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A TWO-PORT HIGHPOWER FLYBACK INVERTER FOR PHOTOVOLTAIC APPLICATIONS

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Abstract:

Electricity is widely demanded throughout the world .Due to the rapid depletion of non-renewable sources nowadays demand for renewable energy sources is growing tremendously. Among the various renewable sources, Solar power is reliable and has high potential. Flyback inverter is used here to convert the DC into AC. The flyback inverter has the advantages of simple control loop, less cost, high efficiency, compact confirmation. It is operated in BCM mode for its added advantage of wider switching frequency. Thus the Improved flyback inverter operated in BCM mode is an ideal solution for the PV applications.

Keywords:Renewable energy, Flyback inverter, BCM mode, photovoltaic applications, AC systems.

1. INTRODUCTION

Solar power is the best available renewable energy that has wide scope for harvesting huge amount of electricity. It can be said that An average home has more than enough area in the roof to produce sufficient amount of solar electricity to meet all its requirements. Using an Inverter, the DC power from the PV array can be conveniently converted to AC similar to connection with normal power grid. There are only two primary disadvantagesto using solar power: amount of sunlight and cost of equipment.The best way of lowering the cost of solar energyis to improve the cell's efficiency. In this project we have proposed an Improved flyback inverter which operates in BCM mode so as to increase the efficiency. In this paper, the efficiency of inverter can be improved by using flyback topology.The topology of the flyback inverter, which consists of three MOSFETs, two diodes, and a flyback transformer.The two outputs from the transformer are connected to the grid, through a common filter circuit, which can switch reciprocally and synchronouslywith the polarity of the grid voltage.It is simple, has less component count hence reduced cost and has advantage of isolation through transformer.A Pulse Width Modulation (PWM) control circuit to control the duty ratio of the switch. In fly-back circuits, for closed loop output voltage regulation, one needs to feed output voltage magnitude to the PWM controller.Here the Boundary Conduction Mode is used for the purpose of choosing broader frequency range.The energy from sun is transformed into direct current electricity. Maximum power point is a unique operating point supplying maximum power to the load which is present in a PV array. Tracking the maximum power point of the PV array is done to improve the efficiency of the photovoltaic energy system MPPT is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the modules to produce all the power capable of PV module. MPPT is not amechanical tracking system that “physically moves”themodules to make them point more directly at the sun.

2. INVERTER TYPES

The basic function of the inverterin a photovoltaic solar power system array is to convert the DC electricity generated by the solar panels into standard AC power. Any photovoltaic system which supplies power to an load must use an inverter to cover the DC power generated into AC power . There are four basic types of inverters commonly used namely Standalone inverters, Grid Tie inverters ,bimodal inverters,AC module inverters. In this project we are using Grid Tie Inverters. Popularly known as utility-interactive inverters, these inverters are connected to and work concurrently with the localutility grid. Power from the PV array is first directed to the point of consumption based on the load demand. Any excess power from the solar array which is not consumed is fed back into the utility grid through the power company's electrical meter. These inverters are inbuilt with safety features like anti-islanding. Anti-islanding will shut down the transmission of power from the solar array to the utility in case of any fault or other serious fluctuation in voltage or frequency.

3. MODES OF OPERATION

In this paper, we have analyzed about the working of flyback converter operating in BCM mode. Conventional converters used like Buck boost have certain disadvantages hence we go for the improved flyback topology in this paper. The flyback converter is used in both AC/DC and DC/DC conversion along with the galvanic isolation between the input and any outputs. The flyback converter is nothing but a buck boost converter with the inductor split to form a transformer, with an additional advantage of isolation. The flyback converters provide isolation between input and output.The main reason for isolation is for safety to prevent any kind of shock hazard when using a piece of equipment. In addition to providing safety, isolation is used to separate sections from one another. The flyback converter usually operates in three modes namely CCM ,DCM and BCM. They can exclusively operate in one mode for their load and line range but can also switch between modes of operation.

