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CONTINUOUS CONDUCTION MODE FLY BACK INVERTER USING MPPT TECHNIQUE

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***Abstract*— This paper proposes a new technology on decentralized grid connected PV systems called "AC PV Module" which is characterized by a number of clear advantages over conventional large PV systems. But when PV panels are connected in series to feed a string inverter the power that is transferred to the power network has a large amount of power pulsation. In such cases there will be more power losses and efficiency will be lower.Inorder to overcome such defect we can use fly back inverters operating on continuous conduction mode for ac module application. Design issues, both for the power scheme and the control scheme, are identified and trade-offs investigated. An open-loop control of the secondary current is done here. The results presented show an improvement of efficiency for a 200-WPV module application. The output power quality at rated power level is capable of meeting IEC61727 requirements. The stability of the fly back inverter in CCM has been verified at selected working conditions. Thus the target is to develop new and cost-effective solutions for injection of electrical power, generated by PV modules, into the grid.**

***Index Terms*—PV module, CCM, power loss, fly back inverters, solar energy.**

1. INTRODUCTION

Nowadays the fossils fuel deficit, skyrocketing oil prices, global warming, and damage to environment and ecosystem are increasing, the promising incentives to develop alternative energy resources with high efficiency and low emission are of great importance. Among the renewable energy resources, the energy through the photovoltaic effect can be considered the most essential and prerequisite sustainable resource because of the ubiquity, abundance, and sustainability of solar radiant energy. Regardless of the intermittency of sunlight, solar energy is widely available and completely free of cost. It can generate direct current electricity without environmental impact and contamination when is exposed to solar radiation.

Being a semiconductor device, the PV system is static, quite, and free of moving parts, and these make it have little operation and maintenance costs. Even though the PV system is posed to its high capital fabrication cost and low conversion efficiency, the skyrocketing oil prices make solar energy naturally viable energy supply with potentially long-term benefits. distributed power generation in residential areas, using solar panels, is well accepted and also supported by recent developments in building integrated photovoltaic (BIPV) systems as well as micro grid systems. However, when PV panels are connected in series to feed a string inverter with a global maximum power point tracker (MPPT), a considerable power loss due to modular mismatches caused by both varying panel orientations and shading would occur. A major approach to solve this issue has been to package the PV panel with a module-integrated inverter, called an "ac module", which directly serves the grid.

Considerations of reducing the cost have led to an approach based on an unfolding type inverter. Here, the voltage boosting, isolation, and output current shaping are all performed by a dc–dc converter that is then followed by a low-frequency unfolding stage. A fly back inverter with center-tapped secondary windings is often adopted leading to a simple overall system When operated in continuous conduction mode (CCM), a fly back converter has lower peak currents and hence higher efficiencies. This has been exploited before in both dc/dc power conversion and ac/dc power factor (PF) correction applications. In our approach, we investigate the feasibility of a fly back inverter operating (mainly) in CCM mode as a grid-connected ac module inverter, with a view to demonstrating that a significant efficiency improvement can be realized without adding to the complexity of both the power and control circuits.

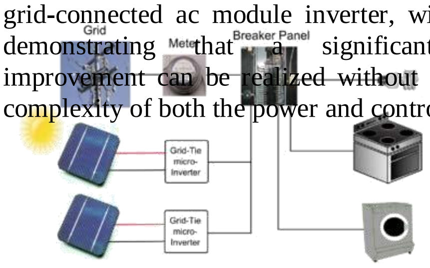


Fig.1**.**Diagram of a residential grid-connected PV system

1.1. FLY-BACK CONVERTER

The fly back converter is used in both AC/DC and DC/DC conversion with galvanic isolation between the input and any outputs. More precisely, the fly back converter is a buck-boost converter with the inductor split to form a transformer, so that the voltage ratios are multiplied with an additional advantage of isolation. When driving for example a plasma lamp or a voltage multiplier the rectifying diode of the buck-boost converter is left out and the device is called a fly back transformer. The schematic of a fly back converter can be seen in Fig. 1.1.

The operating principle of flyback converters is given below:

When the switch is closed (top of Fig.1.2), the primary of the transformer is directly connected to the input voltage source. The primary current and magnetic flux in the transformer increases, storing energy in the transformer. The voltage induced in the secondary winding is negative, so the diode is reverse -biased (i.e., blocked). The output capacitor supplies energy to the output load. When the switch is opened (bottom of Fig. 2), the primary current and magnetic flux drops. The secondary voltage is positive, forward-biasing the diode, allowing current to flow from the transformer. The energy from the transformer core recharges the capacitor and supplies the load.The operation of storing energy in the transformer before transferring to the output of the converter allows the topology to easily generate multiple outputs with little additional circuitry, although the output voltages have to be able to match each other through the turns ratio. Also there is a need for a controlling rail which has to be loaded before load is applied to the uncontrolled rails, this is to allow the PWM to open up and supply enough energy to the transformer.

