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A Novel Concept of Interleaved Flyback Inverter for Photovoltaic Application for Higher Efficiency

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Abstract:

Demand of electricity goes on increasing every year. For this renewable energy sources is the best solution.The Study shows that how Interleaved flyback inverter is useful in photovoltaic application in order to achieve higher efficiency for improving the performance. The flyback topology is basically operated in Discontinuous conduction mode. The main aim of this study to develop the inverter with low cost which will help in order to achieve the higher efficiency. This reduction of cost is achieved by using flyback inverter topology. The controller performance and inverter design checked by using the simulation result for given particular specification. With help of experimental result it is possible to achieve the efficiency at 86% at full load and power factor which is very close to the unity.

Keywords :**Photovoltaic(pv), Discontinuous current mode(DCM)**

I. INTRODUCTION

This topology having the lower cost as compared to the other topologies because it uses less component as compared to the other scheme. The energy storage inductor is combined with the transformer which is separate in other topologies. Transformer performs the function of transfer of energy while inductor performs the function of storage of energy. The reduction of cost is possible by using the combination of this two equipment. The transformer used in this scheme having the special name called as the “Flyback transformer” in order to distinguish it from other transformer. Therecommended useof flybacktopologyislimitedbelow200W.Nevertheless, ifadvanceddesigntechniquesareemployed, theflybackconvertercanbeusedinhighpowerapplicati onsaswell. Whatever the power of scheme is there which shared equally by each unit which is another advantage of this technique. When Photovoltaic module generates the maximum power at that time the efficiency of system is maximum. Here in this scheme the photovoltaic module having the energy conversion unit and because of this reason this technology having the another name as AC PV module application. A simple structure of this system makes it more applicable for various applications

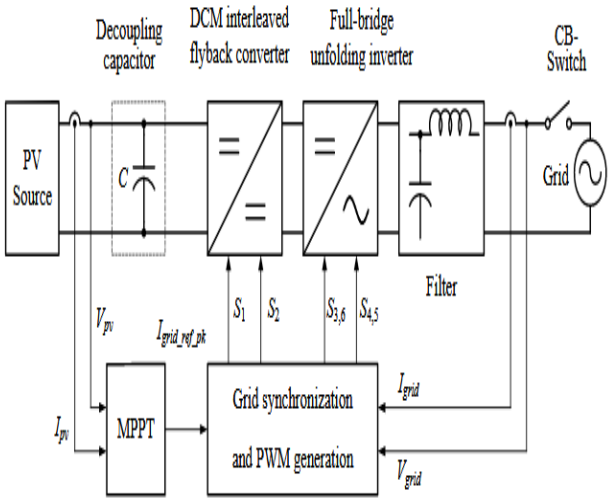

Fig. 1 Block Diagram of the PV based System

Fig.1 shows the block diagram of the proposed flyback based inverter system in which the PV source is connected to the interleaved flyback converter.Grid synchronisation is also shown in to the block diagram.Fig.2 showsthetopology oftwo-

cellinterleavedflybackPVinvertersystem,forillustrati ve purposes.Theactualandoptimumcell numberisdeterminedin thedesignsectionofthepaper.

