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MODELLING AND SIMULATION OF MULTI INPUT DC-DC CONVERTER FOR INTEGRATED RENEWABLE ENERGY GENERATED SYSTEM USING FUZZY CONTROLLER.

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ABSTRACT- The objective of this paper is to propose a Multi-input power converter for the hybrid system in order to simplify the power system and reduce the cost. Renewable energy technologies offers clean, abundant energy gathered from self-renewing resources such as the sun, wind etc. As the power demand increases, power failure also increases. So, renewable energy sources can be used to provide constant loads. A new converter topology for hybrid wind/photovoltaic energy system is proposed. Hybridizing solar and wind power sources provide a realistic form of power generation. The topology uses a fusion of Buck converters. This configuration allows the two sources to supply the load separately or simultaneously depending on the availability of the energy sources. Simulation is carried out in MATLAB/ SIMULINK software and the results of the Buck converter and the hybridized converter are presented.

KEYWORDS

Renewable energy, Buck converter.

1. INTRODUCTION

The energy consumption of the world is increasing dramatically energy resources are holding the predominant with the rapid increase of population. Renewable place for satisfying the future energy demand. Among the available renewable sources, wind and solar are predominant ones, since they have more advantages on production, maintenance, etc, when compared with others. However, the renewable energy generation has a drawback that the change of the output characteristic becomes intense because the output greatly depends on climatic conditions, including solar irradiance, wind speed, temperature, and so forth. Many researches are still going on this field to improve the efficiency of this type of systems having wind and solar as resources. Batteries are usually taken as storage mechanism for smoothing output power, improving startup transitions and dynamic characteristics, and enhancing the peak power capacity. Combining the photovoltaic generation with wind power generation, the instability of an output characteristic each other was compensated. Combining such energy source introduces a PV/WIND/battery hybrid power system.

In comparison with single-sourced systems, the hybrid power system has the potential to provide high quality, more reliable, and efficient power. In these systems with a storage element, the bidirectional power flow capability is a key feature at the storage port. Further, the input power sources should have the ability of supplying the load individually and simultaneously. Many hybrid power systems with various power electronic converters have been proposed in the literature up to now. However, the main short comings of these integrating methods are complex system topology, high count of devices, high power losses, expensive cost, and large size. In this proposed work multiple input dc-dc converters will be used for combining several energy sources whose power capacity or voltage levels are different. The proposed multi-input dc–dc converter has the capability of operating in buck mode in addition to its bidirectional operation and positive output voltage without any additional transformer.

2. PROPOSED SYSTEM

The objective of the proposed work is to propose a novel multiple input power converters for the grid connected hybrid renewable energy system in order to simplify the power system and reduce cost. The proposed multiple input power converters consists of multiple input DC-DC converter and a full bridge DC-AC inverter.

The proposed work focuses on modeling of photovoltaic, wind hybrid electric power system.

PV and Wind are used as primary sources and battery acts as backup supply.

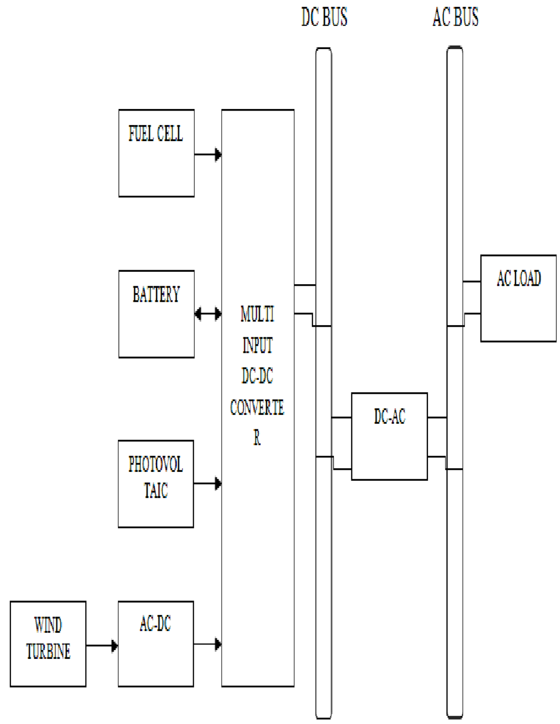

Fig 2.1 shows proposed integrated renewable energy system.

