# Autonomous PV Module using Fsbbc for Dmppt System

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***Abstract*— Analyzing the stability of autonomous pv module based on different modes is used to achieve small signal ac model for series connected distributed maximum power point tracking pv system. The FSBBC function is controlled by the PI controller. Instead of designing a controller the voltage PI controller having the ability to control the automatically mode changes, there are three types of modes are adopted to realize the maximum power point tracking (MPPT) function for each PV modules are simulated. The alternative operation of modes does not affect the particular function of the circuit with less passive components using this switching strategy the transition was smooth. This paper shows that the development of an autonomous distributed maximum power point tracking (DMPPT) photovoltaic (PV) system which can compensate the shading effect of the PV module mismatching as well as to increase the overall output power. Because of the series-connected configuration, the FSBBC has low rating devices and low voltage conversion ratio, it can achieve the low cost and it is high efficiency autonomous DMPPT PV system. A general simulation method is developed to quantify the total energy efficiently for different levels using Distributed Maximum PowerPoint Tracking (DMPPT)pv system. Computer simulations and circuit experimental results are used to verify the performance of the autonomous DMPPT PV system.**

***Index Terms*— *Solar energy, distributed maximum power point tracking (DMPPT*),fsbbc, small signal ac model**

## I.INTRODUCTION

The cost of photovoltaic (PV)panels have gradual reduction combined with favorable feed-in tariffs in a variety of countries. It is leading to the rapid deployment of PV installations in urban areas. The energy yield of these small-scale, sub 10 kW installations is usually reduced by mismatches in the operating conditions of the individual PV cells In figure1 it is a conventional single-phase grid-connected PV system. And it is constructed by a PV array, there is a single central inverter which is a linked collection of PV panels,. It is well known that the actual output power of the PV array, then it will be reduced because of shading effect or PV module mismatching. Many of the solutions have been proposed to optimal the output power of the PV array. The general idea is to perform the maximum power point tracking(MPPT) function on each individual PV panel, instead of the PV array.

A PV system with the feature is to performs the MPPT function on each individual PV panel can be named as a distributed MPPT (DMPPT) PV system and are typically connected in series/parallel arrangements. The non uniformity in the operating conditions is caused by the external factors such as temperature gradients, reflections, clouds, partial shading, dirt, or intrinsic factors like semiconductor process variations and aging. The PV panels having non-uniform irradiation and temperature and cannot be operated at their respective Maximum Power Point (MPP), they are forced to operate with the same terminal voltage in parallel-connected systems. The micro converter PV system control of a parallel-connected is relatively simple, but the large difference between the input and output voltage of the converter require high rating devices and high voltage conversion ratio. It will increase the cost and reduce the efficiency. On the contrary, the series-connected micro converter (SCMC)PV system as shown in Fig. 1(b) with low rating devices and low voltage conversion ratio can be the promising candidate for a low-cost and high-efficiency DMPPT PV system or at the same string current in series-connected systems Using power electronic converters for Distributed Maximum Power Point Tracking (DMPPT) is well known to alleviate problems associated with mismatched panels

## DISTRIBUTED MPPT (DMPPT) PV SYSTEM

Introduced 'distributed power conditioning'(later known as distributed MPPT-DMMPT),where MPP tracking is performed at the module level by means of module integrated DC-DC Converters(MIC),located the MIC-based DMPPT concept was further investigated to derive the small-signal AC model and to analyze its steady-state behavior, dynamics and stability, Another DMPPT approach, the 'minimal power processing', applies DC-DC converters just for balancing the PV string, while most of the string's power flows directly without being processed by the converters, thus the losses are reduced considerably. The interest in distributed maximum power point tracking increases along with increasing to reduce the cost of photovoltaic generated energy. The deployment of photovoltaic generators and the constant pressure

