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A Review of Study and Analysis of Photovoltaic Solar Energy Connected to three-phase grid using MPPT Controller

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ABSTRACT-

Solar energy is eco-friendly and very simple to apply compared to alternative renewable energy sources. Solar energy usually meets the direct desires for electricity with the help of a photovoltaic system and power electronic devices. With the rapid use of the photovoltaic panel, the generated energy is transferred to the grid due to the limitations of value and useful life of the energy storage system. The inverter supplies DC power to AC power and is useful for powering electronic and electrical instrumentation rated at AC mains voltage. Before developing the inverter, a mathematical model was designed for the photovoltaic system without mentioning the proportional-integral controller and disturbances and observing the MPPT formula to access the various characteristics of the photovoltaic module About 75% of the photovoltaic systems installed in the world are connected to the network.

Keywords- Photovoltaic, MPPT, Proportional Integral (PI).

1 INTRODUCTION

The design and analysis of a photovoltaic electrical converter connected to the three-phase grid are well discussed. The inverter supplies DC power to AC power and is useful for powering electronic and electrical instrumentation rated at AC mains voltage. The demand for electricity has been growing proportionally to population growth and also due to rapid industrialization [1]. To fill the gap between demand and supply, additional fossil fuels need to be burned, leading to various disadvantages such as rapid depletion of fossil fuels, environmental pollution, greenhouse effect, acid rain, global warming, etc. Fossil fuels are replaced by renewable energy sources (RES). The various RES available are solar energy, wind energy, tidal energy, geothermal energy, small hydropower, biomass energy, etc., among the various RES available; solar energy has an advantage over other RES [2]. The solar photovoltaic (PV) system converts solar energy into electrical energy. Photovoltaic system has several advantages such as required input i.e. solar energy is available for free, less dependency on oil, gas, coal for electricity production; therefore no pollution will be produced as there are no moving parts. Maintenance is not required; in the long term there will be a high return for the amount invested in the photovoltaic system [3].

The disadvantages associated with the photovoltaic system are that the solar energy required will not be available 24 hours a day, solar panels require additional equipment such as converters, inverters, charge controllers, the land needed to install the solar panels will be higher, the cost of Installation The photovoltaic system is high, the solar panels have an efficiency in the range of 15% to 25%. As the advantages of the photovoltaic system outweigh the disadvantages, photovoltaic systems are most used in the generation of electrical energy. The photovoltaic system can be used to supply local load or it can also be connected directly to the grid [4-6]. The solar photovoltaic (PV) system converts solar energy into electrical energy. Photovoltaic system has several advantages such as required input i.e. solar energy is available for free, less dependency on oil, gas, coal for electricity production; therefore no pollution will be produced as there are no moving parts. Maintenance is not necessary, in the long term there will be a high return on the amount invested in the photovoltaic system [9].

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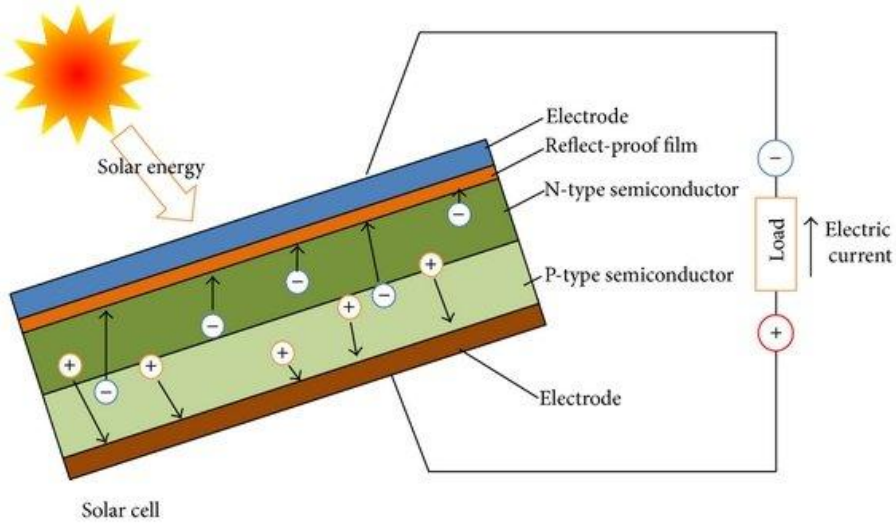