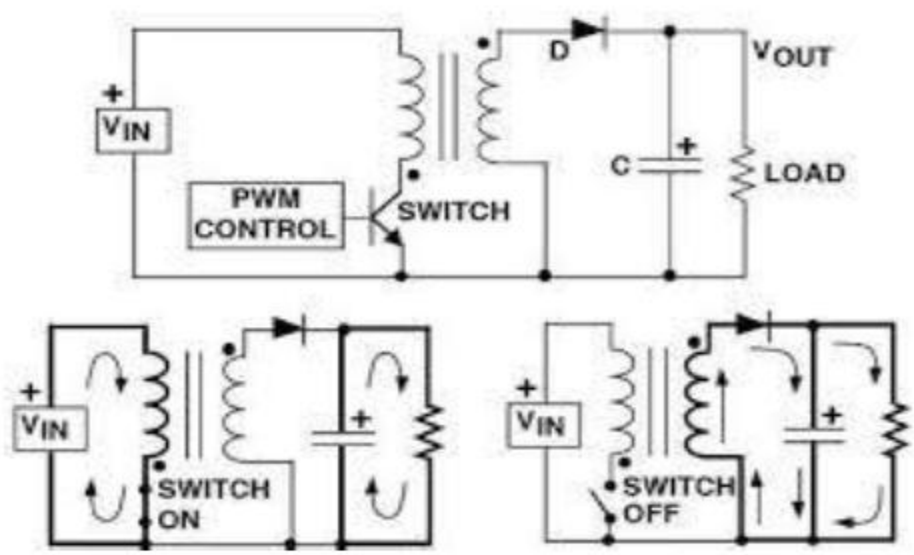

Fig.1. Basic Flyback Inverter and its functioning

Forexample, aflyback converter can be designed to operate in CCM for high loads and then transition to DCM for light loads. In this paper we have realized the operation of flyback in BCM mode for high loads and enter DCM at light loads .In the BCM the flyback operates at a variable frequency that is varies with the output load for a given input voltage and output voltage. Entering DCM allows the flyback to handle with light loads eliminating the need to operate at higher frequencies. If the flyback remained in BCM, then the operational frequency might increase to infinity while operating at lighter loads. The name boundary conduction mode comes from the fact that the controller operates right on the boundary between CCM and DCM. During this mode, the switch turns on and stores just enough charge to replenish the load during the time the switch opens. Thus the switch will turn on again once all the energy stored is transferred to the output load. The point where the switch is turned on and the current begins to ramp in the primary occurs as soon as the current returns to zero in the secondary. since the switching occurs after all the energy is transferred, the operating frequency is dependent on line and load conditions. There are four major losses which include conduction losses, switching losses ,transformer losses and diode losses. Of the four losses diode loss accounts for about half of the accountable loss. When comparing CCM and BCM,certain losses are higher for one than the other. For example in terms of conduction loss, the BCM mode shows higher loss because of its higher relative RMS current levels. On the other hand in terms of switching loss ,the loss here is higher for CCM since the strategy operates at higher frequency resulting in a larger loss. It was not clear whether CCM or BCM resulted.

4. RESULT ANALYSIS

BCM differs from CCM fact that switching occurs only after all the energy stored in the primary of the transformer is transferred to the secondary. One key advantage gained from switching at a known condition on each cycle is that no oscillator is required. A second operational difference is how the two topologies deal with current limit or short circuit conditions.

