International Journal on Recent and Innovation Trends in Computing and Communication
Volume: 4 Issue: 1
ISSN: 2321-8169
265 - 267

Photovoltaic Grid Integrated System Based on MPPT Technique By using MATLAB/SIMULINK

Reshma Sadhu Tidke
ZES's Dnyanganga College of Engineering and Research,
Narhe Savitribai Phule Pune University
Pune, Maharashtra
tidkers@gmail.com

Prof. Dipak Kumar D. Gavai
ZES's Dnyanganga College of Engineering and Research,
Narhe Pune.
dipakmangla@gmail.com

Abstract:-This paper provides an easy accurate method of modeling photovoltaic arrays. The methodis comfortable to obtain the parameters of the array model using information from the datasheet. The electric system consists of a photovoltaic module (PV) module, a DC/DC converter and a DC/AC converter to release the grid connection. A maximum-power point tracking (MPPT) technique is used to extract maximum amount of power from solar cells. The photovoltaic model is established using basic circuit equations of the Photovoltaic (P-V) cells including the effects of solar radiation and temperature changes. One-diode equivalent circuit is used in order to study I-V and P-V characteristics of a typical 36W solar module and draws results according to values changes of the temperature and solar irradiation which is observed in MATLABSIMULINK. Hence, the P-V module has nonlinear characteristics, and the Photovoltaic system characteristic curves such as current-voltage (I-V) and power-voltage (P-V) characteristics are drawn according to values change in temperature and solar radiation which is observed in MATLAB-SIMULINK.

Keywords: *Photovoltaic module, power system, Mat lab/Simulink*

*****

I. INTRODUCTION

Solar energy is green source of energy and also inexhaustible and environmentally friendly. It is one of the most importantanother for conventional energy sources. Due to this, photovoltaic solar energy has been increasingly used to generate. The conversion of solar energy from a solar cell into electricity is still considered as an expensive method compared withconventional fossil fuel generated electric power .Solar energy obtained from a solar PV cell is not constant all the time which is used for production of electricity. Solar energy is inflated by external conditions like solar irradiance and temperature. Solar irradiance and cell temperature are pointed out to be affecting PV cell output to a much greater extent than the other conditions. Likewise, the amount of extracted power from a PV system is a function of the PV array to produce voltage and current set point. Due to these reasons stated, it isnecessary to maximize the output electric power available from the PV cell. Actually the solar PV cell has nonlinear I-V and P-V characteristics which is depends on the irradiance and the operating temperature also in loadcondition of the solar cell.PV modulecharacteristics and mathematical modeling indicates anexponential and nonlinear relation between the outputcurrent and voltage of photovoltaic module(PV).Block diagram of photovoltaic system:

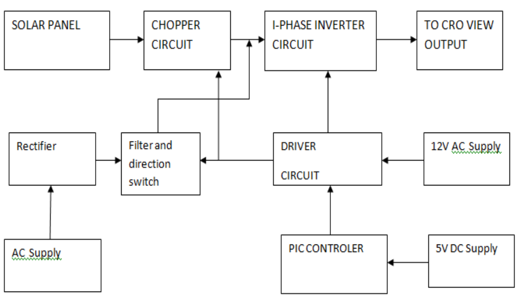


Figure1. Block diagram of photovoltaic grid system

The block diagram of photovoltaic system consists of solar panel, dc-dc converter, single phase inverter, driver circuit, filter, ac supply.

II. PRINCIPLE OF OPERATION

With no creating pollution, Photovoltaic cells convertsunlight directly to electricity. Basically it is made up of a PN junction. Figure 1below shows the photocurrent generation principle of PV cells. In fact, when sunlight hits the solar cell, then the photons are immersed by the semiconductor atoms, freeing electrons from the negative layer. This free electron finds its extra path through an external circuit toward the positive layer resulting in an electric current from the positive layer to the negative one.

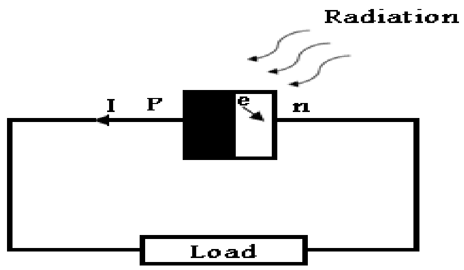


Figure2.Photocurrent generation principle.

Typically, a PV cell generates a voltage around 0.5 to 0.8 volts depending on the semiconductor and the developed technology. This voltage is low sufficiently as it cannot be of use. Therefore, to get advantage from this technology, tens of PV cells (involving 36 to 72 cells) are connected in series to form a PV module. These modules can be interconnected in series and/or parallel to form a PV panel. In these, modules are connected in series; their voltages are added with the same current. However, when they are connected in parallel, their currents are added while thevoltage is the same.

