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Research Article

Uses and Comparison of Multi Input Converter Topology with Power Control

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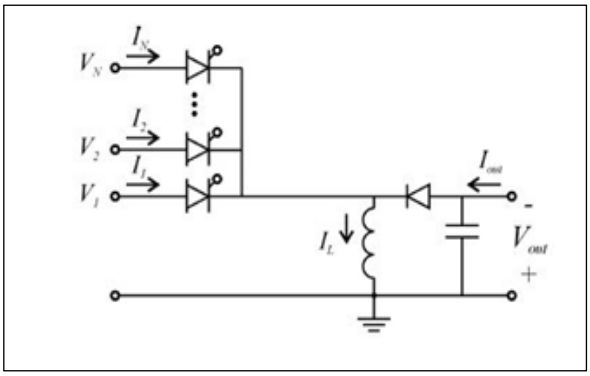
Abstract

In this article a new topology is introduces which shows multiple energy sources input to a common load. But as we know about that all different type of energy sources have different voltage and current characteristic and in DC to DC converter a switching strategy is isolated but in this article we use constant frequency. In 3-level converter there are two uni-directional input power port and a bi-directional port. It have four power switches which control with different duty ratios. In the boost converter topology we use two inductor strategy. The benefit of this technology is the higher voltage gain. In this paper we focused on switching with fixed frequency.

Keywords: DC-DC Converter, Multiple Input, Hybrid Energy System

Introduction

Generally electrical systems are supplied by single energy source like solar, wind and batteries etc. but the requirement for next generation is that the supply is uninterruptible which is nothing but the supply should not be disconnected in any means. So, for full fill this requirement certain cases are made up with two or more energy sources whether it is wind, solar, batteries, any utility etc. Renewable energy source will be most interested mode of operation of the present generation. In any power system if we increase



number of input so, we can improved flexibility and reliability of the system.[1] But if we use different energy sources of input so, voltage and current characteristics are different.

If we use multiple input so, we have to face some problems such that different operating modes of different types of input working simultaneously. Nowadays, mostly demandable electricity generation is used by photovoltaic cell because it gives various advantages such that noiseless, maintenance free and pollution less energy generation. Such converters take advantages of present or local environment due to sun irradiation level, shadow and ambient temperature. Due to their high efficiency and high reliability we can use fuel cell in such converters. Fig. 1 shows a basic fly-back converter with multiple inputs. The method of developing these circuitry is to use of parallel two switch phase legs. In this paper we introduce the topology with continuous and discontinuous modes of operation.

Circuit analysis

In this circuit we have to use two major components says multi-input buck boost converter and secondary converter with various input voltages and input currents respectively (V_1, V_2, V_3 .....V_N) and (I_1, I_2, I_3 ..... I_N). There are N number of bidirectional blocking switches in series with individual input line which have capability to conduct in forward direction

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only. There are various other combination of switches and they all can be realized with gate turn-off thyristor (GTO). This type of configuration allows for unidirectional power flow and for bidirectional power flow, output voltage can be used as a input for different converter or it can feed back to the same converter for better output.

For bidirectional configuration there are N numbers of input

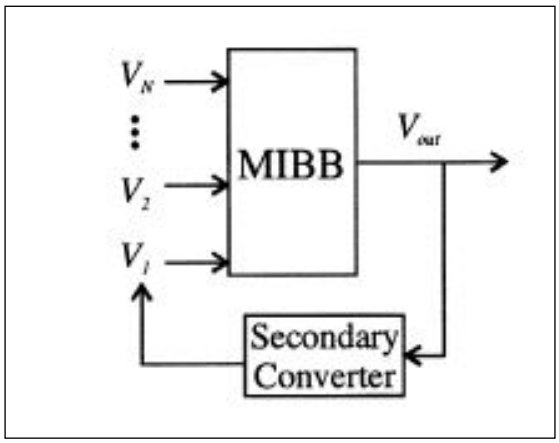

Figure 2.Multi-Input Buck Boost Converter with Bidirectional Energy Sources [1]

lines and a feedback system says which fed the output of first converter in to second converter as an input.

In the same context if we want to use three-input DC-DC boost converter for hybrid power system applications. The configuration have two unidirectional port which behaves like input power source and a bidirectional port which behaves like storage element. This method use four power switches which have four independent duty ratios. The basic use of storage element is to charge and discharge,

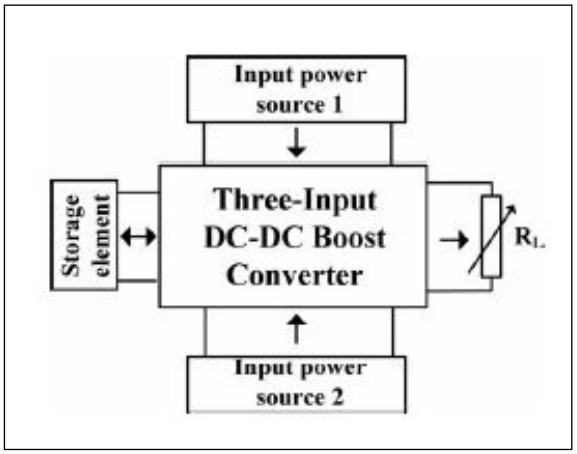

Figure 3.Three-Input DC-DC Boost Converter [2]

according to the situation and both the process depends on the input power sources. We can use photovoltaic or fuel cell for power sources and a battery for a storing element.

