HIGH EFFICIENCY DC-DC CONVERTER WITH DUAL INPUT POWER SOURCES

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Abstract: **A dual DC input power supply for high output efficiency DC-DC converter is developed. The proposed converter can boost the varied voltages of different power supply in the sense of hybrid power supply to obtain a stable output dc voltage for the load demand. Based on the varied situations the operational mode of the proposed converter can be divided into two modes including a single power supply mode and dual power supply mode .In dual power supply state the input circuits are connected in series get added together with the designed pulse width modulation can greatly reduce the conduction loss of the switches. Single mode power supply will operate whenever it is capable to meet the load demand, when it cannot meet the load demand then dual power supply mode will operate .The proposed high efficiency DC-DC converter with dual input power supply greatly reduces the conduction and switching losses in the system. This topology is developed to cope with the demerits of large size ,complex topology, and expensive cost in conventional converter with single power supply mode. MATLAB has been used to make the model and simulate the system and PI controller is used.**

Index Terms: DC-DC Converter, hybrid power supply

I. INTRODUCTION

One of the major concern of power generation sector is day to day increasing power demand .Based on the current scenario all over the world especially India has lot of power shortage issues. The power developed from the fossil fuels are becoming so less as it degrade the environment and getting depleted day by day. So now days we are looking forward for the power generation from renewable energies like solar, wind, biomass, tidal etc which does not create any pollution to the environment. At present stand-alone solar PV system has been promoted around this global level on comparatively larger scale but this independent system cannot provide continuous energy as they are seasonal hence hybrid systems come into play. As the solar radiation varies throughout the day, the power generated also varies. Maximum power point trackers (MPPTs) play an important role because they maximize the power output for a set of conditions, and therefore maximize the efficiency generation from renewable energies like solar, wind, biomass, tidal etc which does not create any pollution to the environment. The use of renewable energy is helping the environment to reduce the global warming effect. In rural areas or remote areas where grid cant supply the power there we can use this proposed dual input power source to meet the load demand. The use of solar energy can meet the load demand during day time and the excess energy it will store in the battery but during night time and winter season if the load demand is increased then it is difficult for the solar energy to meet the load demand hence we use ac supply and solar energy together to meet the demand so that the power is not interrupted. The input impedance of the DC-DC converter is matched with the optimum impedance of PV panel. This method has good performance under MATLAB. R. J. Wai,.et.al [1] From this paper based on the environmental concern and the energy status, the developed electrical power may be insufficient to drive the load. To have the continuous power supply, we use hybrid power supply by using different kinds of sources. Those sources can be capacitor, fuel cell, rechargeable battery or best source renewable energies..

A. Kwasinski[2] When the multi inputs are used in DC-DC converter simultaneous power will be delivered from all the sources which is not required at all the time, hence it increases complexity and cost of the system. As well the system design requires an enlarged storage equipment independently. Savita Nema,et.al[3] This paper helped in studying and modelling the PV panel using PV cell circuit model. Where the PV cell is been derived from the PN junction and it reflects the characteristics of the cell.

S. H. Park,et.al.[4] In this paper soft switching is used for the proposed boost converter that has an auxiliary switch . In this paper we have come to know that how the conduction loss is been reduced across the switch, how the efficiency of the system is improved, Much more than the hard switching converter.

T.Bhattacharya, et.al[5] for more input electric vehicles, one input as the batteries and the other as drive dc link may be at varying voltages. The batteries are at low voltage to obtain increased level of efficiencies, and the dc link is at higher voltage to have increased level of efficiency on the motor side.

II.TOPOLOGY AND OPERATION OF DUAL –INPUT CONVERTER

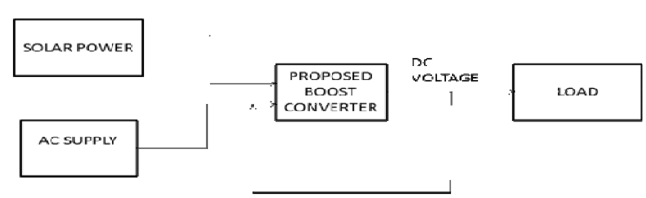


Fig1 Block Diagram of Dual Input Power Source

This block diagram shows the way in which the dual input is fed to the boost converter. Solar and AC supply are the two input sources used here, these two sources are fed together to a boost converter to power the load based on load demand, so that the load demand is satisfied continuously.