The main aim of proposed work includes selection of appropriate topologies of three phase inverter/rectifier, multiple input DC-DC converter and their control schemes, design and simulation of proposed system and comparison of conventional system with proposed system.

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3. PROPOSED TOPOLOGY

Double-input buck-buck converter shown in fig.3 consists of two switches and two diodes. Switching pattern of switches S1 and S5 of the conveter are shown in fig.2.1.

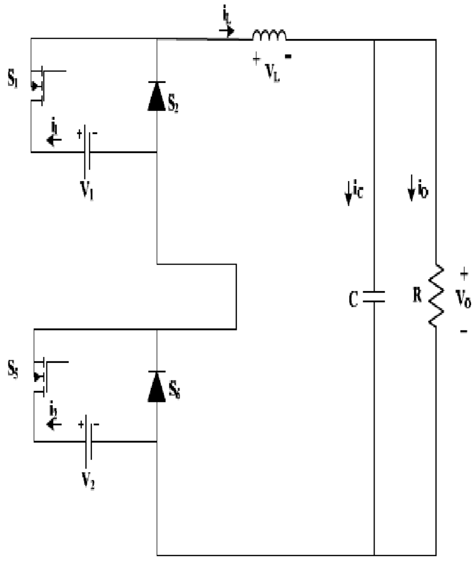


Fig.3 Double-input BUCK-BUCK converter.

The pattern is true for all the possible arrangements of the converter as it consist of all the four modes. Table1.shows the voltage across inductor for different modes of operation of the circuit.

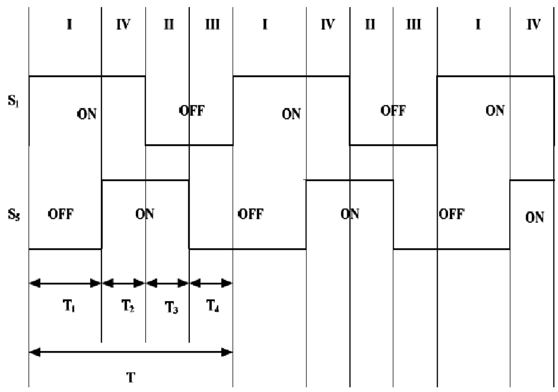


Fig.3.1 Switching pattern of BUCK-BUCK double input DC-DC converter.

One can see from fig.3.1 that the sum of T1 and T2 is the on time of switch S1 and sum of T2 and T3 is the is the on time of switch S5. Duty cycle is defined as the ratio of switch on time to the period.

$$T1+T2=d1*T \quad (1)$$

$$T2+T3=d2*T \quad (2)$$

T is the time period of the switching pattern of S1 or S5, and d1 and d2 are the duty cycles of switches S1 and S5 respectively. One can write the following equations based on the fig.3.1, Table 1 and volt-second balance equation of inductor.

$$T1+T2+T3+T4=T \quad (3)$$

$$T1*(V1-V0)+T2*(V1+V2-V0)+T3*(V2-V0)+T4*(-V0)=0 \quad (4)$$

This can be simplified as the following equation

$$V1*(T1+T2)+V2*(T2+T3)=V0*(T1+T2+T3+T4) \quad (5)$$

Combining equations (1),(2),and (5) one can obtain the following equation which gives the relation between input and output.

$$V1*d1+V2*d2=V0*1$$
$$V0=d1*V1+d2*V2 \quad (6)$$

Equation (6) determines the transfer function of the double-input buck-buck dc-dc converter. It can also be observed that the output is positive as long as the two sources are positive.

	T_1	T_2	T_3	T_4
S_1	ON	ON	OFF	OFF
S_5	OFF	ON	ON	OFF
V_L	V_1-V_0	V_1+V_2-V_0	V_2-V_0	-V_0

Table.1 Voltage across the inductor for different modes of operation of BUCK-BUCK converters.

Double-input converter topology	Voltage transfer ratio	Range of v0
Buck-Buck	$V_0=d_1*v_1+d_2*v_2$	$0<v_0<v_1+v_2$

Table.2 Transferfunction ratio of double input DC-DCconverter.

