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Vol. 3 Iss.2, pp. 31-37, 15th NOV, 2017
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ISSN Online : 2454-1443 © 2017, IJRMMAE
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International Journal of Research in Mechanical, Mechatronics and Automobile Engineering (IJRMMAE)

RESIDENTIAL APPLICATION OF PHOTOVOLTAIC INVERTER FOR RENEWABLE ENERGY SYSTEM

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Received 7, October 2017 | Accepted 24, November 2017

Abstract: A single stage grid-tied photovoltaic (PV) inverter for residential software is presented. In this dissertation utilization of buck-boost converter for control of photovoltaic electricity the usage of maximum power factor tracking (MPPT) mechanism is presented. The MPPT is responsible for retaining the maximum energy from the photovoltaic and fed it to the load through buck-boost converter which step up or step down the voltage to the magnitude required by means of the grid. Here H-bridge inverter is used which is then connected to RL load and grid with LC filter for harmonic reduction and to get sinusoidal waveform required for grid.

Keywords: MATLAB / Simulink, PV, MPPT, buck-boost, h-bridge inverter, grid

1. Introduction

One of the main worries in the electricity region is the dayto-day growing energy demand but the assets are now not ample to meet the power demand the usage of the conventional power sources. Renewable sources like wind electricity and solar strength are the high electricity sources which are being utilized in this regard. The continuous use of fossil fuels has caused the fossil gasoline deposit to be decreased and has appreciably affected the environment depleting the biosphere and cumulatively including to global warming. Solar electricity is abundantly available that has made it possible to harvest it and utilize it properly. Another advantage of the usage of solar power is the portable operation each time anywhere necessary. The development in electricity electronics and fabric science has helped engineers to come up very small however powerful systems to withstand the excessive energy demand. Trend has set in for the use of multi-input converter units that can successfully manage the voltage fluctuations.

But due to excessive production fee and the low effectivity of these structures they can infrequently compete in the competitive markets as a prime power generation source. The consistent increase in the improvement of the photo voltaic cells manufacturing technology would certainly make the use of these applied sciences viable on a wider groundwork than what the state of affairs is presently. The use of the most modern energy control mechanisms referred to as the Maximum Power Point Tracking (MPPT) algorithms has led to the enlarge in the efficiency of operation of the photo voltaic modules and as a consequence is effective in the field of utilization of renewable sources of energy [7].

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2. Single Stage Grid Tied PV Inverter

A. Proposed Scheme

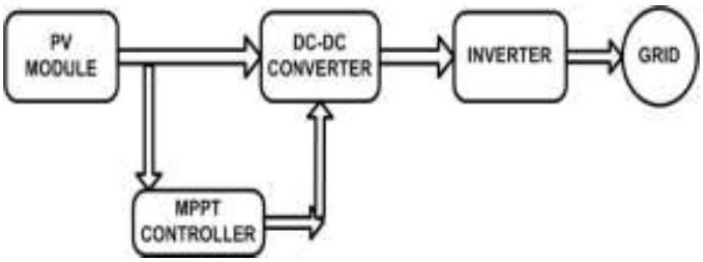

Figure 1: Proposed scheme of grid tied PV inverter

Above figure represents the proposed scheme of grid-tied PV inverter. According to this input electricity is coming from a photovoltaic system which is fed into the DC-DC converter. MPPT is used to music maximum energy from the PV system. Using MPPT, the manipulate scheme is used right here which step up or step down the voltage and gives the constant cost of voltage. This DC voltage is going to single-phase bridge inverter which converts DC to AC and sooner or later gadget is connected to the grid. According to the above-proposed scheme, MATLAB simulation is finished and models are given below.

3. Modeling of PV System

A solar mobilephone is the building block of a photo voltaic panel. A photovoltaic module is formed by connecting many photo voltaic cells in sequence and parallel. A single diode model of the photo voltaic phone is given in the figure below.

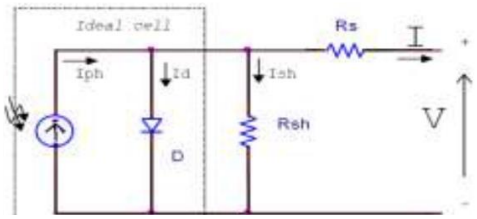

Figure 2: Single diode model of solar cell

From the above figure characteristic equations with their simulation model is given below

$I = Iph - Id - Ish$ (1)

Where Iph = photo current

Id = diode current

Ish = current in shunt (parallel) branch

$Iph = [Isc + Ki\ T - Tr\ \gamma]$ (2)

