for closed loop

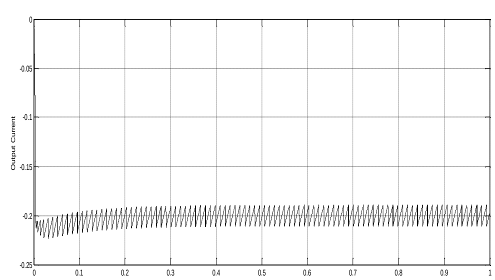

Fig. 5(b): Output current for buck-boost converter with SIESC-SCs for closed loop

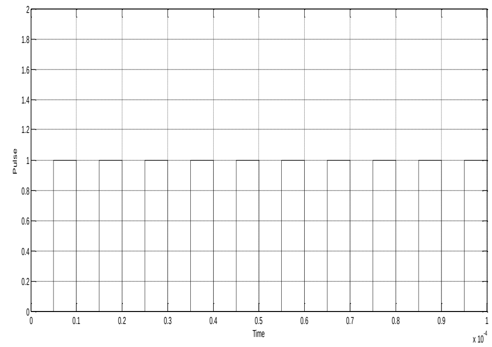

Fig. 5(c): Switching pulse for buck-boost converter with SIESC-SCs for closed loop.

Figures 5(a), 5(b) and 5(c) are shows the output voltage, current for buck-boost converter with SIESC-SCs. For a 45v of input voltage the output voltage is obtained as 20v by using the buck-boost converter with SIESC-SCs.This output voltage and output current is obtained by closed loop modification of circuit.The current value also showned for a given input voltage.

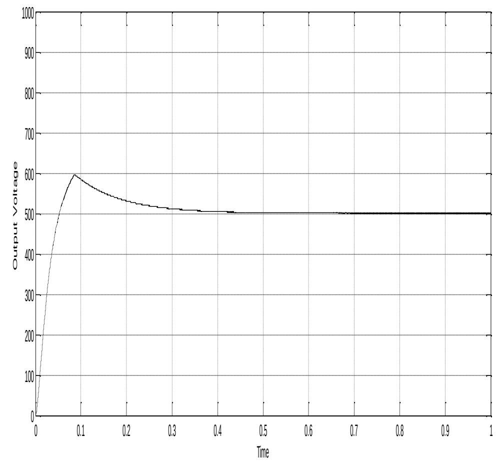

Fig. 6(a): Output voltage for buck-boost converter with MIESC-SCs for closed loop

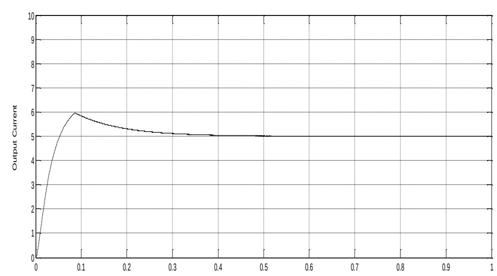

Fig. 6(b): Output current for buck-boost converter with MIESC-SCs for closed loop

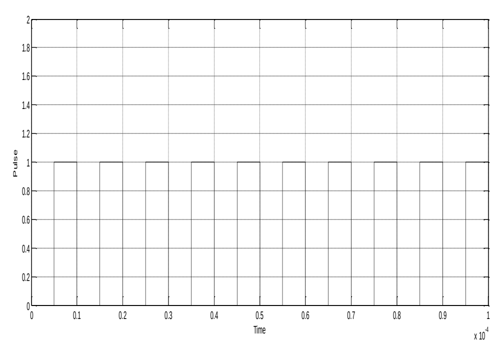

Fig. 6(c): Switching pulse for buck-boost converter with MIESC-SCs for closed loop

Fig 6(a),6(b) and 6(c) shows the output voltage, current for buck-boost converter with MIESC-SCs. For a 45v of input voltage the output voltage is obtained as 500v by using the buck-boost converter with MIESC-SCs.This output voltage and output current is obtained by closed loop modification of circuit.The current value also showned for a given input voltage.

IV. CONCLUSION

Thus a new method of combination of the SC converter and switching-mode dc–dc converter has been proposed. The output voltage and the efficiency of the proposed system is high. By using the Multiple Inductor Energy Storage Cell-SCs in the boost and buck-boost converters the output voltage and efficiency is improved. The results indicate that the converters proposed in this paper can steadily operate and that the performance is good.

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