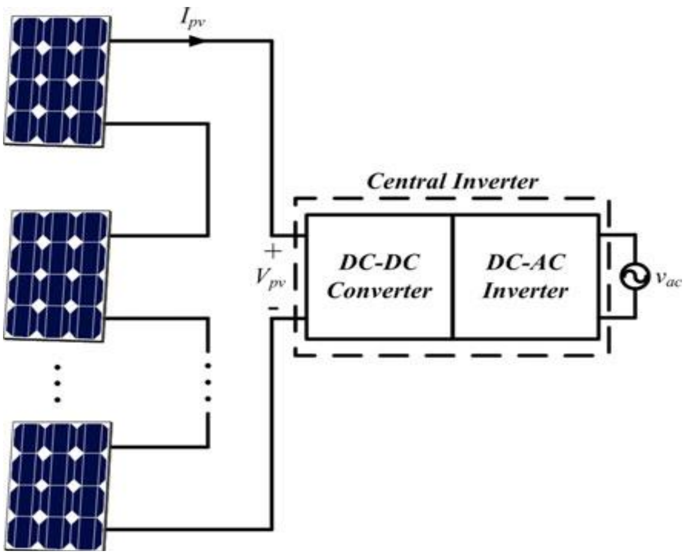


figure1 conventional pv system

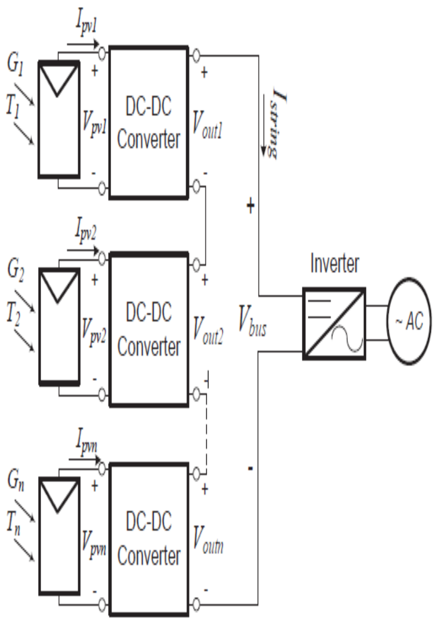


figure2 dmppt pv system

Rrepresents the proposed system and working of controller. the simulation result using MATLAB/SIMULINK. .

II CONCEPT OF MPPT

MPPT algorithm is one which includes the charge controllers for extracting maximum available power from PV module under some conditions. The voltage at which PV module can produce maximum power is called peak power voltage. Power varies with solar radiation and temperature. The converter has the capability of MPPT and ac side current control and also having the ability of controlling the battery charging and discharging. This algorithm works effectively in the lack of renewable energy. The process starts by reading the current and voltage which falls on the panel, then it compare the value of each panel from 1 to N-1 cell. If the power is high, it moves to next function. Otherwise the loop back to starting stage. Figure 4 shows flow diagram of MPPT algorithm

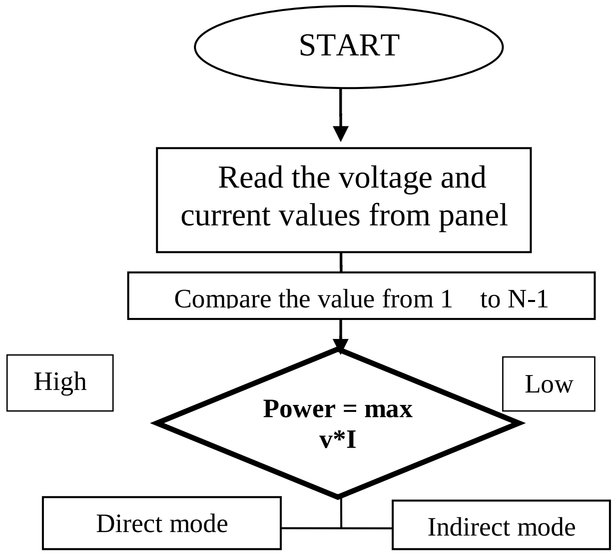


figure3 MPPT flow chart

***APVM***

In the switching strategy of operating modes, the FSBBC will be introduced. After this, with passive components design criteria of the FSBBC will be derived and the small-signal ac model of the APVM will be developed