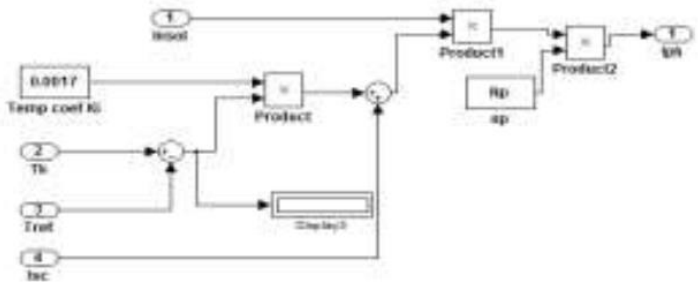

Figure 3: MATLAB model of photon current

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$$Id = Is \cdot (\exp^{\frac{V+Rs*I}{AKT}} - 1) \quad (3)$$

and

$$Vt = \frac{KT}{q} \quad (4)$$

On the other hand, the cell's saturation current varies with the cell temperature, which is described as

$$Is(t) = Irs \left(\frac{T}{Tr}\right)^3 ex\left[\frac{qEg\left(\frac{1}{Tr} - \frac{1}{T}\right)}{KA}\right] \quad (5)$$

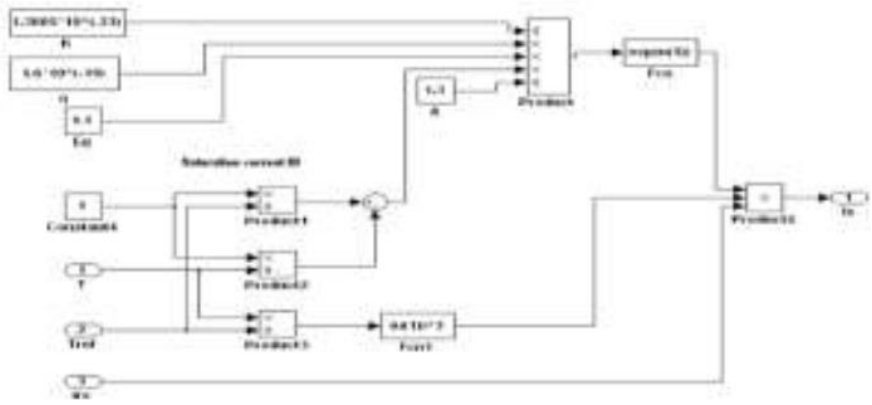

Figure 4: MATLAB model of saturation current of diode

Where Isc = short circuit current

Ki = temperature coefficient of short circuit current (here 0.0017 A/˚C)

T = working temperature

Tr = reference temperature

γ = solar radiation W/m2

Vt = terminal voltage

K = Boltzmann"s constant having value 1.38*10^-1J/K

q = electron charge having value 1.6*10^-19 C

Eg = band gap energy of semiconductor which is approximately 1.2 eV

A = diode ideality factor whose value always lie between 1to 5 (here 1.3)

The reverse saturation current at reference temperature can be approximately obtained as

$$Irs = \frac{Isc}{\left[\exp\left(\frac{q*Voc}{KTA}\right) - 1\right]} \quad (6)$$

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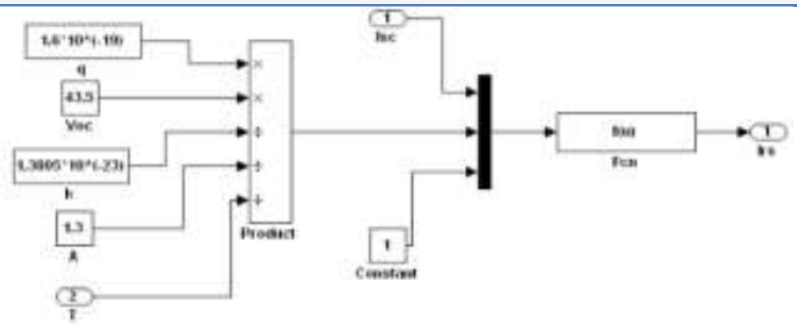

Figure 5: MATLAB model of diode reverse saturation current

Where Irs = diode reverse saturation current
Voc = open circuit voltage
and current in shunt branch is given as

$$Ish = \frac{(V+I*Rs)}{Rsh} \qquad (7)$$

By placing equations from (2) to (7) in equation (1) we can get output current. Therefore photovoltaic current Ipv is modeled as below