4. SIMULATION RESULTS

Figure 4.1 shows the typical simulation results of the buck-buck converter using MATLAB/Simulink. Two dc voltage sources V_1=100V and V_2=150V are used for the input voltage sources. The switching commands for S_1 and S_5 have fixed duty ratio of 0.5 at the switching frequency of 100KHz. From top to bottom are the waveforms of load voltage and load current, switching commands S_1 and S_5, capacitor voltage V_c. one can observe from the waveforms that the average value of output voltage is arround 125V which can also be obtained from the transfer function of table2.

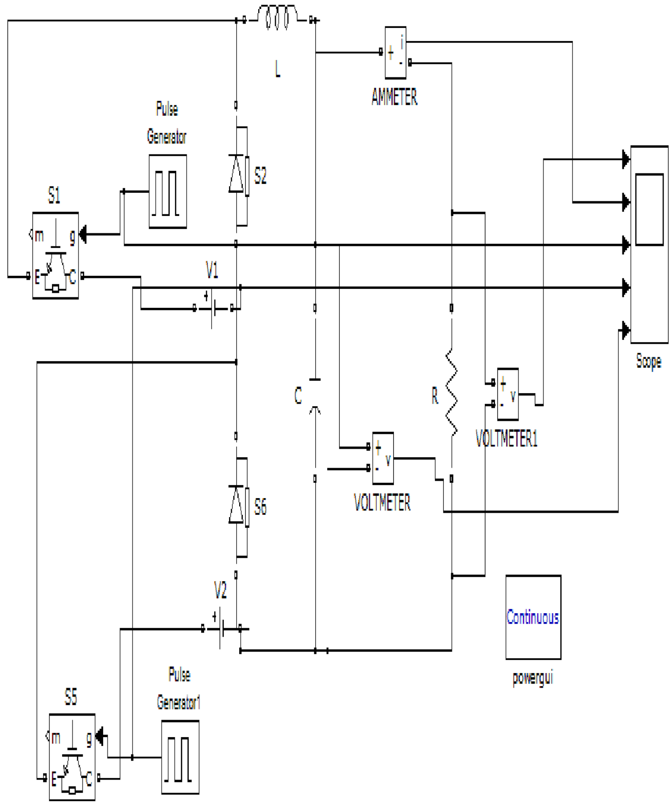
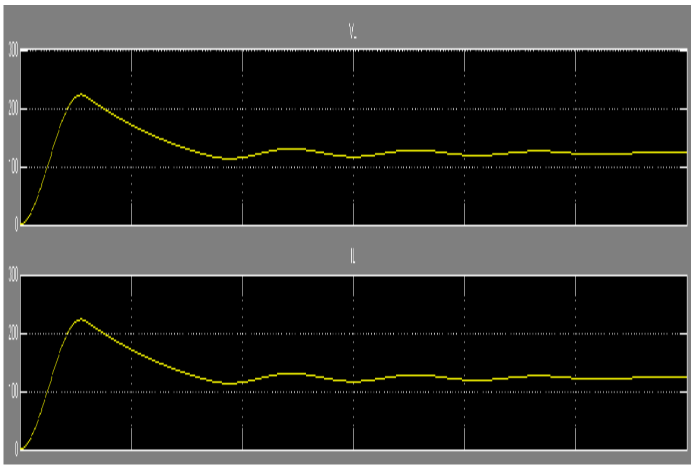


Fig.4 Simulation of double-input buck-buck converter using MATLAB/Simulink.

I. Load voltage and load current.



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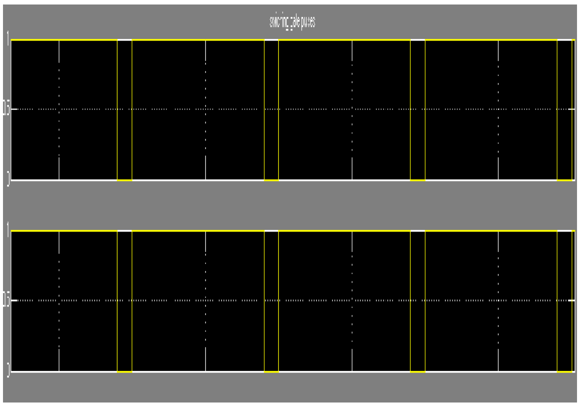
II. Switching commands.