Hence to know the changes in load demand a feedback loop i.e PI controller is used.This feed back loop from the load is taken and given to the secondary input that is to the AC supply, so that whenever the load demand is not satisfied by solar then the AC supply will be added up to the solar supply to meet the load demand.

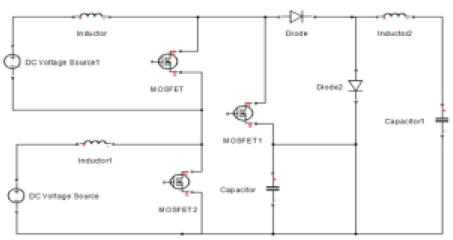


Fig2. Equivalent Circuit of High Efficiency DC-DC Converter with Dual Input Power Sources

A.Single Mode Power supply

In this mode only one switch will be turned ON/OFF at a time to meet the load demand. The duty cycle for one switch will be 50% so that in the given 25khz frequency 50% will be the on time & remaining off time.

Mode1:

Only one switch will be conduct at a time when switch S_1 is turned on, that time S_2 will be turned off, the switch voltage vs_2 increases upto the auxiliary capacitor voltage $V_{a,}$ and auxiliary switch voltage vs_a declines to zero, the body diode of the auxiliary switch will be turned on to receive the secondary inductor current to charge the auxiliary capacitor so that the auxiliary switch also gets turned on. The auxiliary inductor current il_a linearly increases and the current through the auxiliary switch also becomes positive.

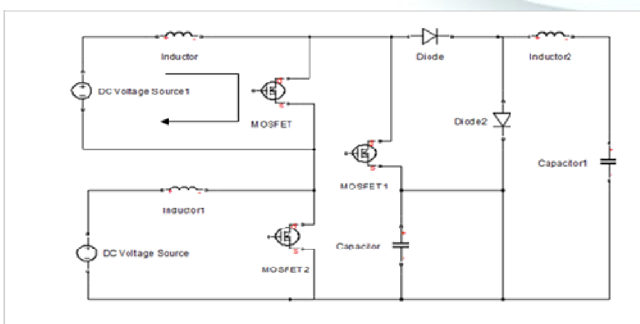


Fig3. Equivalent Circuit of High Efficiency DC-DC Converter with Primary Input as Power Source

Mode2: Same process is followed when the switch S_2 is turned on, the switch S_1 is turned off ,the voltage v_{s1} is increasing to the auxiliary capacitor voltage V_a and where as the auxiliary switch voltage V_{sa} declines to zero .The body of the auxiliary switch diode only conducts to fetch the inductor current il_1 to impose the capacitor voltage and to current increases linearly when it is greater than the primary inductor current the auxiliary switch starts to conduct, its similar to the mode1.

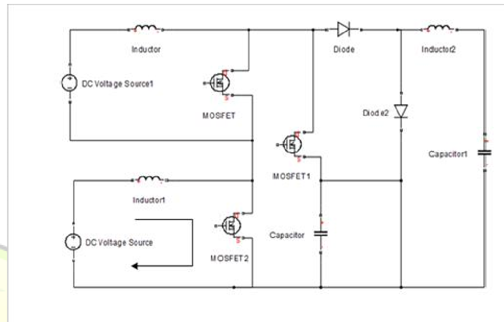


Fig4. Equivalent Circuit of High Efficiency DC-DC Converter with Secondary Input as Power Source

B.Dual Mode Power Supply

In this mode both the switch will be conducting that is switch S_1 and S_2 and at the same time the auxiliary switch S_a will be turned off, as the auxiliary inductor current will return to zero, where as the inductor current l_1 and l_2 increases or charged by the input voltages v_1 and v_2, the dual input voltage source will operate together and flows through the diode, as the auxiliary switch is switched off the current does not flow through the switch hence current across to it is zero

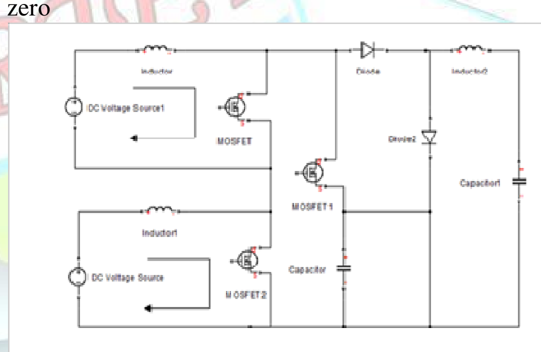


Fig5. Equivalent Circuit of High Efficiency DC-DC Converter with Dual Input as Power Sources

The proposed converter is operated in this dual power supply state with dual input power sources, it is considered as superposition of both the input source that is been conducting, only because of this mode of operation the efficiency of the system is increased as the output voltage obtained is more stable .This mode is only highlighted in this project, and the entire concept used in this project is based on this dual power supply mode.

