ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014

Proceedings of International Conference On Global Innovations In Computing Technology (ICGICT'14)

Organized by

Department Of CSE, JayaShriram Group Of Institutions, Tirupur, Tamilnadu, India on 6th & 7th March 2014

MPPT Algorithm Based PV System Connected To Single Phase Inverter

T.Rengaraj[1], Ms.S.Soniya[2]

M.E Student, P.S.R Engineering college, Sivakasi, Tamilnadu, India[1]

Associate professor, P.S.R. Engineering college, Sivakasi, Tamilnadu, India[2]

ABSTRACT: A single-phase grid-connected photovoltaic (PV) inverter topology consisting of a boost section, a low-voltage single-phase inverter with an inductive filter, and a step-up transformer interfacing the grid is considered. An adaptive harmonic compensation technique and its design are proposed for the lower order harmonic compensation. The inverter current controls that mitigates the lower order harmonics. In addition, a proportional-resonant-integral (PRI) controller and its design are also proposed. This controller eliminates the dc component in the control system, which introduces even harmonics in the grid current. The switches are all rated for low voltage which reduces the cost and lesser component count in the system improves the overall reliability. The design of the inverter current control to achieve a good attenuation of the lower order harmonics. This method estimates a particular harmonic in the grid current using a least-mean-square (LMS) adaptive filter and generates a harmonic voltage reference using a proportional controller. Index Terms: Adaptive filters, harmonic distortion, inverters, solar energy.

I . INTRODUCTION

Renewable sources of energy such as solar, wind, and geothermal have gained popularity due to the depletion of conventional energy sources. Hence, many distributed generation (DG) systems making use of the renewable energy sources are being designed and connected to a grid. In this paper, one such DG system with solar energy as the source is considered. The topology of the solar inverter system is simple. It consists of the following three power circuit stages: 1) a boost converter stage to perform maximum power point tracking (MPPT); 2) a low-voltage single-phase H-bridge inverter; 3) an inductive filter and a step-up transformer for interfacing with the grid. Fig. 1 shows the power circuit topology considered. This topology has been chosen due to the following advantages: The switches are all rated for low voltage which reduces the cost and lesser component count in the system improves the overall reliability. This topology will be a good choice for low-rated PV inverters of rating less than a kilowatt. The disadvantage would be the relatively larger size of the interface transformer compared to topologies with a high-frequency link transformer [1]. The system shown in Fig. 1 will not have any lower order harmonics in the ideal case. However, the following factors result in lower order harmonics in the system: The distorted magnetizing current drawn by the transformer due to the nonlinearity in the B–H curve of the transformer core, the dead time introduced between switching of devices of the same leg [2]–[6], on-state voltage drops on the switches, and the distortion in the grid voltage itself. There can be a dc injection into the transformer primary due to a number of factors. These can be the varying power reference from a fast MPPT block from which the ac current reference is generated, the offsets in the sensors, and A/D conversion block in the digital controller.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014

Proceedings of International Conference On Global Innovations In Computing Technology (ICGICT'14)

Organized by

Department Of CSE, JayaShriram Group Of Institutions, Tirupur, Tamilnadu, India on 6th & 7th March 2014