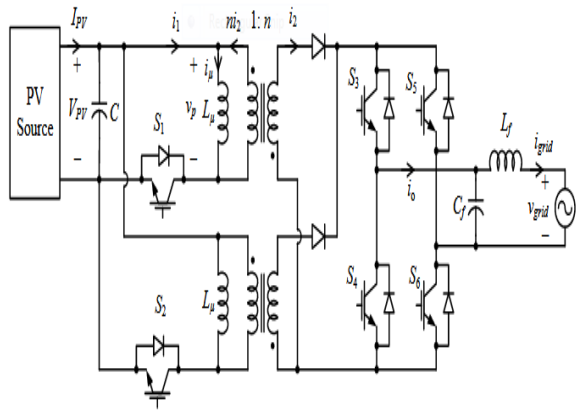

Fig.2 CircuitofflybackPVinverterpowerstagebasedontwo interleavedcells

With the reference of Fig.2 PV source is connected to the converter with the help of decoupling capacitor. Switch used in this scheme is nothing but IGBT.Low pass filter is also used for the interconnection with the grid. WhentheIGBTisturnedon,acurrentflowsfromthePVs ourceintothemagnetizinginductanceof theflybacktransformerandtheenergyisstoredasmagne ticfield;nocurrentflowstotheoutputdue tothepositionof the secondarysidediode.Duringtheon timeofthe IGBT,theenergyto theoutputis supplied bythecapacitor andtheinductor placedattheoutputstage.WhentheIGBTisturned off,theenergystoredinthe magnetizinginductanceistransferredintothegridthrou ghthetransformer windings. Low pass filter is helpful for supplying the current to grid. It is also helpful in removing the high frequency harmonics of the pulsed current waveform. Thedecoupling capacitorplacedattheflybackconverter is designed or placed insuchawaythatboththelowandthe highfrequencyaccomponents areeasily bypassed

andonlytheaverage(dc)componentofthe current isallowedtobedeliveredbythePVsource.

II.CONVERTER ANALYSIS

Whentheswitch isturnedoninFig.2,thePVvoltage isappliedtotheflyback transformer primarywinding. IfitisassumedthatthePVvoltageisconstantandcurrent startsfromzeroinitial value(becauseoftheDCMoperation). Whentheswitch isturnedoff,theflybacktransformerprimaryvoltagebe comesnegativeofthe gridvoltageafterdividedbytheturnratio. Attheendoftheswitchofftime,themagnetizingcurrent decreasesfromitspeakvaluetozero.Fig.3 shows converter voltage,flyback transformer primary voltage V_p and magnetising current I_μ over a one switching period.With the help of switch IGBT it is possible to achieve the high efficiency.

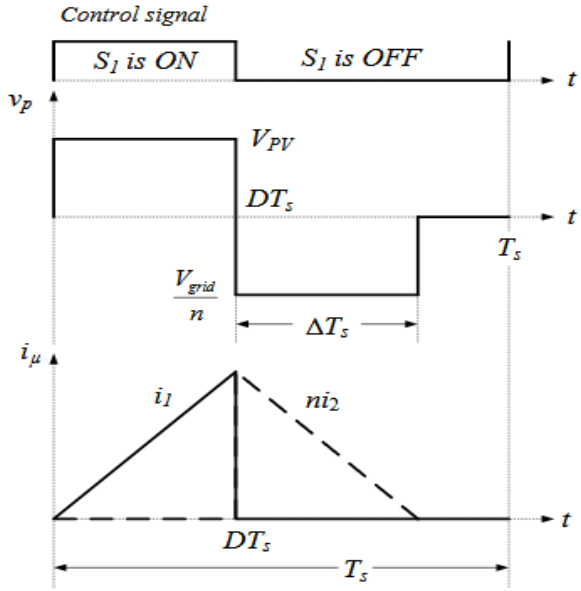

Fig.3:Control signal, flyback transformer primary voltage V_p and magnetization current

III.CONVERTER DESIGN

TABLE I

Design Parameters	Specification
PV model	65 W
Open circuit voltage and short circuit current	21.6 V,3.99 A
Grid characteristics	Single-phase nominal 220 V and 50 Hz ,185V –240 V rms voltage range 45.5 Hz –54.5 Hz frequency range
Voltage and current at maximum power	17.6 V, 3.69 A