III. Capacitor voltage.

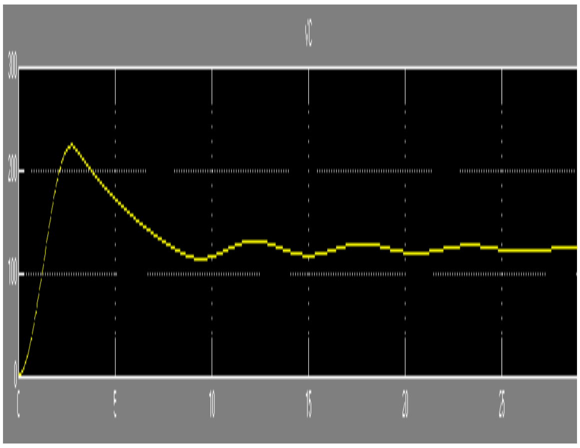


Fig.4.1 Simulation waveforms of double-input buck-buck converter.

SL NO.	Duty ratio	Output voltage
1	0.2	50V
2	0.4	100V
3	0.6	150V
4	0.8	200V

Table.3 Output voltage for various duty cycle are presented in the above table

5. SIMULATION RESULTS USING FUZZY CONTROLLER

Fig 5.1 shows the typical simulation results of the buck-buck converters using Fuzzy controller. Two dc voltage sources V1=200V and V2=250V are used for the input voltage sources. The switching commands for S1 and S5 have duty ratio and switching frequency set by the fuzzy controller. From top to bottom are the waveforms of load voltage and load current, switching commands S1 and S5, capacitor voltage Vc. One can observe from the waveforms that the average value of output voltage is obtained as we required.

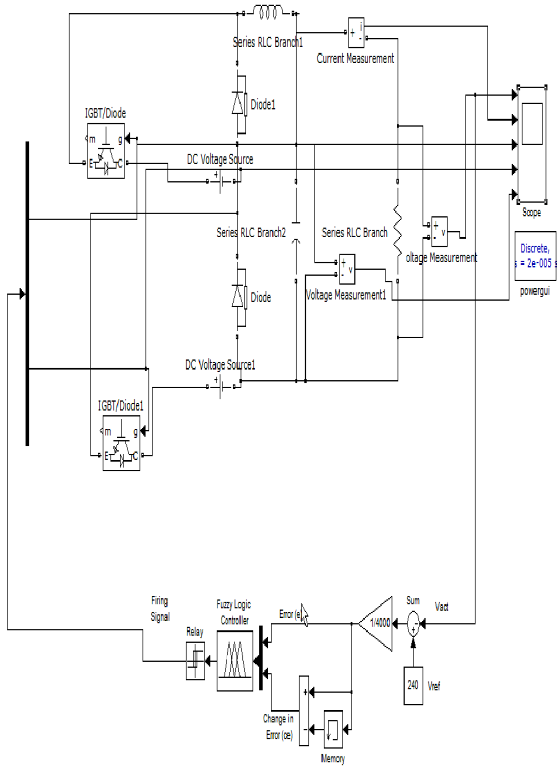
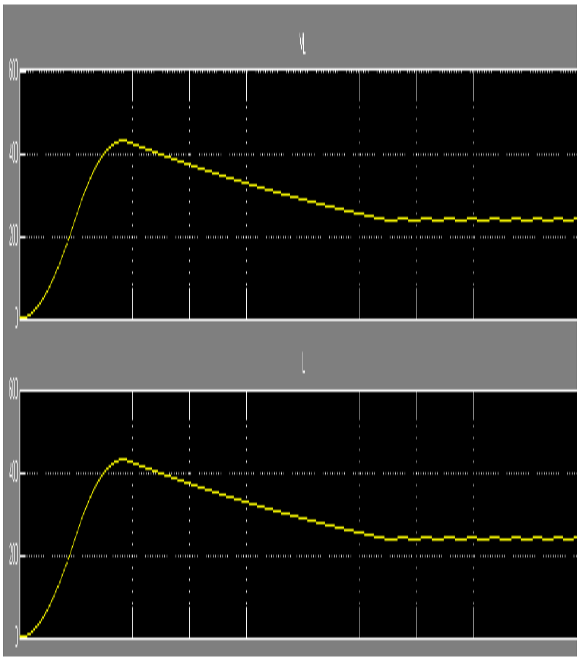


Fig 5 Simulation of double-input buck-buck converter using fuzzy controller.