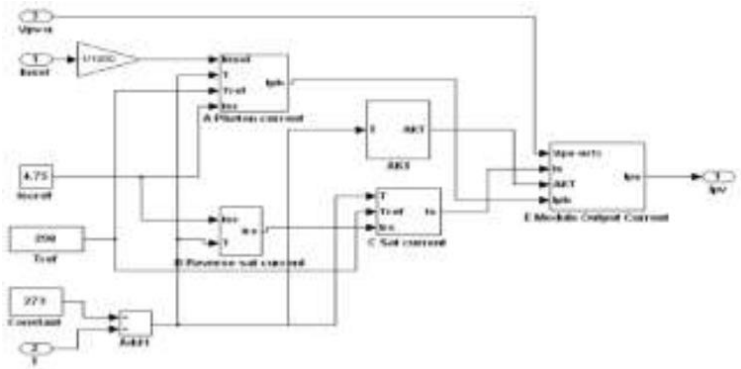

Figure 6: MATLAB model of PV module current

1. IV &PV Characteristic with varying irradiation obtained in MATLAB

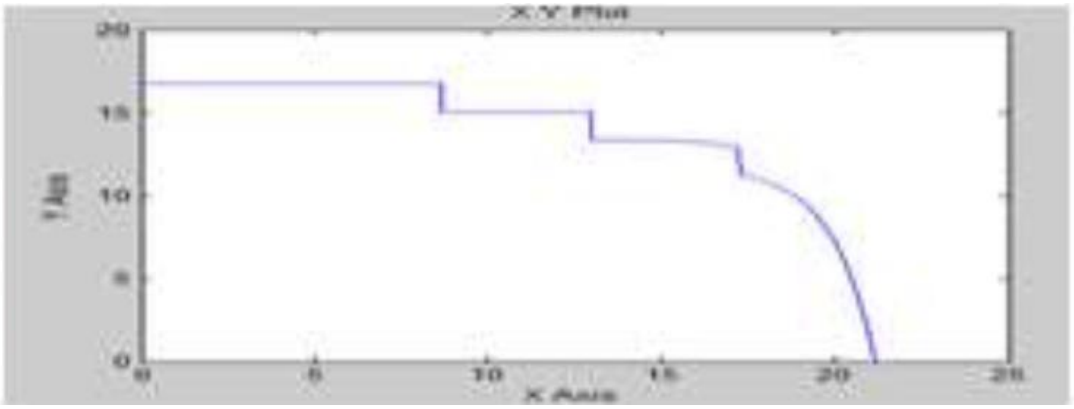

Figure 7: IV characteristic with varying irradiations

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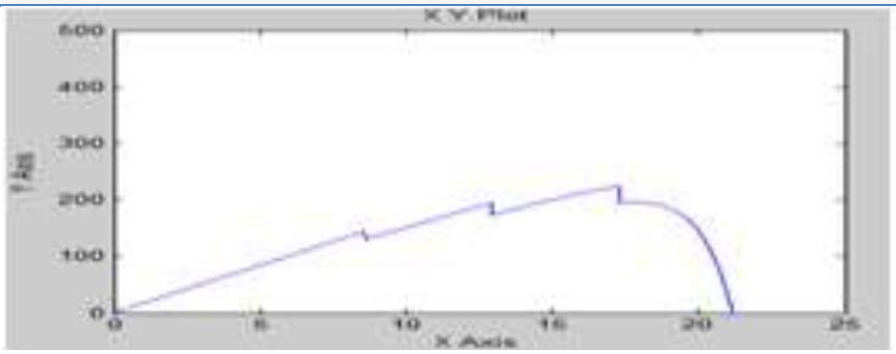


Figure 8: PV characteristic with varying irradiations

4 Maximum Power Point Tracking

There are many specific tactics to maximize the electricity from a PV system. There are two a range of algorithms to music the most electricity point. Out of these techniques P & O method is used here and explains below.

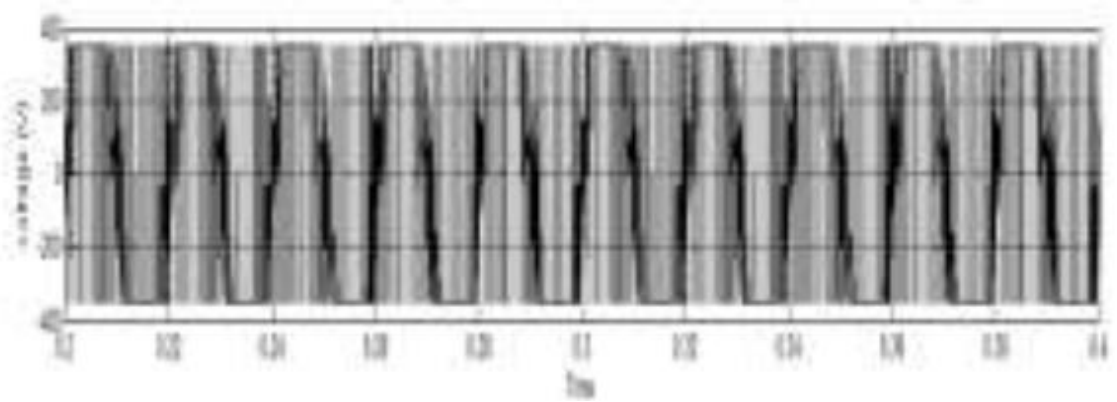
A. Perturb & Observe (P & O) method

The Perturb & Observe algorithm states that when the working voltage of the PV panel is perturbed with the aid of a small increment, if the ensuing alternate in energy P is positive, then we are going in the path of MPP and we maintain on perturbing in the same direction. If P is negative, we are going away from the direction of MPP and the sign of perturbation furnished has to be changed.

