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Boost Converter with Selectable Duty Cycle and Input Current Ripple Cancellation

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Abstract*: This research paper, a suggest an isolated DC/DC converter component that does not require a transformer, and can distinctively cancel input current ripple. Features fixed duty cycle and has high gain output voltage. The literature shows a lot of methods to have high gain voltage but this involves the use of more parts. In the proposed scheme the converter provides high voltage gain without the use of a booster transformer. Utilizing the potential of electricity energy sources with low voltage power generating capacities, this is the major agenda of this proposal. Finally, the functionality of the converter is tested via a prototype version of the suggested converter using a laboratory implementation of the converter.*

Keywords*: Pulse width modulation, DC/DC converter, Power conversion, Cancellation of ripple current, Ripple current*

I. Introduction

DC-DC converters are a common solution in dc motor drive applications and for controlled switch mode dc power sources. Converters present a variable unregulated dc which may be from the battery or from rectified line voltage output; as line voltage varies so do the converters. What we see is that from which to get the stable regulated dc output at a set point we use converter which takes in variable dc input. As for the use of these in the future we see that almost always they are used without an isolation transformer in the case of dc motor drive and also with switch mode dc power supply and in many cases with one [2]. When the input voltage and the output loading vary in a predefined range, the output voltage is stabilized at a predefined tolerance. Isolation: There might be the need to electrically decouple the input and the output. Multiple outputs: It may have multiple outputs that are unrelated with each other and may have different voltages and current capacity as well. Along with these specifications, frequent objectives include lowering the weight and size of power supplies and increasing their efficiency. Conventionally, linear even though the power supplies have been used, the introduction of switching power supplies which are small enough and much more efficient than linear power supplies have been attained through the advancement of semiconductor technology. The cost of switching power supply and the linear power supply is a factor of the power rationing. Considering all the above, in this project, it is proposed that as many small sources of power generation tend to generate low amplitude voltages as in the case of renewable sources, interconnecting the voltage with an inverter needs a boost type of architecture that has a high voltage gain. In renewable energy (like in fuel cells) this will allow a converter to sink a steady current with very small ripple hence it is expected that converters that achieve both these properties, will have a variety of applications in the environment of renewable energy.

Besides a recent scarcity in supply, fossil fuels are causing a significant threat to the environment. Thereupon, because of the extreme scope of low dc output voltage, the design of an effective renewable energy power system high in efficiency has become an urgent issue. The solar cells and any other renewable sources cannot directly drive either ac or dc-based appliances and hence a step-up converter is required, to enable it to have a high voltage gain with low dc output voltage. High step-up voltage gains dc-dc converters have many applications and most include high intensity discharge lamp ballast in car headlights and fuel cell energy conservation systems. This is because there is a lot of concern on reducing carbon emission in the current society and environmental conservation is one of the chief variables where convenient energy is generated out of the readily available natural resources, through these innovations affordable and competent energy sources would be generated with much insistence on the need to reduce pollution and environmental degradation.

Sun's energy as alternative energy is the most frequently used sources of effective as natural energy. This study introduces a novel transformer-less boost converter that cancels input current ripple at a user-chosen duty cycle, meeting every design requirement. The ripple-cancellation technique, applied to the boost DC-DC topology, works at any pre-set duty ratio and effectively smooths the input current. By comparing this method with others that have been reported in the literature, it is obtained by using no more components. What's even better, this converter achieves plenty of voltage gain without having to rely on boosting transformers or pushing the duty cycle into extreme territory. Because of that, it suits low-voltage energy sources like many renewables, turning their modest output into usable higher voltage. Researchers have explored a bunch of techniques to reach that gain, and the literature is full of different topologies each claiming its own approach.

II. Proposed High Gain Booster

Twin inductor boost converters such inductors and voltage multipliers, coupled inductors and voltage doubler circuits, and ripple cancellation of a reduced transformer ratio in order to obtain high voltage gain. The high voltage gain converters proposed to be used in the amplification of power thereby facilitating the rapid penetration of low voltage power generating sources does not need a transformer, or coupled inductors, as well as they do not need to have extreme values of duty cycle. The other significant problem with alternative energy power circuit is input current is decreased [1]-[2]. Finally, this project is finished by using no other parts and the converter offers a high voltage gain.

Not by transformer less, or very high duty cycle levels. Due to these features, the converter is best suited in processing electricity in the low voltage power source such as alternative energy sources. Additional advantages of the strategy proposed here compared to transformer based or coupled inductors-based topologies will be provided by the rapid advances in silicon carbide and other wide-band-gap fast switching power semiconductors which when available will permit the reduction of reactive components.

