MPPT CONTROL OF PHOTOVOLTAIC SYSTEM USING FLYBACK CONVERTER

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Abstract—This paper presents P &O algorithm for Maximum power point tracking of PV systems which can be maximized by distributed module-level by Fly back dc–dc converter in the PV module. This algorithm, will identify the suitable duty ratio in which the flyback convertery should be operated to maximize the output. Under partially shaded conditions, series connection of photovoltaic (PV) modules results in the flow of lowest current in the string corresponding to the most shaded module, reducing the overall power output. Power output can be maximized by incorporating module-level “distributed” maximum power point tracking (DMPPT) wherein the current of each module is compensated by regulating its voltage at the respective maximum power point (MPP) value by connecting a dc–dc converter in parallel. Existing current compensation schemes are either too complex or inaccurate. This paper proposes a novel DMPPT scheme using current compensation, which is simple to implement and yet provides an accurate compensation, resulting in exact maximum power point tracking (MPPT). In the proposed scheme, each PV module is resonated through a special arrangement in the shunt-connected flyback dc–dc converter. The secondary-side diode in the flyback converter is replaced by a power MOSFET with an antiparallel diode. The converter operates in two modes: resonant MPPT mode and normal flyback mode. Thus also provide constant output voltage and simulated using Simulink/Matlab software.

Keywords—MPPT, Distributed modules, photovoltaic (PV) modules; Flyback dc–dc converter

I. INTRODUCTION

Renewable energy is the energy which comes from natural resources such as sunlight, wind, rain, tides and geothermal heat. These resources are renewable and can be naturally replenished. Therefore, for all practical purposes, these resources can be considered to be inexhaustible, unlike dwindling conventional fossil fuels. The global energy crunch has provided a renewed impetus to the growth and development of Clean and Renewable Energy sources. Clean Development Mechanisms (CDMs) are being adopted by organizations all across the globe. Shaded modules of the string may experience large reverse bias voltage across them, leading to hot spots and destruction; and due to shaded module(s) in series, string current is reduced, resulting in the lowering of the overall power yield. In order to handle these issues, most PV modules are manufactured with bypass diode. Inclusion of bypass diodes, however, introduces another problem—the appearance of multiple peaks in the power–voltage characteristics of the PV string, which prevents the tracking of the actual (global) peak by conventional MPPT schemes leading to loss of power. The issue of multiple peaks has been handled in three ways: 1) use of global maximum power point tracking (GMPPT) algorithms; 2) reconfiguration of the PV array/source; 3) use of distributed.

Here two PV arrays are parallel connected to each other. Using MPPT we can get maximum power for the available radiation and temperature. Using PI controller we can obtain the constant output by comparing the output of panel to the pulse generated by the MPPT. Thus we obtain constant output voltage.
II. SOLAR PHOTOVOLTAIC SYSTEM

Solar cell is the basic unit of solar energy generation system where electrical energy is extracted directly from light energy without any intermediate process. The working of a solar cell solely depends upon its photovoltaic effect hence a solar cell also known as photovoltaic cell. A solar cell is basically a semiconductor device. A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Maximum power point tracking technique is used to improve the efficiency of the solar panel. According to Maximum Power Transfer theorem, the power output of a circuit is maximum when thevenin impedance of the circuit (source impedance) matches with the load impedance. In the source side we are using a boost convertor connected to a solar panel in order to enhance the output voltage so that it can be used for different applications like motor load. By changing the duty cycle of the boost converter appropriately we can match the source impedance with that of the load impedance. Controllers can follow several strategies to optimize the power output of an array. Maximum power point trackers may implement different algorithms and switch between them based on the operating conditions of the array.

III. PERTURB & OBSERVE ALGORITHM

The Perturb & Observe algorithm states that when the operating voltage of the PV panel is perturbed by a small increment, if the resulting change in power $P$ is positive, then we are going in the direction of MPP and we keep on perturbing in the same direction. If $P$ is negative, we are going away from the direction of MPP and the sign of perturbation supplied has to be changed. Perturb & Observe (P&O) Algorithm is the simplest method. In this project use two sensor, that is the voltage & current sensor,to sense the PV array voltage and current. The time complexity of this algorithm is very less but on reaching very close to the MPP it doesn’t stop at the MPP and keeps on perturbing on both the directions. When this happens the algorithm has reached very close to the MPP and we can set an appropriate error limit or can use a wait function which ends up increasing the time complexity of the algorithm. However the method does not take account of the rapid change of irradiation level (due to which MPPT changes) and considers it as a change in MPP due to perturbation and ends up calculating the wrong MPP. To avoid this problem we can use incremental conductance method.

