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POWER MANAGEMENT BY USING MULTIPORT DC – DC CONVERTER FOR RENEWABLE ENERGY

S.Sankarananth, G.Syed Zabiyullah T.Parthiban, R.Kavin

Dept.Of EEE, Excel College of Engineering and Technology

Komarapalayam

*Corresponding Author : S. Sankaranath

Email: sankarananth99@gmail.com

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Abstract-

This paper proposes, power management of different types of renewable energy source is controlled by multiport DCDC converter. In this each port of the converter is connected with controller switch to control the source input of converter. This ireduces the turn off switching losses by soft switching. The high frequency switches are used to control the power flow. This converter is proposed to control the hybrid energy generating system, with the ability of bidirectional power flow between battery and load. The diode bridge rectifier is applicable for high switching frequency operation with realizable component compare with existing converter. The efficiency of the converter is verified through MATLAB simulation. The operation and design performance is explained briefly. The proposed converter has reliability operate simultaneous power generation from different renewable energy source. Fuzzy controller controls the direction of power flow and load voltage of the converter.

Keywords-Isolator, high frequency link, soft switching, multiport converter, PV panel, windturbine generator (WTG).

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1. INTRODUCTION

Today's world has the interest to developing hybrid energy generation systemfrom different kind of renewable energy source. The hybrid energy generation system consist of some main issues are stability, reliability, and power quality. To use these problems storage element is used. The clean power generation world prefer PV panel and wind generation system. Multiport dc-dc converters have been proposed to do the efficient power management and load integration for the multiple sources. The isolated dc-dc converter has connected with different sources are photovoltaic (PV) panel, wind turbine

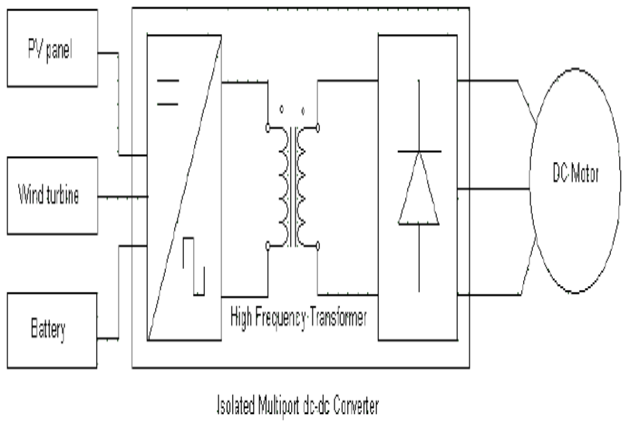
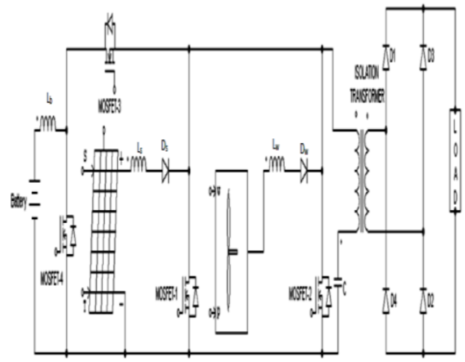


Fig.1 Configuration of single stage multiport generator (WTG) and battery

With its ability to reverse the direction of current flow and power. The multiport dc-dc converters are used to achieve the power transfer between sources and load. It is also regulated by the solar panel photovoltaic(PV) level and wind turbine generator(WTG) wind level, thus to maintain a stable load voltage and make fully usage of the solar panel and wind turbine generator and the storage element battery. This converter is applicable to provide constant high level DC voltage and obtain other important function. Isolated multi port converter is mainly classified in to two categories. One is separate winding method and other one is common winding method. In this common winding method consist of common ground for multi input source. This topology is proposed in power managementsystem. Almost commonly isolated half bridge converters are used. The each side of the transformer connected with bridge type switches. The converter has multiple ports connected to a single winding on the primary side of a transformer. It is suitable for the advantage of using less number of windings in the transformer. In secondary side of the isolator consist of diode bridge rectifier. Controllable switches are used by 2m+2, where m denotes the number of input ports. In this proposed converter switches are reduced into m+1.This multiport dc-dc converter is consists of a PV, WTG, battery and load. Power may be controlled simultaneously use power from wind and sunlight respectively, by using the proposed convert. This proposed of fuzzy control to extract the maximum



converter has only one switch is connected each input source. In the secondary side of the converter have no controlled switches. The efficiency of the converter is increased by switch ON or switch OFF time interval, depend upon decrease peak current.