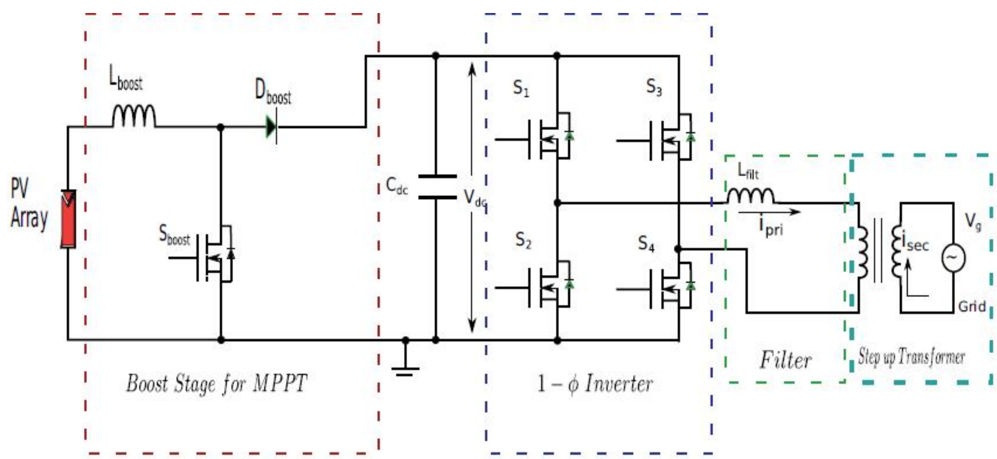

Figure.1 Power circuit topology of 1φ PV system.

This dc injection would result in even harmonics being drawn from the grid, again contributing to a lower power quality. Hence, this paper concentrates on the design of the inverter current control to achieve a good attenuation of the lower order harmonics. It must be noted that attenuating the lower order harmonics using a larger output filter inductance is not a good option as it increases losses in the system along with a larger fundamental voltage drop and with a higher cost. The boost stage and the MPPT scheme are not discussed in this paper as a number of methods are available in the literature to achieve a very good MPPT . The advantage of the adaptive filter-based method is the inherent frequency adaptability which would result in same amount of harmonic compensation even when there are shifts in grid frequency. The implementation of adaptive filters is simple. Thus, in this paper, an adaptive filter-based method is proposed. This method estimates a particular harmonic in the grid current using a least-mean-square (LMS) adaptive filter and generates a harmonic voltage reference using a proportional controller. This voltage reference is added with appropriate polarity to the fundamental voltage reference to attenuate that particular harmonic.

This paper includes an analysis to design the value of the gain in the proportional controller to achieve an adequate level of harmonic compensation. The effect of this scheme on overall system dynamics is also analyzed. This method is simple for implementation and hence it can be implemented in a low-end digital controller.

II . MPPT

Maximum power point tracking (MPPT) is a technique that grid connected inverters, solar battery chargers and similar devices use to get the maximum possible power from one or more photovoltaic devices, typically solar panels, though optical power transmission systems can benefit from similar technology. Solar cells have a complex relationship between solar irradiation, temperature and total resistance that produces a non-linear output efficiency which can be analyzed based on the I-V curve. It is the purpose of the MPPT system to sample the output of the cells and apply the proper resistance (load) to obtain maximum power for any given environmental conditions. MPPT devices are typically integrated into an electric power converter system that provides voltage or current conversion, filtering, and regulation for driving various loads, including power grids, batteries, or motors.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014

Proceedings of International Conference On Global Innovations In Computing Technology (ICGICT'14)

Organized by

Department Of CSE, JayaShriram Group Of Institutions, Tirupur, Tamilnadu, India on 6th & 7th March 2014

Photovoltaic cells have a complex relationship between their operating environment and the maximum power they can produce. The fill factor, abbreviated FF, is a parameter which characterizes the non-linear electrical behavior of the solar cell. Fill factor is defined as the ratio of the maximum power from the solar cell to the product of Open Circuit Voltage V_{oc} and Short-Circuit Current I_{sc}. In tabulated data it is often used to estimate the maximum power that a cell can provide with an optimal load under given conditions, $P=FF*V_{oc}*I_{sc}$. For most purposes, FF, V_{oc}, and I_{sc} are enough information to give a useful approximate model of the electrical behavior of a photovoltaic cell under typical conditions.

For any given set of operational conditions, cells have a single operating point where the values of the current (I) and Voltage (V) of the cell result in a maximum power output. These values correspond to a particular load resistance, which is equal to V / I as specified by Ohm's Law. The power P is given by P=V*I. A photovoltaic cell, for the majority of its useful curve, acts as a constant current source. However, at a photovoltaic cell's MPP region, its curve has an approximately inverse exponential relationship between current and voltage. From basic circuit theory, the power delivered from or to a device is optimized where the derivative (graphically, the slope) dI/dV of the I-V curve is equal and opposite the I/V ratio (where dP/dV=0). This is known as the **maximum power point** (MPP) and corresponds to the "knee" of the curve.

