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Compare Various Filters on Uncoupled Boost Converter.

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Abstract - Renewable energy is derived from natural resources that are replenished constantly. The commonly used renewable energy systems include photovoltaic cells and fuel cells. A suitable DC-DC converter is proposed for highly efficient renewable energy systems .In high-power applications, interleaved uncoupled boost converters has been proposed to increase the output power and to decreases the output ripple . The generally used renewable energy include fuel cells and photovoltaic cells . The IBC is discussed in this paper for renewable energy applications. The applications of interleaved boost converter(IBC) compared to the classical boost converter are lower input current ripple, high efficiency, low electromagnetic emission and improved reliability. In this paper we study uncoupled boost converter with 500 w load using different types of filter. By using this we observe which filter is more efficient on uncoupled inductor for renewable energy. The waveforms of output voltage, inductor current ripple ,error and input current are obtained by using Simulation in MATLAB. The results come from simulation result on MATLAB the best of the five filters on uncoupled boost converter is inferred.

Key Words: *Uncoupled Inductor, (IBC) Interleaved Boost converter, filter.*

I.INTRODUCTION

The world virtually depends on the supply of fossil fuel. Fossil fuels energy includes natural gas, coal and oil but now days fossil fuels are running out. Fossil fuels are non renewable source of energy. Renewable energy comes in and intention for this universal issue. Renewable energy is derived from natural resources that are replenished constantly such as wind, sunlight, rain, tides waves and geothermal heat. Renewable energy resources live over whole world in distinction to other energy sources. That time in international public opinion surveys is that there is strong support for advanced renewable sources such as solar and wind power[1]. Thirty nations around the world already have renewable energy contribution in the national level.

For these application that can be used Interleaved Boost Converter. The Interleaved Boost Converter step up the high voltage and decreases output voltage ripple, decreases electromagnetic emission, decrease inductor current ripple. In high power application interleaved boost converter is used as compare to Conventional Boost converter because it has low ripple in input side and output side. we use uncoupled inductor circuit with C filter, Pi filter, and T filter. In this paper investigate which circuit is having less ripple, more output voltage and less ripple inductor ripple. we compare all four types of waveforms secure in Simulation on MATLAB. Simulations on MATLAB have been performed to validate the concepts.

A. Operation of Uncoupled Interleaved Boost Converter

The two phases of the converter are driven 180 degrees out of phase, this is because the phase shift to be provided depends on the number of phases given by 360/n where n stands for the number of phases[3].Two phases are used the ripple frequency is doubled and results in reduction of voltage ripple at the output side. The input current ripple is also reduced by this arrangement.

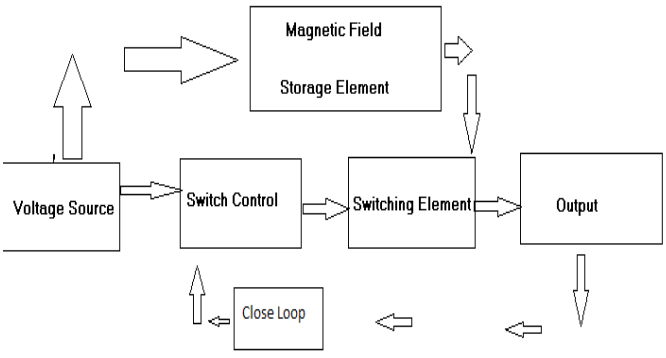


Fig.1.Block Diagram of Close Loop IBC

II. DIFFERENT TYPES OF FILTERS

By using filter in the circuit we reduce the ripple contents present in the system. Filter circuit is a combination of capacitor (C), Inductor (L) called LC filter. To passed capacitor permits AC only and Inductor permits DC only.

Types of filters are given below.

A. Inductor Filter

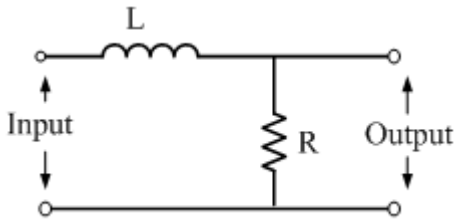
B. Capacitor Filter

C. LC Filter

D. π (Pi) Filter

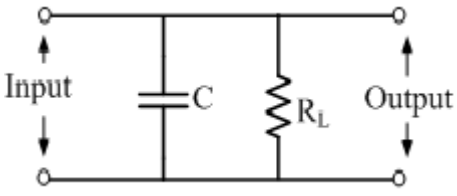
E.T Filter

A. Inductor Filter



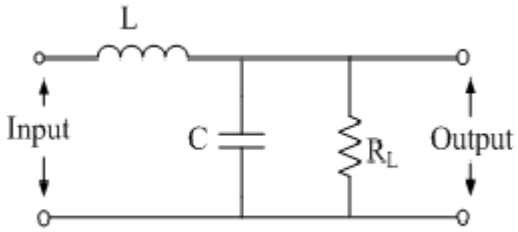
In inductor L is put between rectifier and load resistance. Inductor filter is also called as choke filter. In this, rectifier has AC and DC components. Rectified output is block AC and DC reached to the load resistance.