2. CONVERTER STRUCTURE AND OPERATION

The proposed multi-port dc-dc converter is shown below figure 2, which is consist of high frequency transformer, that is made up of ferric core material. In the primary winding of The transformer's turns ratio(n) is n = Np /Ns, where Np is the number of turns of the primary winding and Ns is the number of turns of the secondary winding. The converter is controlled by the operation of power switches. In this proposed converter capacitors are placed in between the ports to minimize the DC voltage ripples. Motor load is connected for this converter.

3. MODES OF OPERATION

This converter section has three operating modes: 1) MOSFET switch 1& 2 on; 2) MOSFET switch 3 is on and MOSFET switch 1&2 is off; 3) MOSFET switch 3&4 is on. The circuit operation during the high period of the high frequency of square wavem applied to the MOSFET to turn ON. Inductor L is placed between the positive and negative supply to the terminal. Therefore the current flows between the positive and negative supply terminals through the inductor L, which is stores the energy in its magnetic field.m There is no current flowing in the remaining circuit as the combination of D, C and the load represent a much higher impedance than the path directly through the heavily conducting MOSFET.The current path during the low period of the switching square cycle wave. MOSFET is rapidly turned of sudden drop in current causes in L, to produce the back emf in the opposite polarity to the voltage across the inductor during on period, to keep current flowing. Each time MOSFET conducts, the of D is more positive than its anode because of the charge on capacitor. When diode is turned off means, the output of the circuit is isolated from the input, the load is continues to be supplied with VIN+VL from the charge on capacitor. Charging and Discharging of capacitor depends on the following equations at initial condition When switch is closed VC remains constant voltage, capacitor cannot change the voltage.

$$Ic = C\frac{dVc}{dt} \qquad (1)$$

$$Vc(t = 0) = VcI \qquad (2)$$

The current flow through the capacitor, it will energize to increase voltage.

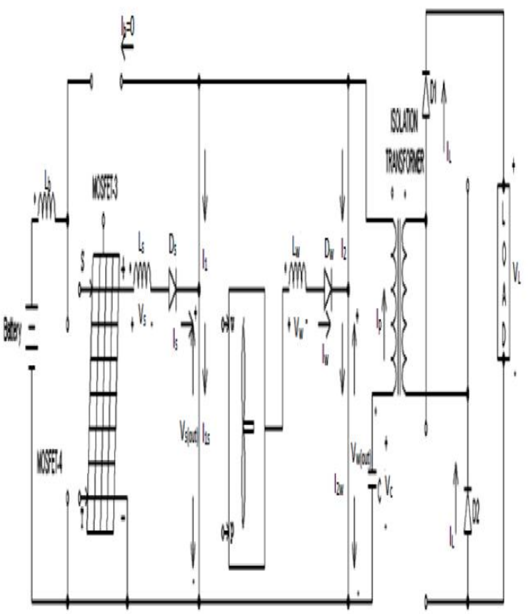
$$Vc(t>0)=VcI \ \ (increasing) \qquad (3)$$

When the capacitor voltage increases, capacitor current will decreases

$$Ic(t)=\frac{Vs-Vc(t)}{dt} \qquad (4)$$

Mode: I

When PV is supplying power to the load, the current path will flow in positive direction. Inductor Ls is used for boost operation and diode is used to block the voltage.



The capacitor will charge when MOSFET1 turned ON in OFF condition capacitor will discharge the power to load through the high frequency transformer, D1 and D2 will conduct. Excess amount of energy is stored in battery through MOSFET3 is in ON condition, at the time battery current IB=0.

$$Ip = I1 + I2 \quad (5)$$

$$I1s = I1 + Is \quad (6)$$

$$I2w = I2 + Iw \quad (7)$$

Ip, Is, Iw are primary current of the transformer, solar current and wind current respectively. Vs, Vw are solar and wind voltage respectively. Vs out and Vw out is zero.

$$Vs = ls\frac{dis}{dt} \quad (8)$$

$$Vw = lw\frac{diw}{dt} \quad (9)$$

$$Vc = \frac{1}{c}\int Ic(t)dt \ (Vc\ decreasing) \quad (10)$$

When PV is supplying power to the load, the current path will flow in positive direction. Inductor Ls is used for boost operation and diode is used to block thevoltage. MOSFET switch 1 is on condition, the capacitor will charging condition.when the MOSFET 2 is OFF condition the capacitor discharges the power to load through high frequency transformer. Excess amount of generating power flows to battery when MOSFET 4 is OFF and current flows the reverse directiondirection

Mode: II

When the MOSFET1 and MOSFET2 is OFF condition the power flows through the diode. The current flows through the primary winding of the transformer to the secondary winding of the transformer for step up the voltage and Diode D1 & D2 will conduct. when MOSFET switch 3 is on the power fed to the battery for charging and load voltage and current is VL and IL. Battery for charging through bidirectional power flow only to the battery.

