PHOTOVOLTAIC SOLAR MODULATION ON MATLAB

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Abstract

Solar brilliant energy represents the greater part of the usable sustainable power on this planet. Photovoltaic (PV) is a strategy for producing electrical force by changing over sun powered radiation into direct flow power utilizing semiconductor that display the photovoltaic impact This work centers around a program created in MATLAB/Simulink of photovoltaic module. The created program permits the forecast of PV module conduct under various physical and ecological boundaries. This program can likewise be utilized to extricate the actual boundaries for a given sun based PV module as an element of temperature and sun based radiation

Keywords : *photovoltaic, PV module,*

1. INTRODUCTION

Photovoltaic (PV) and sustainable power sources (RES) have tested an extraordinary advancement lately [1], for the most part as a result of the developing worry about environmental change and the oil cost increment, which has driven numerous nations to embrace new guidelines to advance this sort of energy. Photograph voltaic cells are low misuse costs (free fuel), restricted upkeep prerequisites, solid, quiet and simple to introduce. Furthermore, in some independent applications photovoltaic cells are absolutely advantageous in examination with other fuel sources, particularly in those spots that are not open which is unbeneficial to introduce conventional electrical cables.[1]

Any photovoltaic model is based on diode behavior, which gives to photovoltaic cell its exponential characteristic.The solar cell can be modeled with three modeling systems [3]. The first possibility of modeling can be done with instruments which can implement any differential equation or algebraic relationship of a highly complex mathematical model. Another possibility is given by Simscape, which allows direct model- ing using physical components of the electric field (resistors, capacitors, diodes) to implement exactly the same mathemati- cal equation. A modeling system more complex than those described above is performed using Sim Electronics advanced component library, which contains a block called Solar Cell. The solar cell from MATLAB 8.5.0. (R2015a) is a solar current source, which includes solar induced current and temperature dependence.

In this paper, a photovoltaic board demonstrating technique and recreation will be introduced. The boundaries for the PV model depend on qualities gave from the producer's datasheet. The proposed model is like a solitary diode model with an arrangement opposition. Be that as it may, the boundaries utilized in proposed model are gotten from just the datasheet estimated at STC and the model needn't bother with emphasis routine to remove the boundaries of I-V attributes. Thus, this model is appropriate for SPICE demonstrating and Matlab/Simulink displaying when creating and planning MPPT calculation. This paper additionally gives the Simulink demonstrating of the photovoltaic model presentation and some recreation results.

II . GENERAL DESCRIPTIO OF A PHOTOVOLTAIC CELL

Photovoltaic cells convert solar radiation directly into DC electrical energy. The basic material for almost all the photovoltaic cells existing in the market, which is high purified silicon (Si), is obtained from sand or quartz. Basically, three types of technology are used in the production of photovoltaic cells. monocrystalline; polycrystalline; and amorphous silicon [2]. The crystalline-Si technology is commonly used as areference, or baseline, for the solar power generation technology. In general, the status of a photovoltaic cell technology depends on the cell efficiency, and manufacturing cost. The focus of R&D all over the world is on improving its efficiency and cost, where the optimal solution is based on a trade-off between the two. The efficiency of a photovoltaic cell is determined by the material"s ability to absorb photon energy over a wide range, and on the band gap of the material. Photovoltaic cells are semiconductors that have weakly bonded electrons at a level of energy called valence band [33, 34]. When energy strikes this valence band, it frees those bonded electrons and moves them to another energy level called conduction band. At the conduction band, the electrons are able to conduct electricity through an electrical load. PV cells use the energy of photons from sunlight to break their band gap energy thereby producing DC current. Typically, PV cells produce low power (approximately 2-3Watts); [39] hence several cells are connected together to form modules and panels for higher power applications. Power regulation elements *(e.g.* battery, charge controller, converter, etc....) mare also incorporated to match the output power form to the demanded application. Figure 1 shows the simple concept of.
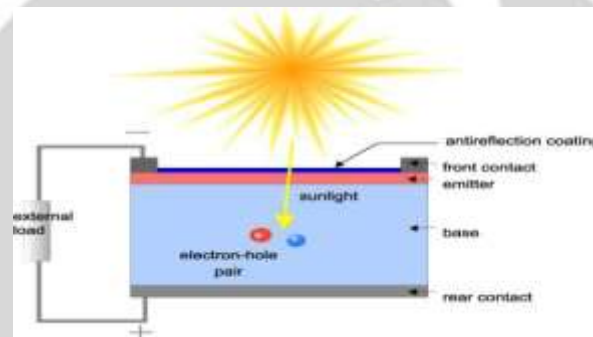

Fig 1: photovoltaic system.