B. Capacitor Filter



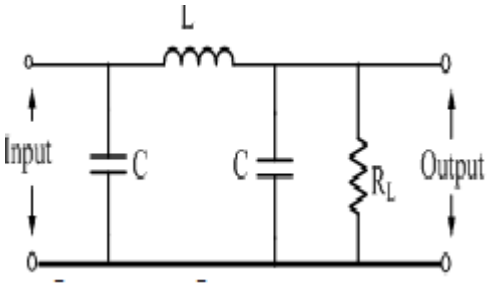
During increases voltage the capacitor is connected across the load it gets charge and the charge is given to the load through the decrease in the voltage cycle. This operation is repeated for every cycle and then the output ripple is decreases across load resistance.

C. LC Filter



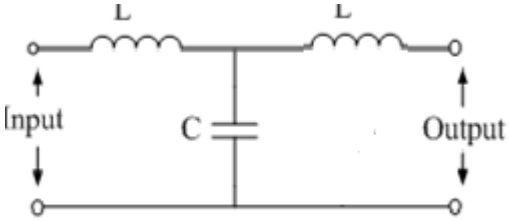
In LC filter, if we merge inductor filter with capacitor filter, the most of the ripple factor independent of the load filter. The LC filter inserted in the series with load, it provides high resistance to AC component and permits DC component to flow through the load, and capacitor connected parallel across the load, filtered out AC component flowing through the LC filter. By using this we reduces ripple and offers smooth DC flow through the load.

D. Pi or CLC Filter



In Pi filter, Three components are connected in shape of Pi. In this circuit two capacitor and one inductor connected across it's each end. The Pi filter gives much better filter then LC filter. The Pi filter is used for low current equipment.

E. T Filter



III.DESIGN METHODOLOGY OF UNCOUPLED IBC

The design procedure for interleaved boost converter need a choice of actual values of power semiconductor

devices, capacitor and inductor. The step require in procedure for designing the uncoupled interleaved boost converter are as follows

1) Decision of duty ratio and number of phases
2) Selection of Inductor and capacitor values
3) Selection of power switches
4) Output filter

A) Decision of duty ratio and number of phases

If we used increase in the number of phases, reduces more ripple contents. In this paper we use two phase Interleaved Boost Converter. The number of switches, diodes, inductors are same as n number of phases[1].

$$\frac{Vin}{L}\left(\frac{2-3D}{D'}\right)\frac{T}{N}\,d(0.34 < D < 0.66) \qquad (1)$$

Where Vin is input voltage, D is duty ratio

B) Selection of Inductor and capacitor values

For the selection of the inductor and capacitor the design equation part for uncoupled IBC is given below

Uncoupled inductor

The value of inductor for uncoupled IBC is

$$L = \frac{Vin\ DT}{\Delta Iph} \qquad (2)$$

Where Vin is input voltage, D is duty ratio

I. Selection of power Devices

The power semiconductor devices for two phase uncoupled interleaved boost converter is IGBT, because IGBT has many advantages to other conventional boost converter. It has high switching operation, lower on state resistance.

$$Vswitch = Vin\ \frac{1}{1-D} \qquad (3)$$

Where Vin is input voltage, D is duty ratio

II. Output Filters

Filter is use to reduce ripple at load side.

$$C = \frac{V0\ DT}{R\,\Delta V0} \qquad (4)$$

Where R is load resistance ,V0 is output voltage and T is switching period.

IV. SIMULATION RESULTS

As per equation number 1,2,3 and 4 from above Two phase IBC with uncoupled inductors are simulated in MATLAB Simulation. The values of uncoupled IBC are L=2.5 mH, F=2.5 KHz, C=78µF,R=3.2 ohm, duty ratio D=0.5,input is Vin=20 V and output voltage is Vout= 40