III. Design of Boost Converter

3.1 DESIGN CALCULATION:

ASSUMPTION
FOR SINGLE INPUT
V_S= 12(V)
V_O=24 (V)
K=0.55
R=16Ω
SUBSTITUTION

OUTPUT VOLTAGE, $V_O = \frac{V_S}{1-K}$

$V_O = \frac{12}{1-0.55}$ =26V

OUTPUT CURRENT, $I_A = \frac{V_O}{R} - \frac{24}{16}$ =1.4A

CAPACITOR, $C = \frac{I_A \times K}{F X \Delta V_C} = \frac{1.4X0.55}{25000X0.077}$ =400X10^{-6}F

INDUCTOR, $L = \frac{V_{SXK}}{f x \Delta I} = \frac{12X0.55}{25000X0.6}$ =440X10^{-6}H

so,for Dual Input
V_S = 24(V)
V_O =48 (V)

3.2 LOSS CALCULATION

Input power For Single Supply=3.4*12=34W
Output power For Single Supply =34.38
Input power For dual Supply=7.08*24=169W
Output power For dual Supply =130.2w
Conduction loss For Single Input Supply:

$P_{cond} = I_{ON}^2 \times RDS_{ON} \times D$

$= 0.0003955^2$ *0.35*0.6

=0.000083W

Conduction loss For Dual Input Power Supply:

$P_{cond} = I_{ON}^2 \times RDS_{ON} \times D$

$= (0.0003923^2 + 0.0003923^2)$*0.35*0.6

=0.00001W

Switching loss For Single Input Supply:

$$P_{SW} = \frac{t_{sw1ON} \times V_{OFF} \times I_{ON} \times f_{SW}}{2} + \frac{t_{sw1OFF} V_{OFF} I_{ON} f_{SW}}{2}$$

=(25*10^{-9}*24*9.5*25000)/2+(24*10^{-9}*23.5*9.5*25000)/2

=0.06976+0.066975 =0.136W

Switching loss For Two Input Supply:

$$P_{SW} = \frac{t_{sw1ON} \times V_{OFF} \times I_{ON} \times f_{SW}}{2} + \frac{t_{sw1OFF} V_{OFF} I_{ON} f_{SW}}{2}$$

=(25*10^{-9}*77.8*0.0008*25000)/2+(24*10^{-9}*77.8*0.0008*25000)/2

=0.000038

IV Simulation and Simulation results

4.1 Open Loop Control of High Efficiency DC-DC Converter with Dual Input Power Sources:

The circuit topology of High Efficiency DC-DC Converter with dual input power sources it works in open loop condition ,it means without using any feedback loop.