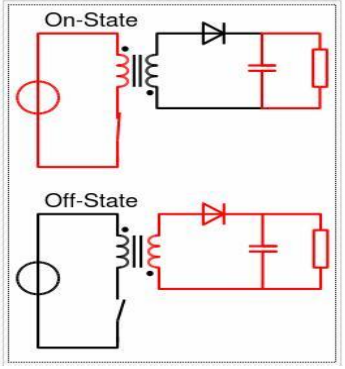
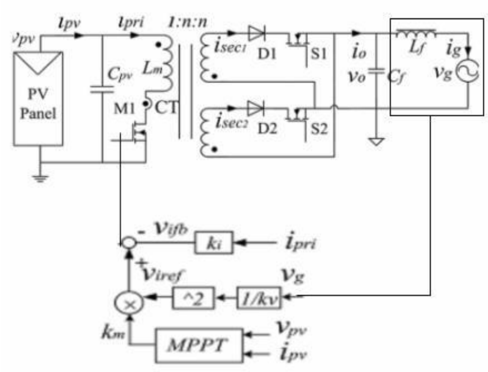


Fig.1.2 The operation of a flyback converter

II. FLYBACK CCM INVERTER

The topology consists of an input capacitor *C*pv, a fly back dc/dc converter with two secondary windings together with a waveform unfolding arrangement, and an *LC* output filter. The secondary side switches are turned ON and OFF, respectively, during the positive and negative half cycles to generate the ac output. In each half cycle, the inverter works as a dc to dc fly back converter with the average output current (*i*sec1 or *i*sec2) shaped as a half sinusoid at the line frequency. Though the inverter is designed to operate in CCM under full load conditions, it is inevitable that it would enter the DCM region around the zero crossing instants of the line cycle or at low solar irradiation levels. As the operating condition of the inverter changes slowly during an ac period compared to a switching period, the inverter can be assumed to operate in quasi-steady state around each instant of an ac cycle. It is also assumed that capacitor *C*pv is large so that the input voltage *V*pv is nearly constant in an ac cycle.



The transformer core will not be fully demagnetized in CCM operation in each switching cycle. This causes the transformer core to serve as an energy buffer, adding to the order of the system. However, our earlier investigations have shown that the effect of this incomplete core demagnetization on the input–output energy balance in each switching cycle is very small and can be neglected. Assuming lossless operation, the power balance equations under CCM conditions can be written as

$$I_{\mathrm{pri}}V_{\mathrm{pv}} = I_q V_q = 2V_{\mathrm{rms}}I_{\mathrm{rms}} \sin^2 (\omega t) \qquad (1)$$

where V_{pv} ,I_{pv} = the dc values of the PV module voltage and current, V_{rms} , I_{rms} = the RMS values of the grid voltage and current, I_{pri} = the quasi-steady-state value of the primary side current averaged over a switching cycle, I_g , V_g = the quasi steady values of the grid current and voltage assumed to be constant in one switching cycle, and ω = the angular frequency of the ac supply.

Equation (1) is based on the power balance in each switching cycle.

When operated in CCM, by assuming quasi-steady-state operation and using inductor volt–seconds balance over a switching period, the duty ratio D_{CCM} can be obtained

$$D_{\mathrm{CCM}} = \frac{|V_g|}{(nV_{\mathrm{pv}} + |V_g|)}. \qquad (2)$$

Here, the duty cycle does not directly determine the current and hence power level. Therefore, a closed-loop current control is necessary in this case.

III. CONTROL CIRCUIT

The two basic control requirements are: MPPT capability required by the PV application and output current shaping required by the grid connection. In a single- stage inverter, a dual- loop configuration is usually adopted, wherein a fast inner control loop tracks the line frequency waveform and a slow outer loop ensures operation at MPP. In order to prevent distorting the output current, the MPPT tracking speed is purposely designed to be slower than the line frequency. The performance of the implemented MPPT scheme in the outer loop does not, in general, depend on the inverter and the control scheme adopted.

The challenges of the inverter control for the proposed fly back CCM scheme lie in the output current shaping. This challenge is due to the wide-ranging operating conditions of the inverter. Although designed to operate in CCM at rated powerful, the inverter, in reality, would operate in combined CCM/DCM mode, slipping into DCM operation around the zero-crossing instants of the ac cycle.

The primary current reference signal's (V_{iref}) magnitude is determined by an external MPPT scheme and its shape is determined by the sensed instantaneous grid voltage by assuming input–output power balance based on (1) in each switching cycle. As a result, the output current is controlled in an open-loop manner. The effect of the RHP zero is felt, in this case, only in the uncontrolled dynamics relating the output current to the input current. We had applied earlier “one-cycle control” (OCC), which is a fast and large-signal nonlinear control method, for the control of the primary current in this application. However, the scheme was found to suffer from bifurcation problems at low-power levels. In this paper, a simple average current mode (ACM) control has been adopted for the primary current control loop.