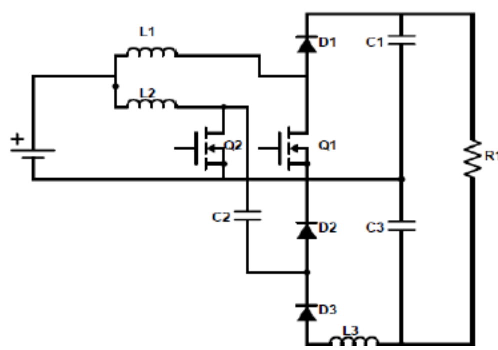

Fig 1: Schematic diagram of boost converter

III. Design Considerations for Proposed Converter

According to Fig. 1, the inductor current is a feature of the suggested boost converter with input ripple cancellation. Together with two inducers, limiting, which has no impact on the converter's fundamental power transfer function, enables current ripple cancellation at a predetermined duty cycle. The DSPIC30F devices were designed from the bottom up to offer every functionality a user could want. A comprehensive instruction set in addition to a wealth of addressing modalities, rely on a software stack and a big collection of general-purpose working registers. Very good C compiler efficiency is the end result. For their Program Memory and Data EEPROM, maximizes manufacturing cycle time flexibility. Data EEPROM and Program Memory can be remotely updated thanks to quick, in-circuit self-programming technology.

IV. Experimental Results

To verify its working principle, the converter suggested here was prototyped in a lab, and the outcomes are initially simulated in as seen in figure (2), MATLAB-2013a displays the simulated circuit that reflects the simulation results, where high voltage gain is achieved by cancelling current ripples at 80% duty cycle. The image in Fig. 3 illustrates the hardware as shown below.

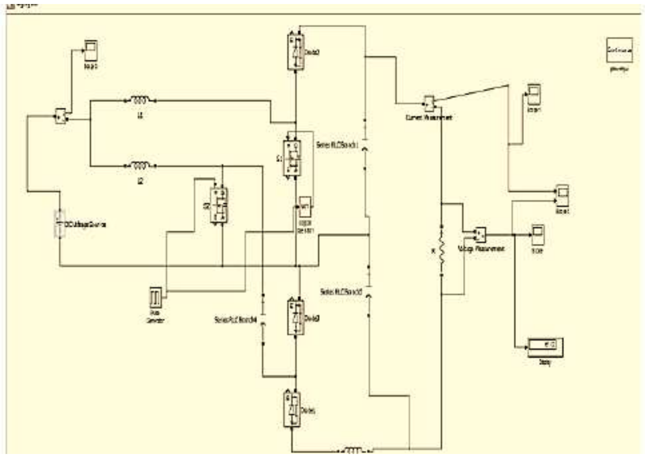

Fig 2: Converter Simulink model

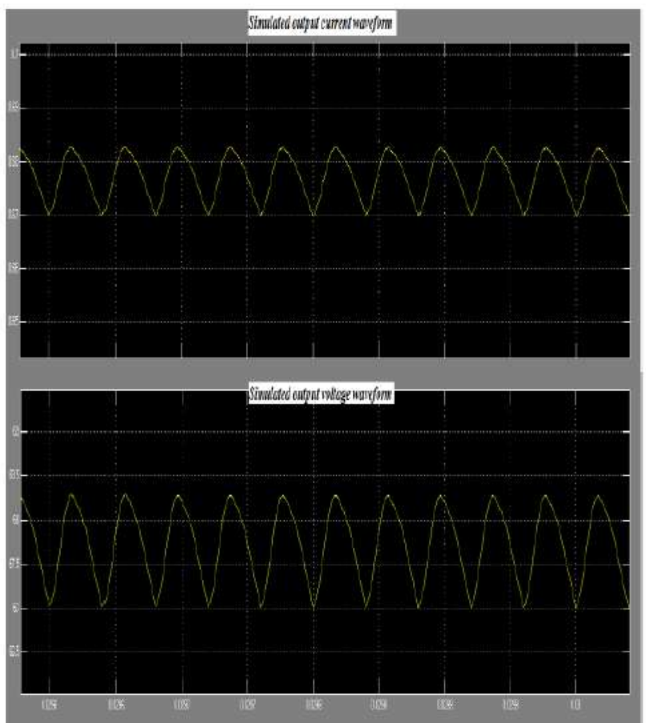

Fig 3: Simulation results

V. Conclusion

The boost dc/dc converter topology proposed in this research has the unique ability to cancel the duty cycle that has been pre-selected. Comparing this method to other alternatives found in the literature, it is achieved without adding more components. Furthermore, the duty cycles with transformer less converters have high gain in radiancy. Because of these characteristics, the converter is perfect for processing electricity from low-voltage power sources like renewable energy.

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