***FSBBC***

The FSBBC is a cascaded buck and boost converter, the main switches *SSR*1 and *SSR*2 are the synchronous rectifier switches of *S*1 and *S*2 ,respectively. the dc voltage gain of the buck and boost converter, the dc voltage gain of the FSBBC *GV* can be derived as the output terminal voltage of the PV panel and the FSBBC, *D*1 and *D*2 are the duty cycles of *S*1 and *S*2 respectively. when *S*1 is fully ON (*D*1 = 1) or *S*2 is fully OFF (*D*2 = 0), the dc voltage gain of an FSBBC will be equal to the 1 for a conventional boost converter or buck converter, respectively. Usually, during the transition between the buck and the boost mode of the FSBBC, there is a discontinuous voltage gain region caused by limitations in the minimum and maximum effective duty cycles which is created by switching time delay from the controller to the switches, and it will affect the performance of the MPPT function. Hence, in order to have a continuous voltage gain during the transition, a smooth transition buck–boost mode has been proposed by overlapping the two carrier waves. the generation of PWM gate signals for the FSBBC with smooth transition. The control signal, *V*ctrl , is compared to two saw-tooth carrier signals, *V*tri1and *V*tri2, to generate the PWM gate signals for switches *S*1and *S*2 , respectively. The offset voltage of Vtri2 determines the operation region of the buck–boost mode.

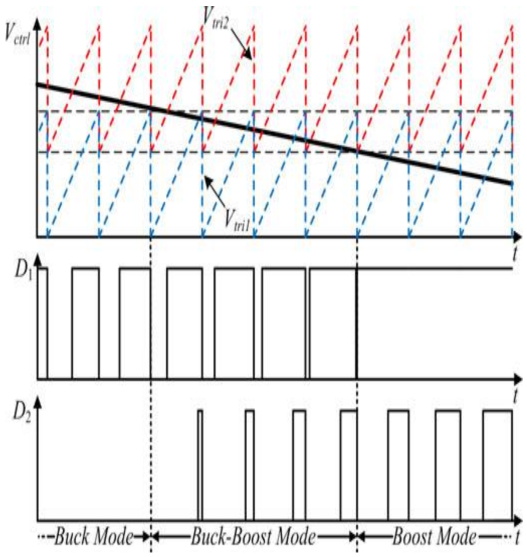


figure4 FSBBC with smooth transition of PWM gate signals

TABLE I
THE FSBBC MODES OF OPERATION

| Mode | Condition | $S_1$ | $S_{SR1}$ | $S_{SR2}$ | $S_2$ |
|---|---|---|---|---|---|
| Buck | $V_{pv} > V_{out}$ | $D_1$ | $1\text{-}D_1$ | 1 | 0 |
| Boost | $V_{pv} < V_{out}$ | 1 | 0 | $1\text{-}D_2$ | $D_2$ |
| Buck-Boost | $V_{pv} \approx V_{out}$ | $D_1$ | $1\text{-}D_1$ | $1\text{-}D_2$ | $D_2$ |

## *SMALL-SIGNAL AC MODEL*

It will decrease the MPPT performance, if the propagation of the double line frequency oscillations from dc string voltage to the PV panel terminal, , the well-designed controller for the proposed APVM is necessary. Since the small signal ac model characteristic of the FSBBC under the PV application with input voltage control is different to the conventional application with output voltage control, the development of the small-signal ac model of the APVM is necessary

## II PROPOSED SYSTEM

The FSBBC is a cascaded buck and boost converter with combined inductor and synchronous rectifier. the FSBBC has found a lot of attentions in PV system applications. Among them verified the power saving advantage and proposed a transient control strategy for the SCMC PV system, respectively. Here PI controller is used to perform the switching operation to detect the error voltage generated from PV panel.The compensation of buck and boost converter is always in continuous mode, because the time delay affect the application across the inverter. The voltage and current received from pv panel and it is calculated power there is to perform the maximum power point tracking function on each individual pv panel named as distributed MPPT PV system

The voltage and current is received from pv panel and it is calculated by the power, the four switch buck boost converter is used to step-up and step-down the output voltage, if it is manually changing the mode there is some time delay instead of this the PI controller made this operation automatically under different mode it is controlled the error voltage which was given from pv panel.There is predetermined current subsystem and different irradiance condition 1000W/m$^2$ with constant pv temperature in 25°C.the current or voltage split from panel and calculate the power.it is defined as the ratio of output voltage to input voltage. The maximum power point tracking (MPPT) techniques are used in photovoltaic (PV) systems to maximize the PV array output power by tracking continuously the maximum power point(MPP) which depends on panels temperature and on irradiance conditions. Pulse width modulation technique is used to given the pulse to AC inverter which is inverting the output voltage and finally given to resistive load. Then, the output was stable sinusoidal waveform.

The voltage and current available at the terminals of a PV may directly feed small loads. Many applications require electronic converters for process the electricity from the PV. These converters may be used to regulate the voltage and current at the load and also control the power flow in grid systems. It is mainly used to track the maximum power point (MPP) of the device. In order design a PV systems, one first needs to know how to model the PV device that is attached to the converter.