A photovoltaic array (PV system) is a interconnection of modules which in turn is made up of many PV cells in series or parallel. The power produced by a single module is not enough for commercial use, so modules are connected to form array to supply the load.[4]
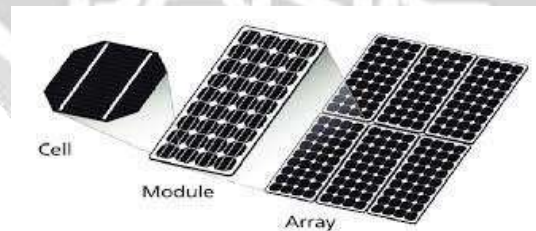

Figure 2: Solar PV Cell, Module and Array

Most PV arrays use an inverter to convert the DC power into alternating current that can power the motors, loads, lights etc. The modules in a PV array are usually first connected in series to obtain the desired voltages; the individual modules are then connected in parallel to allow the system to produce more current [12].

III. **METHODOLOGY**

The photovoltaic module is a sort of semiconductor diode, whose p–n junction is exposed to light. Basically, the PV phenomenon may be described as the absorption of solar radiation. When the energy of the incident photon is sufficient to detach the covalent electrons of the semiconductor, charges are generated. The incidence of light on the cell generates charge carriers that originate an electric current. A solar cell is the building block of a solar panel. A photovoltaic module is formed by connecting many solar cells in series and parallel. Considering only a single solar cell; it can be modeled by utilizing a current source, a diode

and two resistors. This model is known as a single diode model of solar cell. Two diode models are also available but only single diode model is considered here
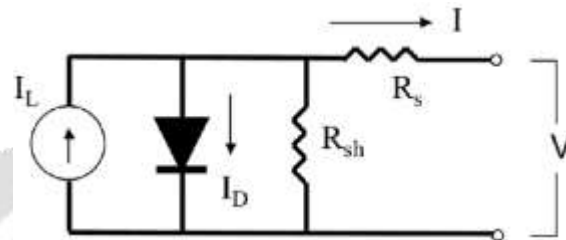

Fig3 : Single diode model of a solar cell

The basic current-voltage characteristics of the PV module can be expressed

$$= h - 0 [(+ R) - 1] - +$$

where, *I* and *V* are the current and voltage of the photovoltaic panel,respectively.

Iph (=Np Iph,cell)

is the photo-generated current in the PV module consisting of Np cells connected in parallel. Each cell can generate the photo current of

Iph,cell. I0 (=NpI0,cell)

is the reverse saturation current of the PV module consisting of *Np* cells connected in parallel where each cell has the reverse saturation current of

I0,cell. VT (=aNs·kT/q)

is the thermal voltage of the array with *Ns* cells connected in series where

a(=1.0~1.5)

is the ideality factor of the diode,

k(=1.38*e*-23 J/K)

is the Boltzmann's constant,

q(=1.602*e*-19 C)

is the electronic charge and *T* is temperature of the array in Kelvin. *Rs* is the equivalent series resistance of the PV array. *Rp* is the equivalent parallel resistance of the PV array.

IV. PROGRAMMING BASED SIMULATION ON MATLAB/SIMULINK FOR SOLAR PV MODULE

The model of PV panel is implemented withMatlab/Simulink. Its input is the ambient conditions like ambient temperature and solar irradiation and its output will be the panel current-voltage characteristics and panel parameters(the thermal voltage and the series resistance). This model needs the parameters from the manufacturer's datasheet measured under standard test condition, such as open circuit voltage, maximum power point voltage voltage-temperature coefficient, short circuit current, maximum power point current and the current-temperature coefficient at STC.