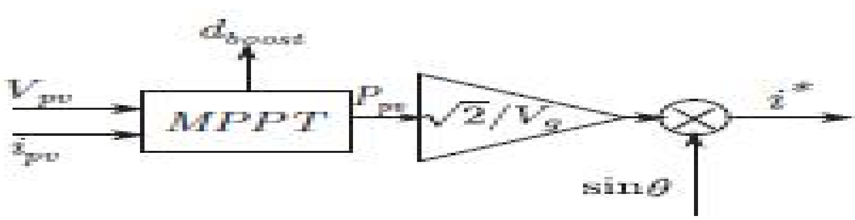

Figure 2. Maximum Power Point Tracking

A load with resistance R=V/I equal to the reciprocal of this value draws the maximum power from the device. This is sometimes called the **characteristic resistance** of the cell. This is a dynamic quantity which changes depending on the level of illumination, as well as other factors such as temperature and the age of the cell. If the resistance is lower or higher than this value, the power drawn will be less than the maximum available, and thus the cell will not be used as efficiently as it could be. Maximum power point trackers utilize different types of control circuit or logic to search for this point and thus to allow the converter circuit to extract the maximum power available from a cell.

$$V_{error} = \frac{4}{h\pi}\frac{2V_{dc}t_d}{T_S} \quad (1)$$

The term "constant voltage" in MPP tracking is used to describe different techniques by different authors, one in which the output voltage is regulated to a constant value under all conditions and one in which the output voltage is regulated based on a constant ratio to the measured open circuit voltage (V_{OC}). The latter technique is referred to in contrast as the "open voltage" method by some authors. If the output voltage is held constant, there is no attempt to track the maximum power point, so it is not a maximum power point tracking technique in a strict sense, though it does have some advantages in cases when the MPP tracking tends to fail, and thus it is sometimes used to supplement an MPPT method in those cases.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014

Proceedings of International Conference On Global Innovations In Computing Technology (ICGICT'14)

Organized by

Department Of CSE, JayaShriram Group Of Institutions, Tirupur, Tamilnadu, India on 6th & 7th March 2014

$$G_{PR}(S) = K_P + \frac{K_r S}{S^2+\omega_0^2} \quad (2)$$

In the "constant voltage" MPPT method (also known as the "open voltage method"), the power delivered to the load is momentarily interrupted and the open-circuit voltage with zero current is measured. The controller then resumes operation with the voltage controlled at a fixed ratio, such as 0.76, of the open-circuit voltage V_{OC}. This is usually a value which has been determined to be the maximum power point, either empirically or based on modeling, for expected operating conditions. The operating point of the PV array is thus kept near the MPP by regulating the array voltage and matching it to the fixed reference voltage $V_{ref}=kV_{OC}$. The value of V_{ref} may be also chosen to give optimal performance relative to other factors as well as the MPP, but the central idea in this technique is that V_{ref} is determined as a ratio to V_{OC}.

$$G_{plant}(S) = \frac{V_{dc}}{R_S+SL_S} \quad (3)$$

PROPOSED SYSTEM:

We presented RMS adaptive filter to estimate a particular harmonic in the grid current that needs to be attenuated. A design of inverter current control that mitigates lower order harmonics is presented in our method.
An adaptive harmonic compensation technique and its design are proposed for the lower order harmonic compensation.Improve the quality of current as much as possible.Cost of method and complexity is less as compared to existing method.