The MPPT block determines the requested dc voltage across the PV to achieve the MPPT condition. This voltage can be determined by using another control loop, with slower dynamics using the measurement of the available PV power. After evaluating the requested voltage, the appropriate waves in the can be determined .the selection of the carrier signal will determine which capacitor is to be charged or discharged.

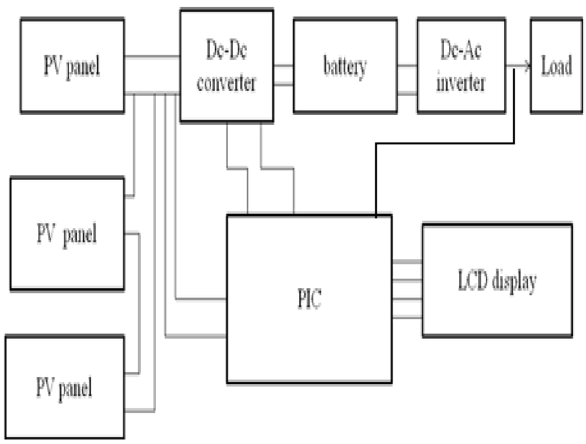


Figure5 Block diagram

## III SIMULATION RESULT

The simulation results are examined using a software MATLAB/SIMULINK..For technical computing the MATLAB is a high performance language. In an easy-to-use environment programming where the problems and solutions are expressed in familiar mathematical notation. MATLAB serves as a best tool for signal analysis. Open the Simulink library browser. need MATLAB running before can open the Simulink browser. Start MATLAB, and then in the matlab command window, enter Simulink the Simulink library opens. From the Simulink library browser menu, select file> new > model. The main incentive for choosing deeper levels of DMPPT granularity for a PV installation is the improvement in harvested energy. It is One of the main reasons of degradation in a system's performance is the partial shading effect. This effect is illustrated on a series-connected PV panel string. By-pass diodes are introduced to clamp the negative voltage *Vpv*, in order to avoid dissipating excessive power when a shaded panel is forced to operate at a high string current, *Istring*, The extent to which a certain PV installation suffers from the partial shading effect depends on many factors that should be considered for a system design. The software package components are discussed in the following subsections

Simulation steps

(1) Buck mode
(2) Boost mode
(3) buck boost mode
(4) sinusoidal waveform

### *A. Buck mode*

The buck is a popular non-isolated power stage topology, sometimes called a step-down power stageThe input current for a buck power stage is discontinuous, or pulsating a power stage can operate either in continuous nor discontinuous inductor current mode. During the entire switching cycle in steady-state operation, the continuous inductor current flows continuously. The portion of the switching cycle is zero in discontinuous inductor current mode,It, reaches peak value and starts at zero,during each switching cycle returns to zero.

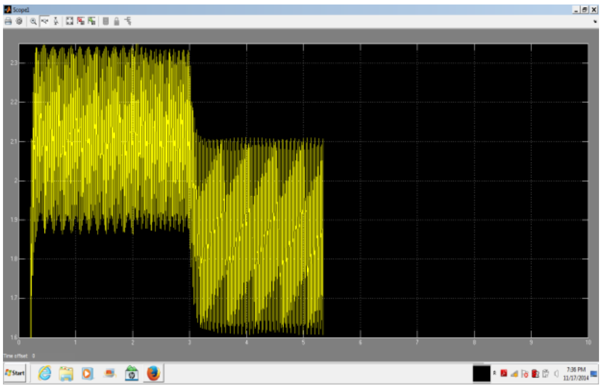

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Figure6 step-down mode

### *B. Boost mode*

The boost is a popular non-isolated power stage topology, manytimes called a step-up power stage. Output is always higher than the input voltage because the power supply designers choose the boost power stage. the output diode conducts only during a portion of the switching cycle because the input current for a boost power stage is continuous ,or non-pulsating,. The output capacitor supplies the entire load current for a power stage, in rest of the switching cycle it can operate either in continuous nor discontinuous inductor current mode. During the entire switching cycle in steady-state operation the inductor current flows continuously in continuous inductor current mode,.