Due to this process we can achieve a bidirectional multi-input and multi-output converter topology. This conventional converter is fed by solar, fuel cell and batteries etc. which have the capability of reverse the terminals. According to the requirement of the circuit if we use isolation and voltage reversal so we have to use double winding inductor which behaves like a load and source as well. In this process all the input ports can share the advantages of the inductor.

Mode-I (Continuous Conduction)

In this mode at least one switch or any diode is in conducting condition. If we check the output voltage of this circuitry so, it will founded that the output voltage is almost constant because in first half cycle of source current the inductor is charged sufficiently and in second half cycle the inductor discharged and make output voltage constant. This mode can be achieved if the current over inductor is greater than zero in steady state condition. In this particular model either switch is on or respective diode is in on condition. If only diode is on so the inductor voltage should be . If any switch is on so the voltage of inductor is denoted by the highest voltage which reflect on the switch which is on at that particular instant. So, the voltage of inductor is given by

$$V_L = (maxQ_iV_i) - V_{Out}\prod Q_i$$

By solving the above equation

$$V_{Out} = \frac{\int_0^T (maxQ_iV_i)dt}{\int_0^T \prod Q_i\, dt}$$

Suppose, each switch operates at a same frequency where the starting point Q_i is matched and ending point does not match because duty cycle D_i of each switch is different. Then output voltage is given by

$$V_{Out} = \frac{\sum Deff(i)V_i}{1 - max(D_i)}$$

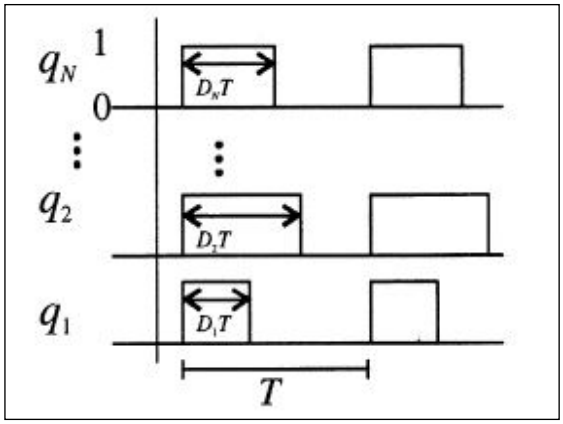

Figure 4.Switching Strategy

Figure 4 shows switching strategy of each switch, where Deff (i) is effective duty cycle.

Mode-II (Discontinuous Conduction)

This mode is very important to consider because without this mode we cannot get complete cycle in the output. There are several advantages in considering the second mode this is nothing but discontinuous mode. If we want continuity in this mode we have to provide a minimum current to inductor. This shows the importance of discontinuous mode in multiple-input converter control.

As we know that only one switch is conducting at a time. Suppose the time when switch is on is T so, the time constant for inductor is less than T. So, the change in inductor current is given by

$$\Delta_i = \frac{V}{L} Deff(T)$$

Where T is the time period.

Similarly we know that there is a situation occurs when all the switches goes off and only diode is in conducting state. Here the diode is called freewheeling diode and it will on till the inductor current becomes zero.

Let us consider two input buck boost converter and there are two diode named as D_1 and D_2 respectively. So, below figure shows the duty cycle of diode a) when D_2 is varied and D_1 is 0.5 and b) when D_1 is varied and D_2 is 0.5. They both are related to continuous mode of conduction.

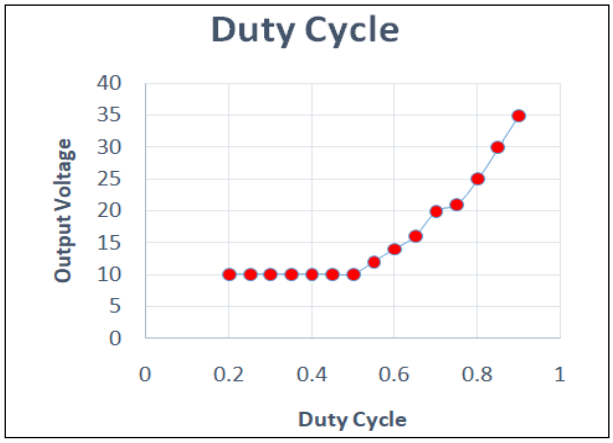

Figure 5.D_2 is varied and D_1=0.5

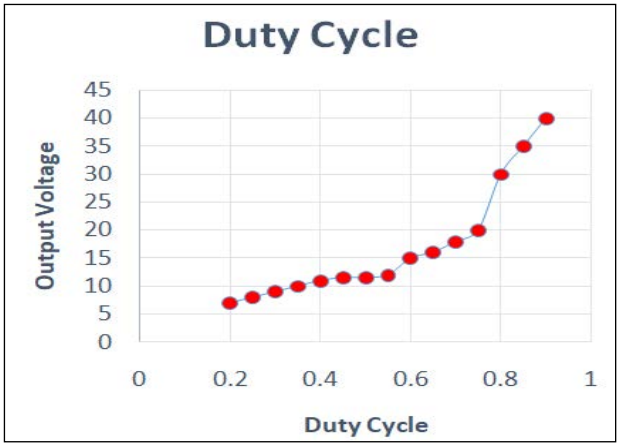

Figure 6.D_1 is varied and D_2=0.5

Conclusion

A comparison of Multi Input Buck Boost (MIBB) converter is present. This topology includes various input sources with idealized equations. This paper shows the achieving diversification of various energy sources.

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