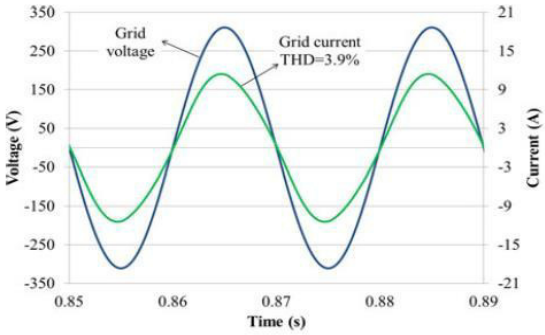

Fig.5.Grid voltage and current waveform

IV.DESIGN IF INVERTER

The decoupling capacitor plays vital role and it is very important part of circuit. The value of capacitor is mainly decided with the help of ripples. A small ripples means large value of capacitance. So there is some proper relation between ripples and value of capacitor that we are going to choose. The value of decoupling capacitor is nearly about 9400 µF.Here in this operation we are giving the preference to use switch as IGBT because of their ruggedness under high current and voltage stress.At the last stage, the converter employs an IGBT bridge operating at the grid frequency. This bridge is responsible for converting the dc secondary currents into ac, and therefore provides an interface to the grid through a low-pass filter. The filter is responsible for removing the switching frequency components of the sinusoidally modulated currents. The switching frequency of each flyback cell is 25 kHz. Therefore, the ripple frequency of current waveform at the output of the inverter is 75 kHz due to the interleaving. So, the corner frequency of the low-pass filter is selected as 7.5 kHz.

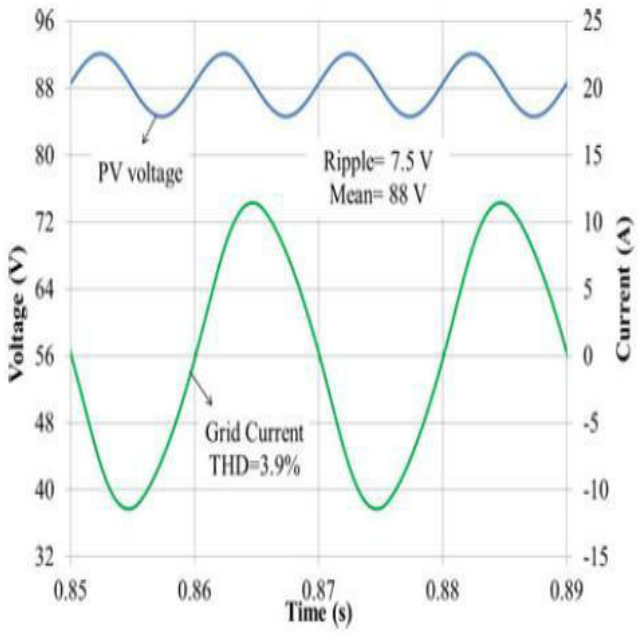

Fig.6.PV terminal voltage and current

IV.SIMULATION RESULT

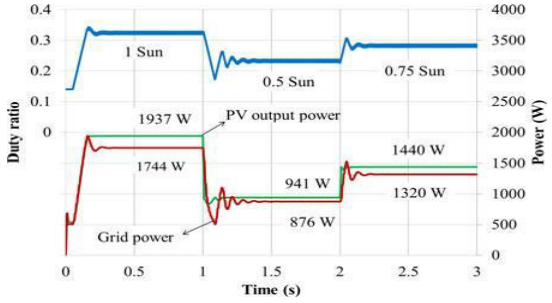

Fig.4:Peak Value of Duty ratio

IV.CONCLUSION

The main contribution of this system is that it helps for reducing the cost of overall system which is main factor while designing.It helps in the commercialization of solar technology in near future.The design whole system is very compact and less bulky as compared to the previous system.Building the inverter system based on the

flybackconverter. The design of converter is simple and it is compact in nature. Building the inverter system based on the flyback convertertopologyoffersthelowestcostsinceitrequire stheleastnumberofcomponents,operating inthediscontinuous currentmodeenablesverysimpleandalwaysstablecont rolsystem,andfinally three-cellinterleavedoperationallowscompactflybacktrans formerconstruction ".

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