There are three major families of PV cells are monocrystalline technology, polycrystalline technology and thin filmtechnologies. The monocrystalline and polycrystallinetechnologies are constructed on microelectronic manufacturingtechnology and also have efficiency is in between 10%and 15% for monocrystalline and between 9% and 12% forpolycrystalline. For thin film cells, the efficiency is 10% fora-Si, 12% for CuInSe2 and 9% for CdTe. This paper presents aMatlab/SIMULINK model of monocrystalline PV cell thatmade possible the prediction of the PV cell behavior underdifferent varying parameters such as solar radiation, ambient Temperature, series resistor, shunts resistor, diode saturationcurrent, etc.

Specification

Maximum Power Voltage(Vmax)=22 V
Maximum Power Current (Imax) = 3.33A
Module Dimension (LxWxH)(mm)=702X666X34
No. of Solar Cells = 36
Normal Operating Cell Temp(NOCT)=25±2^{0}C

III. PV Cell model

The equivalent circuit of a PV cell is shown in Fig. 2. It consists of a current source, a diode, a series resistance and a shunt resistance.

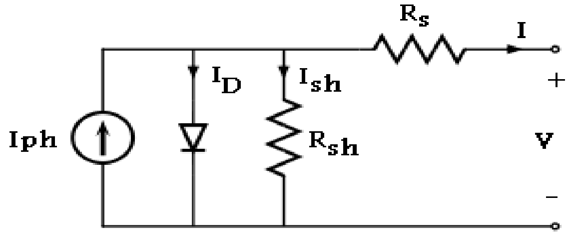


Figure3.PV cell equivalent circuit

IV. EQUATIONS FOR EQUIVALENT PV CIRCUIT

Module photo current:

$$I_{ph} = [I_{scr} K_i (T - 298)] * \lambda / 1000 \quad (1)$$

Modules reverse saturation current

$$I_{rs} = I_{rs} \Big/ \left[\exp\left(qV_{oc} / N_s kAT \right) - 1 \right] \quad (2)$$

The module saturation current Io varies with solar cell temperature

$$I_o = I_{rs} \left[T / T_r \right]^3 . \exp\left[q * E_{go} / BK \left\{ 1/T_r - 1/T \right\} \right] \quad (3)$$

The current output of PV module

$$I_{pv} = N_p * I_{ph} - N_p * I_o \left[\exp\left\{ q * (V_{pv} + I_{pv} R_s) / N_s AKT \right\} \right]$$

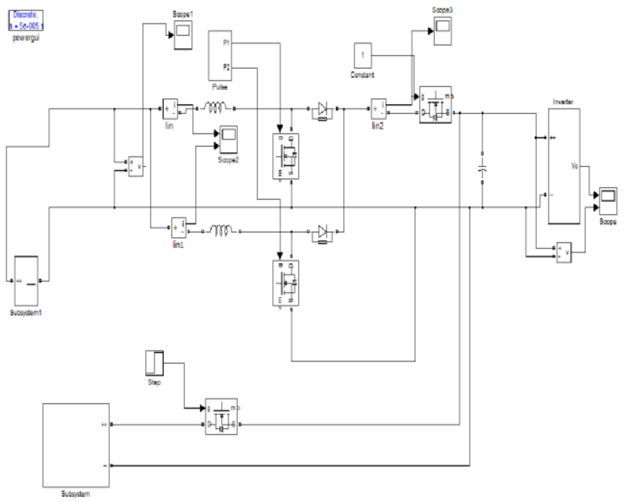
Where

$$V_{pv} = V_{oc}, N_p = 1, N_s = 36$$

V. SIMULATION AND ITS RESULTS

The Simulation diagram and its result of photovoltaic grid system are as follows. A circuit diagram based simulation model for a photovoltaic system for producing the I-V characteristic curves of photovoltaic panel with respect to changes on environmentalparameters (temperature and irradiance) and cellparameters. In this paperdevelopment of MPPT (Maximum Power Point Tracking) algorithm is analyzed.

VI. SIMULINK DIAGRAM OF PHOTOVOLTAIC GRID INTEGRATED SYSTEM:



RESULTS:

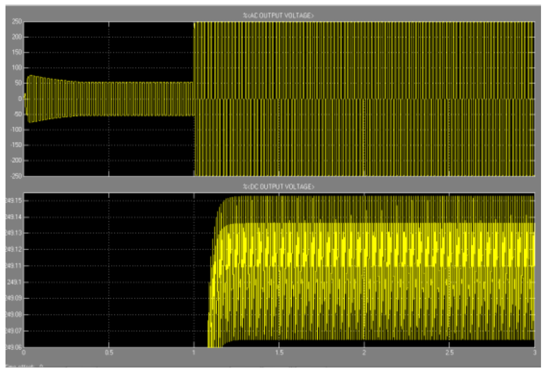


FIGURE.AC AND DC OUTPUT VOLTAGE

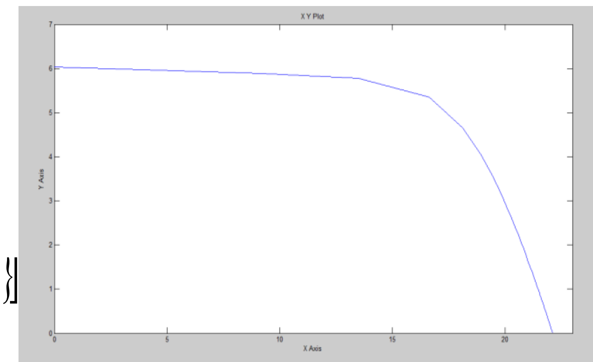


FIG.I-V CURVE

 ISSN: 2321-8169
265 - 267

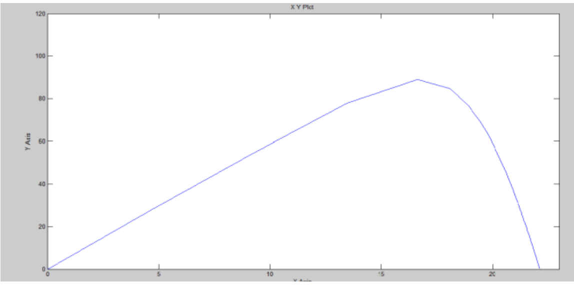


FIG.P-V CURVE

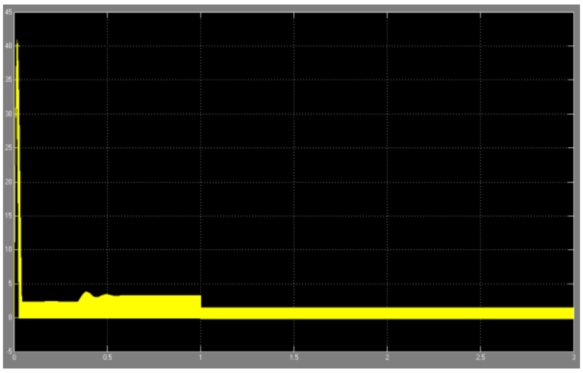


FIG. BUCK BOOST CONVERTER CURRENT

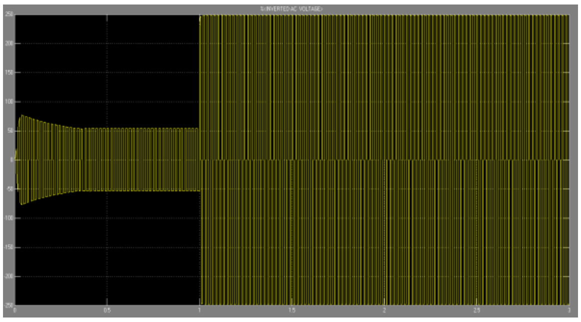


FIG.INVERTED AC VOLTAGE

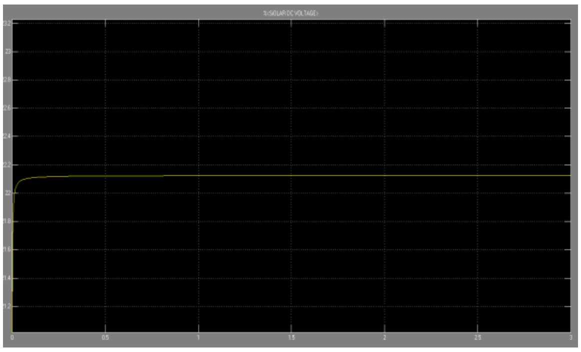


FIG.SOLAR DC VOLTAGE

VII. CONCLUSION

Here modeling of PV module is presented by using step by step procedure. Inthis, I have developed some module from which we get P-V and I-V curve.

A MATLAB/SIMULINK module for solar PV cell, module and array was developed and also shows results in this paper. This PV module is based on some fundamental circuit'sequations of solar PV cell taking into account the effect of some physical and environmental parameters such as solar radiation and cell temperature. The photovoltaic system contains of a high-efficiency, Buck-type dc/dc converter, dc/ac converter and a microcontroller-based unit which controls the dc/dc converter directly from the PV.

REFERENCES

[1] Ahmed N.A.," Modeling and simulation of ac-dc buck boost converter fed dc motor with uniform PWMtechnique", Electric Power systems Research 73 (2005), pp363-372.
[2] Balkarishnan A., Toliyat and Alexander W.C.," Soft
[3] Switched ac link buck-boost converter", APEC 2008,
[4] Twenty-Third Annual IEEE, 24-28 Feb., 2008, pp.1334-1339.
[5] Santos J.L, Antunes F, Chehab A., and Cruz C.," A
[6] Maximum power point tracker for PV systems using ahigh performance boost converter", Solar energy 80(2006) pp.772-778.
[7] Azab M.," Improved circuit model of photovoltaic array', PWASET, Vol.34, Oct.2008, pp.857-860.
[8] [5] H. S. Rauschenbach. *Solar cell array design handbook*.Van Nostrand Reinhold, 1980.
[9] J. A. Gow and C. D. Manning. Development of a Photovoltaic array model for use in power-electronicssimulation studies.Electric Power Applications, IEEProceedings, 146(2):193–200, 1999.