Figure 1 Photovoltaic cells

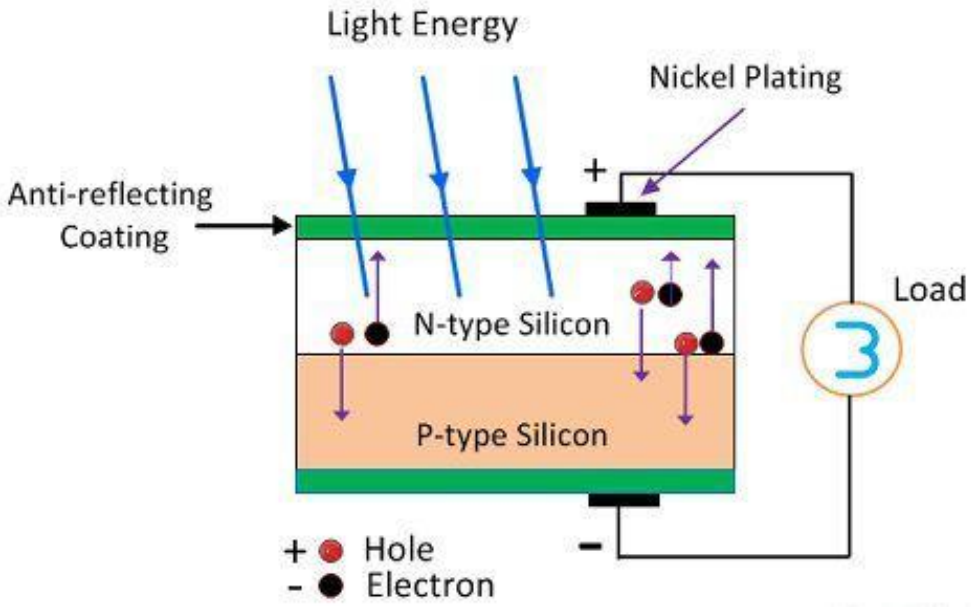

Figure 2 Construction of Simple Photovoltaic Cell

2 GRID-CONNECTED INVERTER

The three-phase power converter connected to the grid completes the power supply where power is converted from DC to AC. To appreciate this, the energy generated by the photovoltaic system is regenerated from DC to AC by an electrical converter connected to the grid.

The output voltage is initialized from the mains so that it is slightly higher than the mains voltage for additional voltage. "The three-phase grid-connected electrical converter is exclusively considered for grid-connected applications that do not require cooperative energy storage systems." The three-phase power converter is commonly used for high power applications, although the project is intended to encourage individual households to use the three-phase electrical converter connected to the grid.

3 PHOTOVOLTAIC ARRAY MODELING

We can say that a solar cell is a kind of p-n junction diode that generates charge carriers when the intensity of an incident photon exceeds the band gap of the semiconductor component. Many photovoltaic cells are connected in series and parallel to form a photovoltaic module and a

photovoltaic array is a series or parallel interconnection of modules composed of several photovoltaic cells to achieve the desired power. The model is ideal for scientific conditions because it includes series and parallel resistance, as well as terminal voltage observation.

The various elements of PV system are PV panel, power conditioning devices i.e. a DC-DC converter, MPPT controller, DC-AC converter i.e. an inverter, filter. The generated output voltage is variable and low, a DC-DC boost converter increases the generated DC voltage to the required voltage level. The generated output photovoltaic power depends on weather conditions. There is a single operating point on the I-V curves, P-V curves where the output power generated by the photovoltaic panels will be maximum and this is represented by Pmax. The MPPT controller tracks this single operating point and operates the PV system at this point.

DC-AC converter i.e. an inverter converts the boosted DC voltage into AC voltage and this converted voltage can be supplied to AC load loads or can be connected to the mains. Filters are used to eliminate harmonics on the inverter output and provide pure AC power.

4 SYSTEM MODELING AND CONTROL METHOD

Usually, the first stage of this power system is applied to increase or increase the voltage value; however, having a two-stage power layer increases the overall cost of the system. Instead, single-stage power converters have been proposed as a way to reduce machine costs, but to increase the DC bus voltage, a group of panels connected in series is required. Although numerous solutions for increasing the DC bus voltage have been suggested, applying a single-stage power layer operation with PV panels connected in series is the most popular method.

4.1 CONTROL SCHEME

The idea of the current control simulation is to obtain the active input current clamping Ii(t). This active fixation offers the following advantages to the system:

- Management of the energy flow between the grid and the photovoltaic solar installation.
- And the possibility of performing MPPT of the photovoltaic panels.

When using the P&O method for MPP tracking in the photovoltaic system and it is noticed that the voltage values vary very little with time, the difference in the intensity of solar irradiation undergoes significant changes. In India, most places do not experience significant and large variations in temperature during the day. The MPP approach is based on the latest control system and this is achieved by keeping the voltage constant and close to MPP at the PV terminals. An example is presented below for the current properties and voltage properties of a photovoltaic cell for various irradiation values.

5 CONCLUSIONS

The current voltage at this radiation intensity and the ambient temperature are plotted for both operating modes. The P&O method of maximum power point tracking strategies is used in this work and is simulated. This paper proposes a control algorithm that is basically a combined form for current control in photovoltaic systems. MPPT algorithms and a control approach essentially based on the dq0 transformation were proposed for active and reactive power control of a three-phase PWM inverter to be used in a grid-connected photovoltaic generation system. The main objective of this project is to develop a dual function system that generates solar energy while still acting as an active energy filter for the system. Under varying irradiation conditions, the algorithm provided accurate monitoring.

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