Table1. Parameter of KC200GT solar array at STC

Open circuit voltage	32.9V
Voltage at MPP	26.3V
Short Circuit Current	8.21A
Current at MPP	7.61A
Voltage-Temperature Coef .	-0.123V/K
Current-Temperature Coef.	0.0032A/K
Maximum Power, exp	200.143W

In order to show the validity of the model, a comparison with other experimental data is very useful. In Figure 3, the I-V characteristics of the photovoltaic panel,KC200GT from KYOCERA [12], are shown where comparing the calculated results with the   experimental ones at the temperature of 25oC. In this figure, the solid line is representing the calculated results and circles are the experimental data. The parameters of the KC200GT solar array at the nominal condition are shown in Table 1.
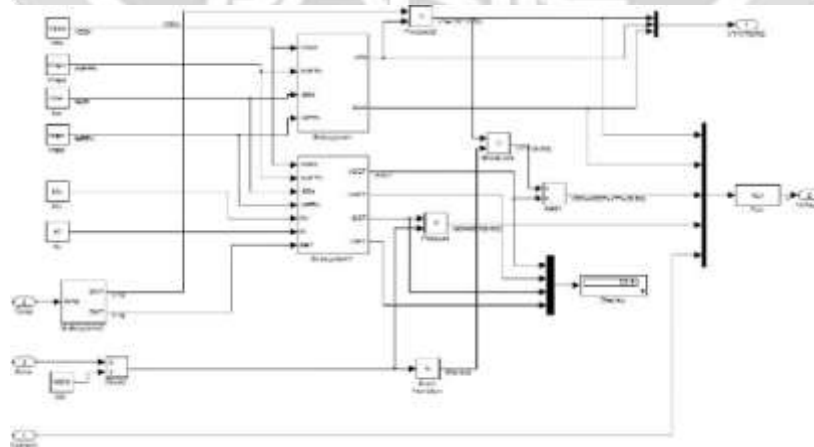

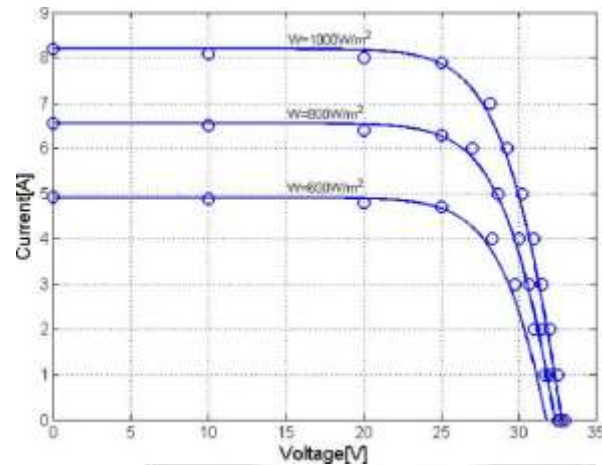**Fig4 Solar Cell Modeling with Simulink/Matlab**

Fig 5. The I-V characteristics and experimental data of the   KC200GT at array ambienttemperature of 25oC

V: RESULT AND CONCLUSION

In this paper, the numerical displaying of photovoltaic board is created. The motivation behind this demonstrating is to just the numerical I-V model of photovoltaic board to effectively apply the model to the circuit test systems like SPICE. The proposed model uses just the information, for example, open circuit voltage, impede, voltage and current at Maximum force point and temperature coefficient for voltage and current got from maker's datasheet at the ostensible condition or the standard test condition. The model in this paper is extremely basic and has no emphasis cycle, which makes model complex and tedious. This model can be reasonable for circuit test system and the demonstrating and reproduction of the MPP tracker including sun oriented pannel. In this paper, we likewise present the Matlab/Simulink model and mimicked aftereffects of the sun based board dependent on the model. The outcomes from reproduction are contrasted with the exploratory outcomes with show the legitimacy of our model.

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