IV. INCREMENTAL CONDUCTANCE WITH DIRECT CONTROL METHOD

The Incremental Cond uctance method makes use of instantaneous and IncCond to generate an error signal, which is zero at the MPP; however, it is not zero at most of the operating points. The main purpose of the second control loop is to make the error from MPPs near to zero. Simplicity of operation, ease of design, inexpensive maintenance, and low cost made PI controllers very popular in most linear systems. However, the MPPT system of standalone PV is a nonlinear control problem due to the nonlinearity nature of PV and unpredictable environmental conditions, and hence, PI controllers do not generally work well.

In this paper, the IncCond method with direct control is selected. The PI control loop is eliminated, and the duty cycle is adjusted directly in the algorithm. The control loop is simplified, and the computational time for tuning controller gains is eliminated.

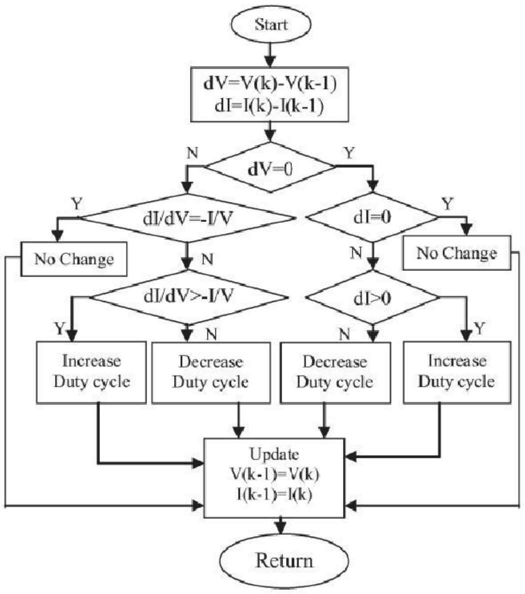
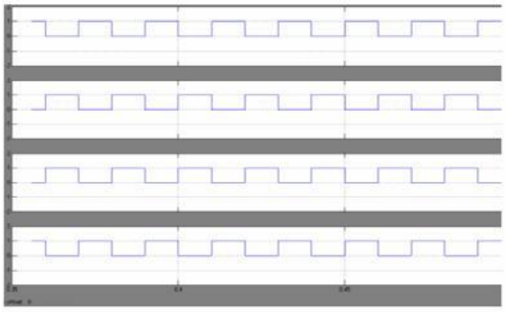
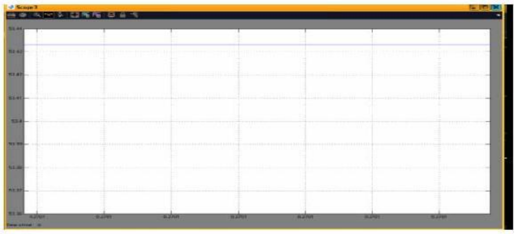


Fig 4.Flow chart of Incremental conductance with direct control algorithm

V. SIMULATION CIRCUIT AND RESULTS





VI. CONCLUSION

The proposed fly back inverter is verified at selected working condition & efficiency is about 85%.Hence it can be used as a viable solution for medium power ac module application. Thus the proposed scheme can be used as a power factor corrector for electric vehicles, distributed power generation and low power switched mode power supplies. In future we can use closed loop control of primary current by which we can obtain better voltage stability. Soft switching techniques can be used to reduce switching losses which will improve the efficiency further.

REFERENCES

[1] S. B. Kjaer, J. K. Pedersen, and F. Blaabjerg, “A review of single -phase grid -connected inverters for photovoltaic modules,” *IEEE Trans. Ind. Appl.*, vol. 41, no. 5, pp. 1292–1306, Sep./Oct. 2005.

[2] R. H. Wills, F. E. Hall, S. J. Strong, and J. H. Wohlgemuth, “The AC photovoltaic module,” in *Proc. 25th IEEE Photovolt. Spec. Conf.*, 1996, pp. 1231–1234

[3] A. C. Kyritsis, N. P. Papanicolaou, and E. C. Tatakis, “A novel parallel active filter for current pulsation smoothing on single stage grid-connected AC-PV modules,” in *Proc. Eur. Conf. Power Ele*

[4] H. Patel and V. Agarwal, “A single-stage single-phase transformer-less doubly grounded grid-connected PV interface,” *IEEE Trans. Energy Convers.*, vol. 24, no. 1, pp. 93–101, Mar. 2009*ctron. Appl.*, 2007.

[5]. O. Abdel-Rahim, M. Orabi, and M. E. Ahmed, “Development of high gain high-efficiency grid-connected inverter for PVModule,” in *Proc. 2nd IEEE Int. Symp. Power Electron. Distrib. Generat. Syst. (PEDG)*, 2010, pp. 368–373