$$Ip = I1 + I2 \quad (11)$$

I1 and I2 both are having opposite polarity.

$$Vs\ out = Vs + Vls \quad (12)$$

$$Vw\ out = Vw + Vlw \quad (13)$$

$$Vc = \frac{1}{c}\int Ic(t)dt \ \ (Vc\ increasing) \quad (14)$$

When Vc<Vb the battery current Ib=0,battery current positive at Vc>Vb

Mode: III

When the MOSFET switch 4 is on condition the capacitor will charged simultaneously the MOSFET switch 3 is on condition battery will charged at the time PV and Wind generating voltage is absence condition. MOSFET 4 is off condition capacitor discharges the voltageto the primary of the transformer and the secondary winding of the transformer increase the voltage to the load. Simultaneous power flows to the load through high frequency transformer. In battery discharging mode primary current of the transformer is

$$Ip = I1 + I2 + Ib \quad (15)$$

$$Vc = \frac{1}{c}\int Ic(t)dt \quad (16)$$

4. DESIGN CONSIDERATIONS

The multiport dc-dc converter has a single stage conversion process with multiple ports. It is emerging because to make, the whole system more compact and simpler. This multiport dc-dc converter cannot only interface all sources and load and also modify the electrical energy form,but it regulate the power flow between the source and load. The high frequency transformer consists of ferric core, which is provide the isolation and voltage matching between source and load. The transformer turns ratio is select by using this formula

$$\frac{Np}{V1} = \frac{Ns}{V2} = \cdots = \frac{Nn}{Vn} \quad (17)$$

where LS is the total inductance to theprimary of transformer and FS is the switching frequency. The requirements of operation on the region for the multiport dc-dc converter are, the following: 1) Independently supply the load power from each of the sources; 2) Share the power between source and load; 3) When the load is regenerative, the power us used tocharge the battery; When the power flow from the port 1 to port 3, the converter operate in boost mode to keep the port 3 at a maximum desired value. The other direction of power flow, the converter operate in buck mode to charge the storage element battery.The following requirement should be satisfied, Tom make multiple sources work effectively: the switch SK (K =1,2,3,4) should not be turned off before S1 is switched off; otherwise, LS will continuously store energy through even S1 and S2 is off, which is not desired. To meet this requirement, the following inequality should be satisfied for the multiport dc-dc converter, where VL is the output voltage of the load. The renewable energy source with the largest nominal output voltage will be connected to converter port which is may lead to one of the following two scenarios.

Scenario 1: If no power is available from Port 1, which is no longer valid but should still be satisfied. In this scenario, the duty cycle of the switch S1 is set to be a constant value such that is satisfied and the function of the switch S1 is to change the direction of the current IP flowing through the transformer. Specifically, when S1 is off, the current IP flows from the, other sources to the transformer to charge the capacitor Cs. When S1 is on, the capacitor Cs discharges so that the direction of the current IP reverses.

Scenario 2: The renewable energy source generate the power at Port 1 is low such that cannot be satisfied, should still be satisfied. In the duty cycle of the switch S1 will bem increased to a maximum value by the fuzzy controller such that is satisfied and the function of the switch S1 is the same as that in Scenario 1. The power generated by the renewable energy source connected to Port 1 might be less than the maximum power that can be generated by the source. In this scenario, at port 1 the difference between the generated and the maximum power is small because of the maximum available power at,Port1 of multiport dc-dc converter is usually very low.

5.SIMULATION AND RESULT

It consists of three ports. There are main port, battery port and load port. It is operates in three modes. Under running condition any one port supplying, one port is charging andm another one is load port. The simulation parameters are input voltage is 12V for PV and wind and the battery voltage is 24V. The load output power is 90W.

Parameters	Value
Battery nominal voltage	24V
Fully charged voltage	26.1316V
MOSFET resistance	1ohm
Diode resistance	0.1ohm
Capacitor	100µf
Switching frequency	5KHZ
Carrier frequency	1080HZ
Motor current	1A
Inductor	.05H
Motor resistance	200ohm

Multiport dc-dc converter simulation parameters

6.CONCLUSION

This proposed multiport DC-DC converter consist of reduces the switches number, for the power management of various renewable energy source. Hybrid generation system and energy storage system are the source of the converter, simultaneous power management is applicable in this proposed topology. And soft switching operation is realized in the isolated high frequency transformer. The both buck and boost operation of the converter is depend on the switches. Simulation for multiport dc-dc converter is verified for either direction of power flow between two DC sources. In this system reverse direction of current flow and thereby the power, while maintaining the voltage polarity is not changed. Under different operating conditions including normal load, large load, small load, even load, the system can remain stable and controlled. The closed-loop control system for the proposed converter is highly stable

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