IV. FLYBACK CONVERTER

The flyback converter is an isolated power converter. The two prevailing control schemes are voltage mode control and current mode control (in the majority of cases current mode control needs to be dominant for stability during operation). Both require a signal related to the output voltage. There are three common ways to generate this voltage. The first is to use an optocoupler on the secondary circuitry to send a signal to the controller. The second is to wind a separate winding on the coil and rely on the cross regulation of the design. The third consists on sampling the voltage amplitude on the primary side, during the discharge, referenced to the standing primary DC voltage.

The first technique involving an optocoupler has been used to obtain tight voltage and current regulation; whereas the second approach has been developed for cost-sensitive applications where the output does not need to be as tightly controlled, but up to 11 components including the opto coupler could be eliminated from the overall design. Also, in applications where reliability is critical, opt couplers can be detrimental to the MTBF (Mean Time between Failure) calculations. The third technique, primary-side sensing, can be as accurate as the first and more economical than the second, yet requires a minimum load so that the discharge-event keeps occurring, providing the opportunities to sample the 1:N secondary voltage at the primary winding (during Discharge).
V. SIMULATION

The simulated diagram to implement MPPT and flyback converter with PI controller to get constant voltage for variable load.

![Simulated diagram to implement MPPT](image1)

The equivalent diagram of solar panel whose output is based on the solar radiation $G$ and on temperature which is given manual in the simulation.

![Simulated model of solar panel](image2)
Module has an inbuilt program using which we can change the number of serious connect and parallel connected PV cells. Scope of this provides the output voltage and current.

This is the simulated diagram of MPPT module which has three inputs, two from the output reference of panel using current and voltage sensor. MPPT schemes become inefficient and ineffective when there are mismatches in the PV module characteristics due to manufacturing inequalities and partial shading. Partial shading occurs because of clouds, trees, buildings, overhead wires, etc. During partial shading, one or more portions of the PV array receive partial or no radiation. Due to the presence of bypass diodes across modules, the power voltage characteristics of the PV source show multiple power peaks which are difficult to track by using conventional MPPT schemes.

VI. SIMULATION RESULTS

6.1 Load at 80ohms

Here the resistance value is maintained as 80 ohms and it is applied. The resistive load can be varied so that we can simulate that to find out the output voltage we obtain as per our requirement. The output curve of flyback converter for the above is below.

Graph gives us details that:
Output voltage : 56v.
Output current : 0.7.
Output power : 40w.
6.2 Load at 160ohms

Now the load changes from 80 to 160, but according to the experiment the output will be same as 56 V. Now the load changes to the value of 160 ohms as these load varies they should be approximate drop in voltage but that is compensated by varying the current.

![Figure 6: Output Voltage, Current and power waveforms](image)

Output voltage : 56v.
Output current : 0.3A.
Outout power : 20W

Hence it clear from comparing two graph that the output for the load 80ohms and the 160 ohms are the same which is 56v.but correspondingly the output current reduces as load is increased .thus by current compensation we can obtain the constant output.

VII. CONCLUSION

In this proposed project we can attain almost a constant voltage for any load that can be varied during operation, this is done with using PI controller ,with which we makes an closed loop circuits and we attain constant load. In spite of all the advantages of the proposed MPPT scheme, there are some issues which need more discussion .First, the scheme requires a large number of voltage and current sensors.Similarly, a large number of intelligent controllers are required. Even though the use of sensors/controllers with every module does not seem to be a major issue today considering the many applications involving extensive diagnostics of the PV modules, yet there is certainly a scope for further optimization of their numbers. However this is not the issue for smaller system, but this may be an issue for large systems, where auxiliary power support may be required.

REFERENCES