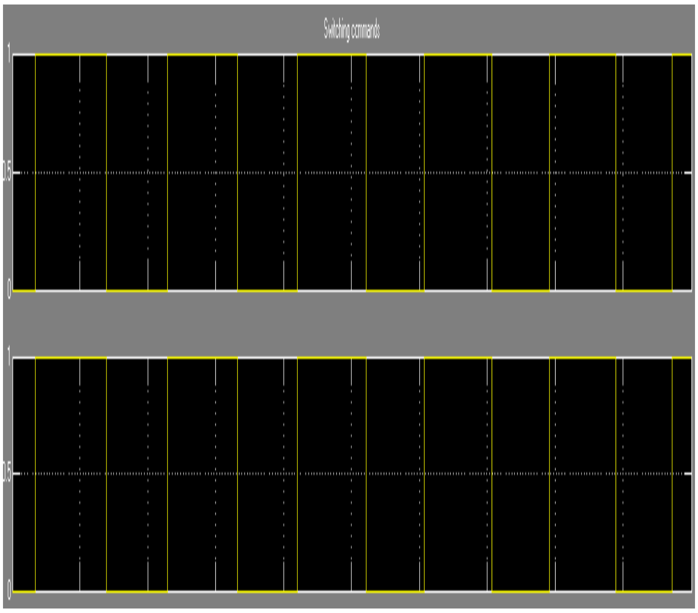
e / ce	NB	NM	NS	ZE	PS	PM	PB
NB	PB	PB	PB	PB	PM	PS	ZE
NM	PB	PB	PB	PM	PS	ZE	NS
NS	NB	NB	NM	NS	ZE	PS	PM
ZE	NB	NM	NS	ZE	PS	PM	PB
PS	NM	NS	ZE	PS	PM	PB	PB
PM	NS	ZE	PS	PM	PB	PB	PB
PB	ZE	PS	PM	PB	PB	PB	PB

Table. 4 Rule table for buck converter

I. Load voltage and load current.



II. Switching commands.



III. Capacitor voltage.

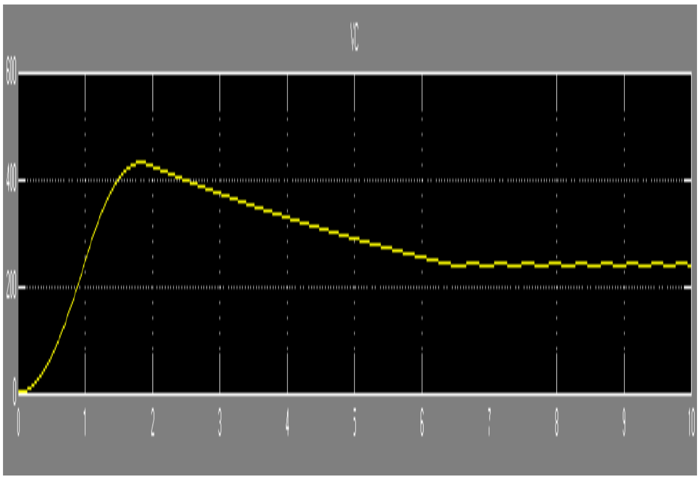


Fig.5.1 Simulation waveforms of double-input buck-buck converter using fuzzy controller.

6. CONCLUSION

In this paper, the operation principle of the proposed multi-input dc-dc converter has presented. The multiple input DC-DC buck converter circuit is designed and simulated using MATLAB/Simulink software. Simulation results are shown here to verify the performance of the proposed multi-input dc-dc converter system with the desired features. From the results acquired during the simulation, it was confirmed that with a well designed system including a proper converter and selecting an efficient controller, it is simple and can be easily constructed to achieve an acceptable efficiency level of the PV modules and wind turbine.

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