a) Uncoupled IBC with C Filter

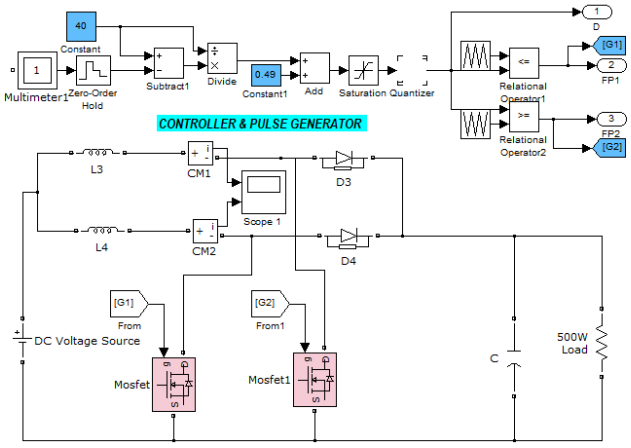


Fig.6 circuit diagram of Uncoupled IBC with C Filter

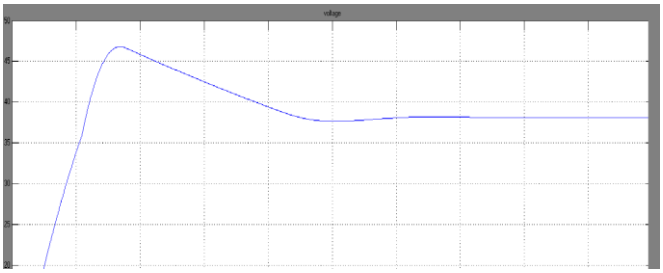


Fig.6.1 output voltage waveforms of Uncoupled IBC with C Filter

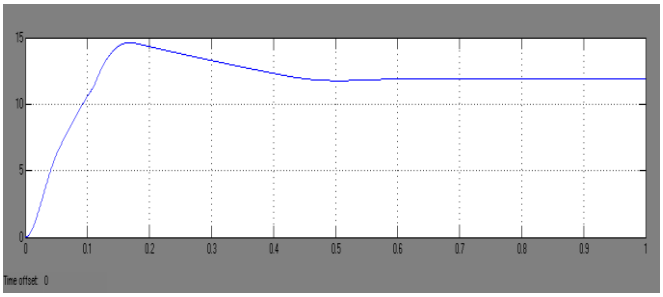


Fig.6.2 output current waveforms of Uncoupled IBC with Pi Filter

b) Uncoupled IBC with Pi Filter

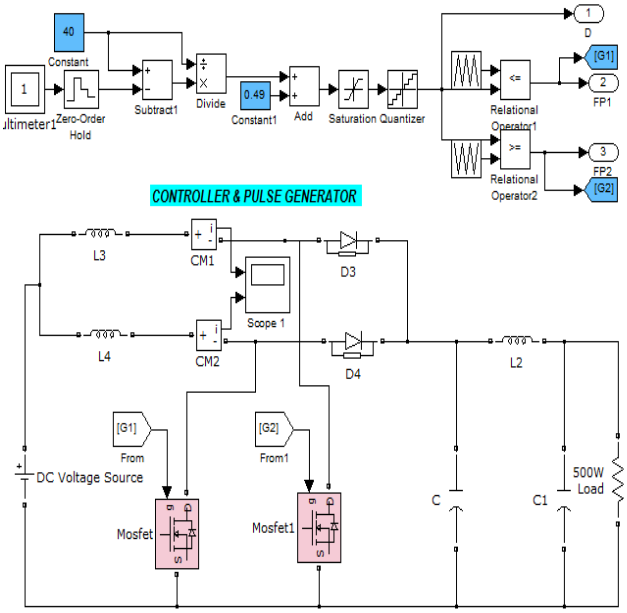


Fig.6.3 circuit diagram of Uncoupled IBC with Pi Filter

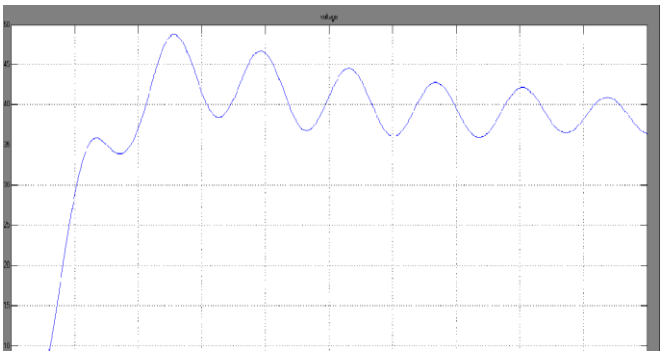


Fig.6 output voltage waveforms of Uncoupled IBC with Pi Filter

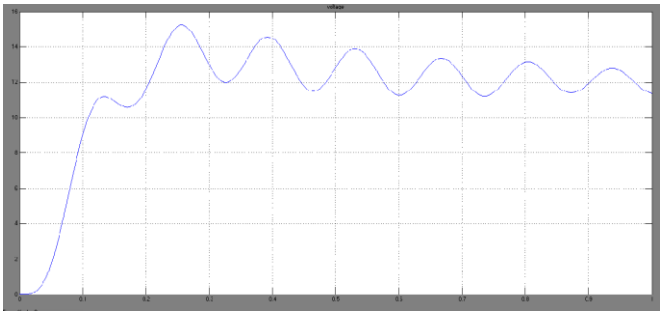


Fig.6.4 output current waveforms of Uncoupled IBC with Pi Filter

C) Uncoupled IBC with Pi Filter

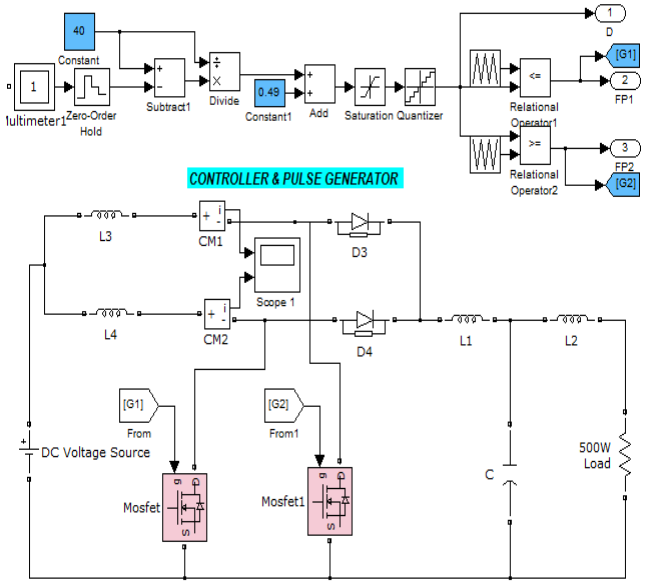


Fig.6.5 circuit diagram of Uncoupled IBC with T Filter

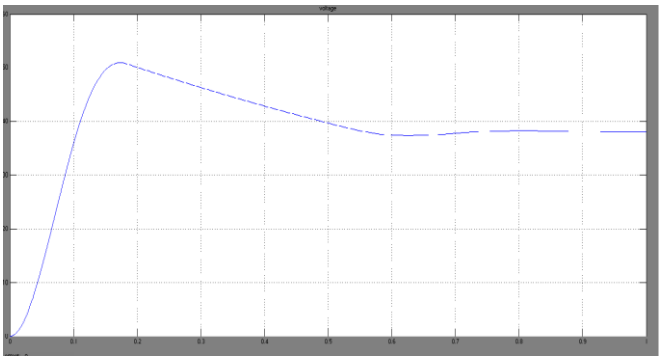


Fig.6 output voltage waveforms of Uncoupled IBC with T Filter

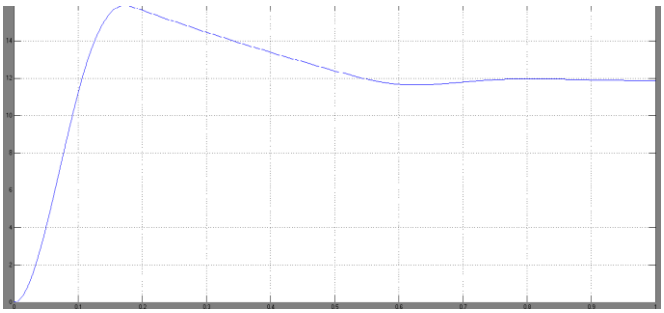


Fig.6.6 output current waveforms of Uncoupled IBC with T Filter

For C filter Output voltage is 38.11 V,Output current is 11.91 A , Ripple is 0.01846 ,voltage error is 1.895 and current error is 0.5922 .

For Pi filter Output voltage is 36.39 V,Output current is11.37 A , Ripple is 4.761 ,voltage error is 3.609 and current error is 1.128 .

For C filter Output voltage is 39.02 V,Output current is 11.88 A , Ripple is 0.2144 ,voltage error is 1.977 and current error is 0.6178.

VI. CONCLUSION

Interleaved boost converter has many advantages over other converter, so we used IBC for renewable energy application.

We use uncoupled IBC with Pi,C and T filter have been analyzed for renewable energy applications. By using their equations performance parameters of all three filter, compared result obtained in simulation on MATLAB. It is demonstrated that the uncoupled interleaved DC-DC converter with C filter effectively reduces the overall current ripple and boost large output voltage compared to that of uncoupled IBC with T and Pi filter.

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