4.1.1. Matlab Simulation Of Single Input Power Source In Open Loop Condition

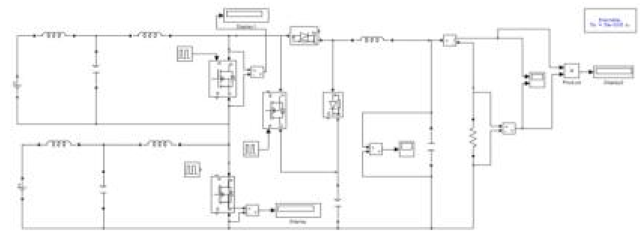


Fig6:Simulink Model of Single Input Power Source in Open loop Condition

4.1.2 when only s1 on - output waveform=0.5

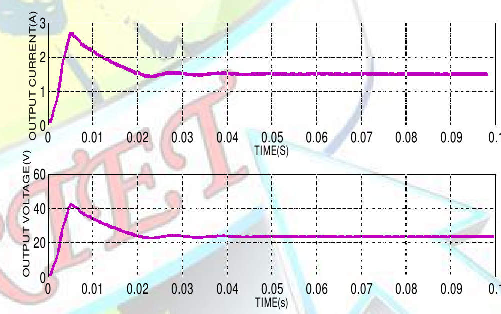
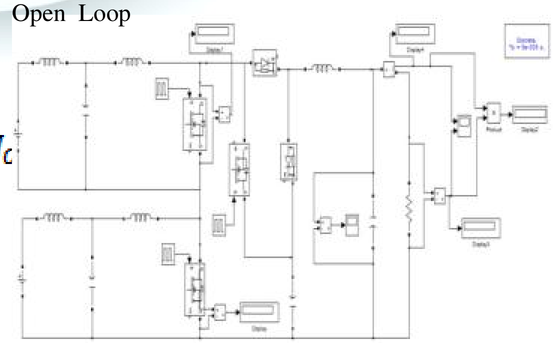


Fig7. Output Waveform When Only S1Operates at a Duty Ratio Of 0.5

4.1.3 Matlab Model of High Efficiency DC-DC Converter with Dual Input Power Sources-Open loop

Fig8. Simulink Model with Dual Input Power Sources in Open Loop



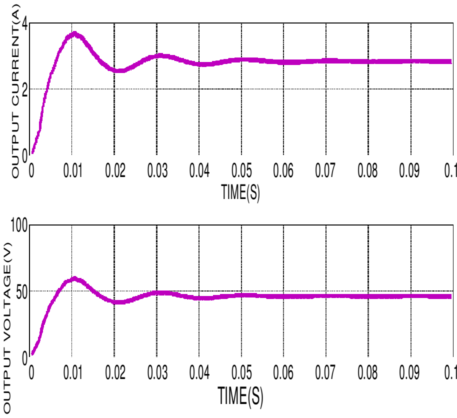


Fig9. Output Waveform When S1 & S2 Operates at a Duty Ratio Of 0.5

4.1.4 Matlab Model of High efficiency DC-DC Converter with Dual Input Power Sources-Closed Loop

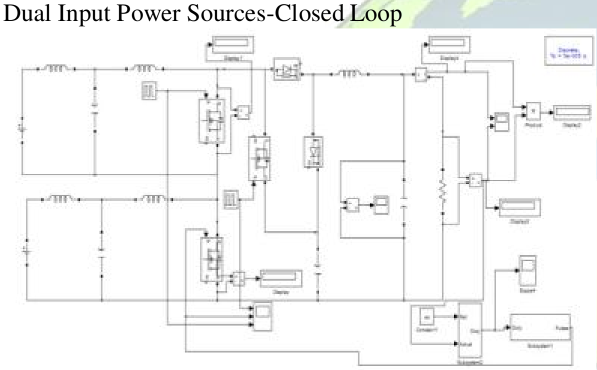


fig10. Simulink Model with Dual Input Power Sources in Closed Loop Condition

4.1.5.Matlab Simulation Output Waveform of High Efficiency DC-DC Converter with Dual Input Power Sources-Closed Loop

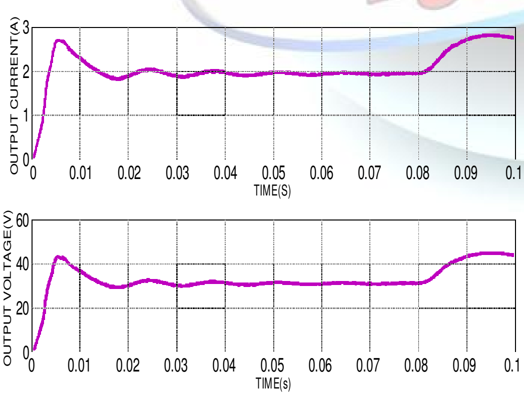


fig11. Output Waveform when Dual Input Operates at a Duty Ratio of 0.5

V.CONCLUSION

A solar–AC hybrid generation system was proposed and implemented. This stand-alone hybrid generation system could effectively extract the maximum power from the solar energy sources .The proposed converter supplies continuous power to the load demand and greatly reduces the conduction and switching losses in the system. The simulation model of the proposed hybrid system is been developed using MATLAB/Simulink. Simulation results showed that the used PI controller could control the second switch properly so as to meet the load demand satisfactorily.

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