International Journal on Recent Technologies in Mechanical and Electrical Engineering (IJRMEE) ISSN: 2349-7947
Volume: 2 Issue: 10 055 - 057

# A Novel Approach for Current Ripple Reduction in Solar Battery Charging by Multiphase Topology Method

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*Abstract*— This paper shows a novel method for analyzing in multiphase topology method for minimizing ripple currents to larger extents in solar battery charging system commonly used for renewable power generation. DC-DC converters plays a vital role in power conversion and becomes important converter topology that are used in power electronics industry. In low power applications, in case of low watts, single phase converters meet their demands. In such a case, if the systems are larger, their supply current demands continue to increase. For that, power regulators are connected in parallel to high power ratings can be employed. By using power regulators, large ripples in input and output current can be limited. With the use of multiphase topology switch stress can be reduced due to reduced current flow in every phase and by increasing the number of phases as in this way that is here with four phases thus provides additional benefit of current ripple reduction in the input and output. This project discusses multiphase buck converter with increased number of phases connected to a solar battery charger.

***Keywords:****dc-dc convertert; solar battery;*

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## I. INTRODUCTION *(HEADING 1)*

This paper presents a novel ideology for analysis in multiphase topology method for reducing the ripple currents to greater extents in solar battery charging system .Though the existing system have either two phase or three phase topology in their model which have the ripple currents at input and output level, our novel idea focuses on increasing the number of phases to a high level of four so that ripple currents are reduced to a greater extent.

A Buck converter is the most common topology for non-isolated DC-DC step down conversion. A single phase buck converter works well for low power applications (low-voltage converter applications with currents of up to approximately 25A). But at higher currents, the power dissipation and its effect on efficiency becomes a noticeable issue. The problem can be addressed by paralleling of converters so that the total capacity is increased. If the gate signals to the paralleled converters are in phase, then there is large current ripple content in input and output thus asking for larger filters on the input and output.

The higher load requirements can be met by making use of multiphase converters. These converters interleave the clock signals of the paralleled power stages, reducing input and output ripple current. A multiphase buck converter is shown in Fig.1. The decreased power loss from the ESR of the input capacitor and the low switching losses associated with MOSFETs at nominal switching frequencies help to achieve high power conversion efficiency. Due to input ripple current cancellation, the size and hence the costs of the input capacitors are greatly reduced. The reduced current ripple and higher switching frequency makes the system more compact with smaller inductor size and lesser capacitor value. The overall result of the ripple cancellation is improved dynamic response to load transients. Interleaving also reduces hot spots on a printed circuit board or a particular component. Multiphase interleaved circuits helps in utilizing commonly available components in the market thus reducing the system cost.

## II. CONCEPT OF DC BUCK CONVERTER

A **buck converter** is a voltage step down and current step up converter.The simplest way to reduce the voltage of a DC supply is to use a linear regulator but linear regulators waste energy as they operate by dissipating excess power as heat.Buck converters,on the other hand,can be remarkably efficient making them useful for tasks such as converting the main voltage in a computer down to the 0.8-1.8 volts needed by the processor.

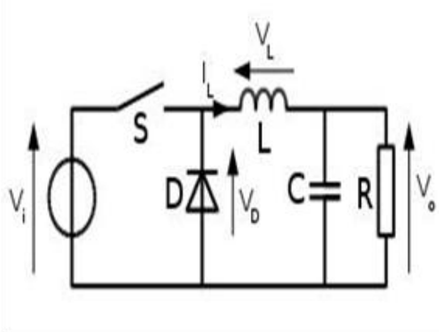


Figure 1 : A simple buck converter

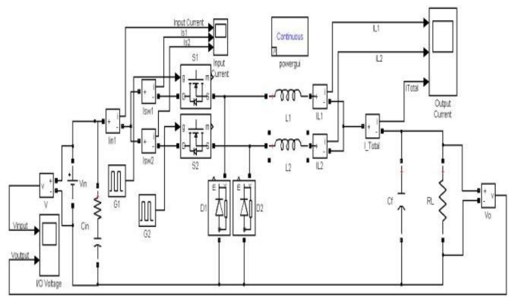

Figure 2:Two phase buck converter – Simulink Model

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## III. MULTIPHASE BUCK TOPOLOGY

### A. *Selecting a Template (Heading 2)*

The multiphase buck converter is a circuit topology where basic buck converter circuits are placed in parallel between the input and load. Each of the n "phases" is turned on at equally spaced intervals over the switching period. This circuit is typically used with the synchronous buck topology:

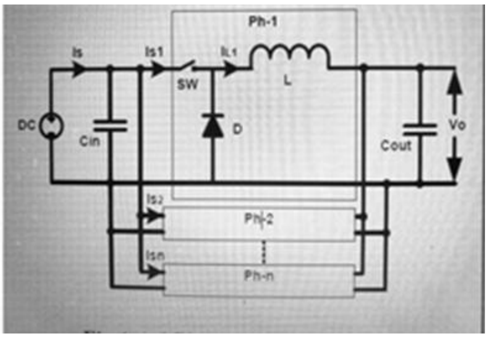
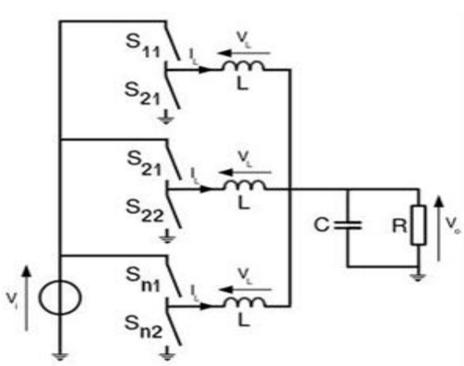



*Figure 3: N-phase buck converter*

The concept proposed for the multiphase coupled-buck converter can be extended to other applications. The isolated counterpart of the multiphase coupled-buck converter is the push-pull forward converter with the current-doubler rectifier. Compared to the push pull converter that is the isolated counterpart of the multiphase buck converter, the push pull forward converter has clamped device voltage and recovery leakage, and therefore it can offer a better efficiency.

Another advantage is that the load current is split among the n phases of the multiphase converter. This load splitting allows the heat losses on each of the switches to be spread across a larger area.




## IV. PROPOSED FOUR PHASE MODEL

The proposed four phase model for the multiphase converter topology is given below in the Simulink model and the difference from the existing model to this model is nothing but the increase in number of phases . The phase here in DC just represents the combination of an inductor, a diode and a switch , here used is MOSFET. The corresponding Simulink Model is:

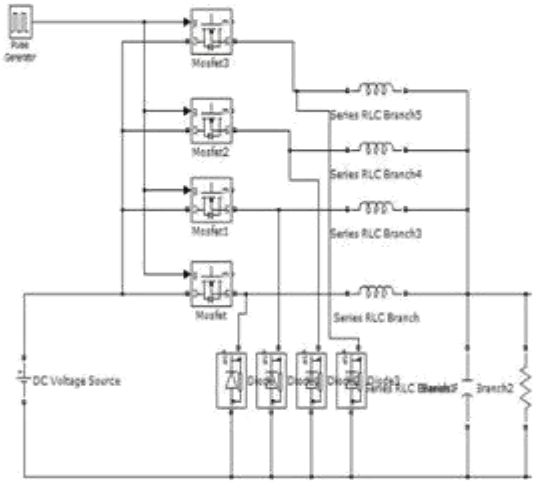


Figure 4: Simulation results of current waveform RLC branch for FOUR phases

## V. APPLICATION AND ADVANTAGES

The multi-phase topology is widely used to improve the transient response, and distribute power and heat for better thermal performance. The model for multi-phase converters can be obtained from the extension of the mode for a single-phase converter.

With the duty cycle reduction the output ripple gets completely eliminated. The reduced output ripple voltage allows more room for voltage variations during the load transient because the ripple voltage now consumes a smaller portion of the total error.. The reduced ripple current allows the use of lower value inductors. This speeds up the output current slew rate of the power supply. Consequently, multiphase topology helps improve the load transient performance of the power supply. Thus from the result it is inferred as follows:

- Reduced ripple current by cancellation
- Improved dynamic response
- Overall reduction in expenses
- Life of panel and battery increases

## VI. EXPERIMENTAL SETUP

The experimental setup of the proposed model for the multiphase topoplogy is given in a clear cut way by means of photograph:

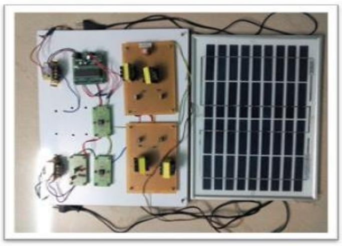


Figure 5 : Designed Working Model

## VII. CONCLUSION

The multi-phase topology is widely used to improve the transient response and distribute power and heat for better thermal performance. The model for multi-phase converter and with the duty cycle reduction the output ripple gets completely eliminated. Thus multiphase converters plays a major role in power electronics industry due to that ,they achieve reduced current ripple in the input and output of the system by just increasing the number of phases. Hence we find that the use of multiphase converters in applications like solar battery chargers will help in increasing the life of panel and battery.

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