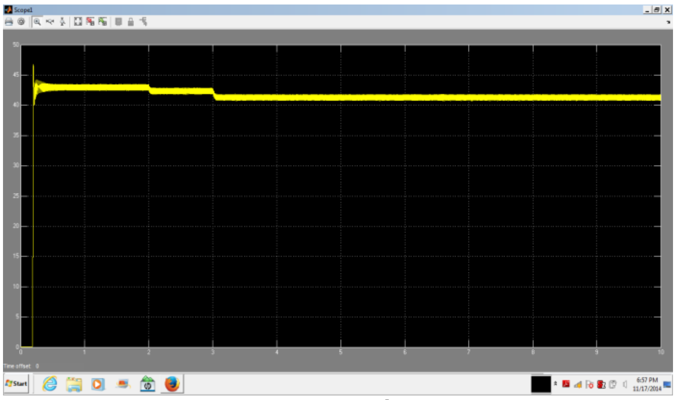

Figure7 step-up mode

### *C. Buck Boost mode*

The buck boost mode both combined to stabilize the output which is high as well as low to regulate the voltage finally given to AC inverter .In buck boost mode, all the switches are connected (i.e.) s1,s2,s3,s4 are on condition.

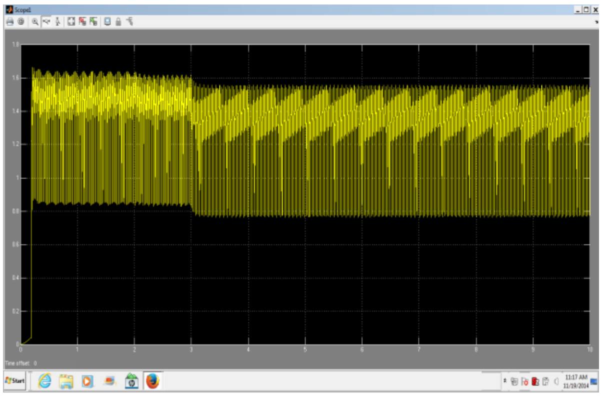

figure8 buck boost mode

### *D..sinusoidal waveform*

An inverter can produce a pulsed sine wave, depending on circuit design produces square wave, modified sine wave, or sine wave. The two waveform types of inverters are modified sine wave and sine wave.

For producing household plug-in voltage, There are two basic designs from a lower-voltage DC source, the first of which uses a switching boost converter to produce a higher-voltage DC and then converts to AC.

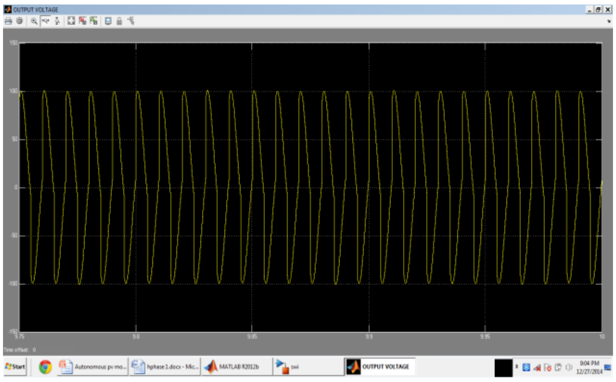

figure9 Sinusoidal waveform

## IV CONCLUSION

Thus, it can conclude this paper, the small-signal ac model of the APVM which is composed of a PV module with a FSBBC. Moreover, the parameter design criteria of the FSBBC and the smooth transition strategy are explained. Computer simulations are presented and compared to verify the accuracy of the proposed small-signal model and the performance of the APVM under different modes. An appropriate designed controller based on the proposed small signal model can achieve better MPPT performance under mode change and output voltage variation situations, the main objective of this paper is to achieve the controllability of the power

## V HARDWARE DESCRIPTION

### *A.SOLAR PANEL*

A mono crystal silicon panel is used for this paper.

### *B. Energy storage unit*

The rechargeable batteries used for this paper is 6V lead acid accumulator, which is used to store the electrical energy by some chemical reactions.

### *C. Voltage divider*

It is used to prevent the pic controller from maximum voltage to 5V, which is acceptable by ADC port.

### *D. PIC16F778A*

Used for compare the actual and reference voltage used for modulating multi level inverter. The system is controlled by the peripheral interface controller for generating the pulse depends on solar and energy storage unit .

### *E. Boost converter*

To step up the received voltage depends the requirement of

Application.

### *F. Buck converter*

To step down the received voltage depends the requirement of application

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