5. Simulation Results

A. Output voltages

1.Inverter voltage



Peak magnitude = 355 V

THD = 98.42 %

To filter out these harmonics LC filter is used with inverter and then RL load is connected. Load voltage after using filter is given below

2. Load voltage

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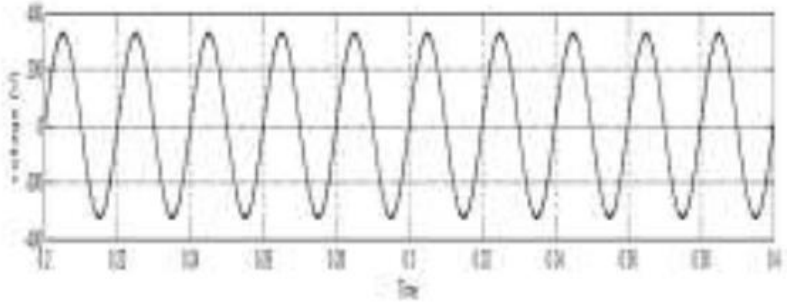
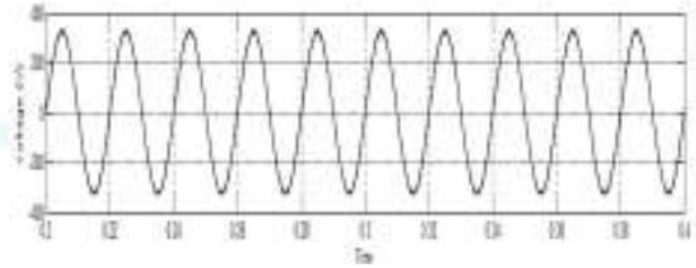


Peak amplitude of load output voltage = 325V
Rms value of load voltage =325/ 2 = 230 V
THD = 0.39 %

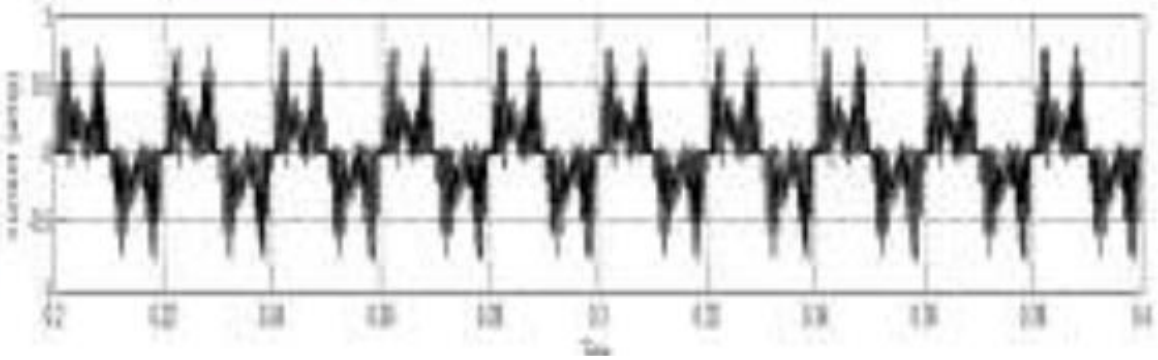
3.Grid voltage



Peak magnitude = 325V
Rms voltage = 230 V

B. Output current

1.Inverter uotput current



6. Conclusion

Modeling of PV module and MATLAB/SIMULINK mannequin of Grid-Tied PV inverter is presented. P&O technique of MPPT is modeled in MATLAB to song most strength factor of PV cell and test Dc-Dc output result. An excessive affectivity boost-buck converter based totally single stage PV inverter is proposed. Control scheme is developed to make a smooth transition between buck and raise mode which offers constant output voltage with various input voltage. Inverter output contemporary and voltage waveform having harmonics are decreased by the use of LC filter and total harmonic distortions calculated. Total system simulation is executed and Results are presented

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7. Future Scope

The Solar Photovoltaic technology has large scope of development as per utilization of generated electricity is concern. We can still boost a better science to extract the strength under low irradiance conditions also as this is essential setback for photo voltaic technology. Also these environmental constraints have an effect on the typical effectively of the system. When the grid is abnormal, the PV inverter needs to be disconnected from the grid. A control scheme wishes to be developed and in addition modifications to make the inverter to function between grid-tied mode and islanding mode. The development also wants in the field of substances used for building of solar cell. These materials figure out the efficiency and overall performance of the photo voltaic PV system. Same gadget increase above can be run with three phase bridge inverter with certain modifications.

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