OUTPUT ANALYSIS:

A. Adaptive harmonic compensation

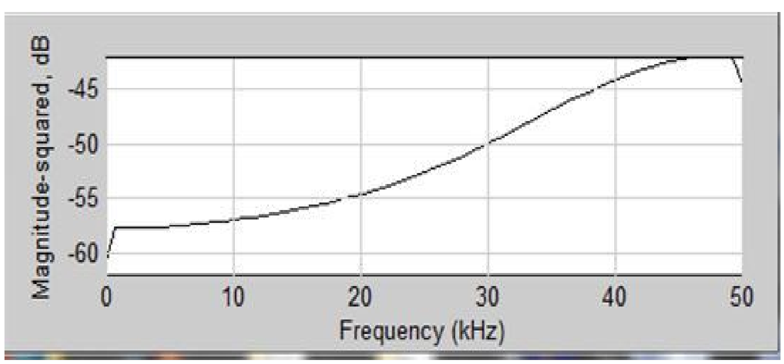

Figure 3: Frequency versus Magnitude in (db)

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014

Proceedings of International Conference On Global Innovations In Computing Technology (ICGICT'14)

Organized by

Department Of CSE, JayaShriram Group Of Institutions, Tirupur, Tamilnadu, India on 6th & 7th March 2014

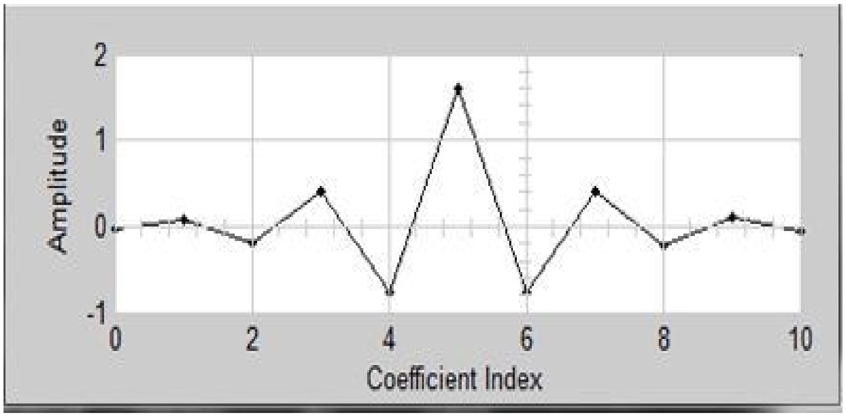

Figure 5: Coefficient versus Amplitude

III . CONCLUSION

Inverter current control for a grid connected single-phase photovoltaic inverter has been proposed.. High quality of the current also injected into the grid. The proposed method uses an RLS adaptive filter to estimate a particular harmonic in the grid current that needs to be attenuated..To avoid dc biasing of the transformer, a novel PRI controller has been proposed and its design has been presented.

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.
Power System, IEEE Standard 1547-2003, 2003.
[2] T. Esram and P. L. Chapman, "Comparison of photovoltaic array maximum power point tracking techniques," IEEE Trans. Energy Convers., vol. 22, no. 2, pp. 439–449, Jun. 2007.
[3] D. De and V. Ramanarayanan, "A proportional + multiresonant controller for three-phase four-wire high-frequency link inverter," IEEE Trans. Power Electron., vol. 25, no. 4, pp. 899–906, Apr. 2010.
[4] R. Kadri, J.-P. Gaubert, and G. Champenois, "An improved maximum power point tracking for photovoltaic grid-connected inverter based on voltage-oriented control," IEEE Trans. Ind. Electron., vol. 58, no. 1, pp. 66–75, Jan. 2011.
[5] A. K. Abdelsalam, A. M. Massoud, S. Ahmed, and P. N. Enjeti, "High-performance adaptive perturb and observe MPPT technique for photovoltaic-based microgrids," IEEE Trans. Power Electron., vol. 26, no. 4, pp. 1010–1021, Apr. 2011
[6] R. C´ardenas, C. Juri, R. Pen˜na, P.Wheeler, and J. Clare, "The application of resonant controllers to four-leg matrix converters feeding unbalanced or nonlinear loads," IEEE Trans. Power Electron., vol. 27, no. 3, pp. 1120– 1128, Mar. 2012.
[7] Abhijit Kulkarni, Student Member, IEEE, and Vinod John, Senior Member, " Mitigation of Lower Order Harmonics in a Grid-Connected Single-Phase PV Inverter ," IEEE Transactions On Power Electronics, Vol. 28, No. 11, November 2013.