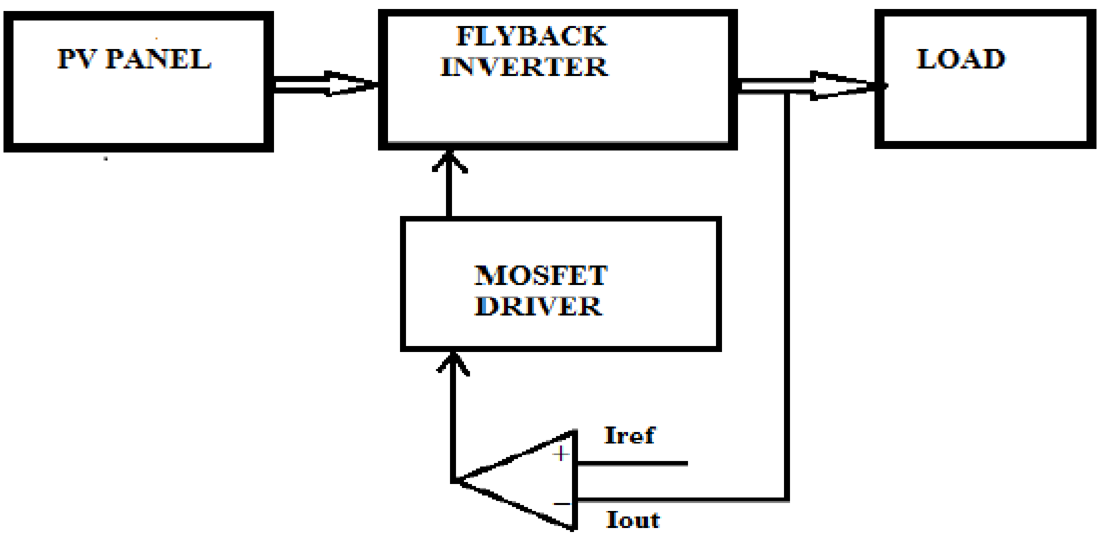

Fig.2.Working circuit

The BCM mode is inherently suited for short circuit operation because it only switches once the current reaches zero in the secondary .In addition, a similar advantage relates from the fact that the diode turns off at zero current in BCM. The soft switching of the output diode reduces EMI generated by the turn off of the output diode. For the reasons listed above, BCM provides some advantages over CCM operation in practical circuit applications. hePV panel supplies DC power tothe Flyback inverter. The Flyback inverter is a combined block of Flyback converter and Grid tied inverter.The grid tie inverter works in tandem with the load. The grid tie inverter inverts the DC into AC and feeds the AC supply to the load. The operation of the converter in the inverter block is controlled using a MOSFET driver. The driver controls the duty cycle of the MOSFET in the converter circuit thereby controlling the operation of the inverter. The output load current is compared with the reference current in the comparatorThe comparator output is fed to the controller. . Based on the error signal the comparator drives the controller. The controller in turn drives the MOSFET driver. During heavyloads the inverter is made to operate in BCM mode when light loads, it

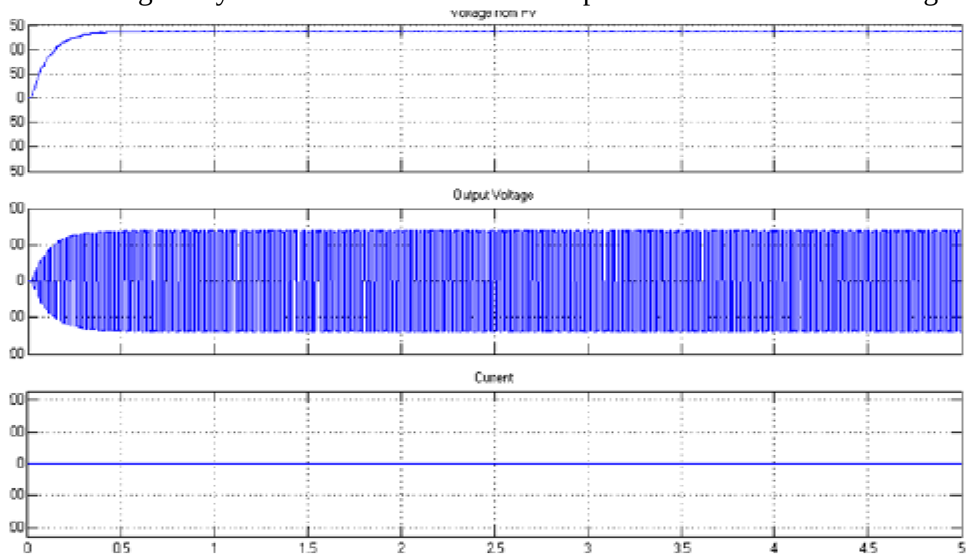

Fig.3.Output waveform

operates in discontinuous conduction mode. Thereby the inverter operates at a wider switching frequency during heavy loads. The MOSFET being a faster switching device and hence the switching losses are reduced.

CONCLUSION

Thus the improved flyback inverter has many advantages including simple control loop,wider switching frequency bandwidth, less cost and higher efficiency compared to other inverters used. Thus flyback inverter is an attractive solution for all the photovoltaic applications. Moreover using a grid tied inverter, it is able to supply voltage that is synchronous with the grid. Having an efficiency of more than 94% it is very advantageous when compared to conventional inverter circuits. The effectiveness of the proposed inverter is confirmed through simulation.

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