GRID CONNECTED SOLAR CELL BASED PHOTOVOLTAIC SYSTEM

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Abstract**:** The photovoltaic (PV) energy effect can be considered an essential sustainable resource because of solar radiant energy abundance and the sustainability thus grid connected photovoltaic system is widely used, although solar energy is available abundantly and free of cost, the cost of the photovoltaic cells is very high. Hence the initial investment on solar energy will be very high. The basic element of a PV system is the solar cell which converts the solar irradiance into direct current. Grid interconnection of PV system requires an efficient converter to convert the low DC voltage into AC. The Gate Diffusion Input requires twin well CMOS or silicon on insulator (SOI) process for fabrication. Depending on the weather and the day time, the amount of electrical energy generated by the solar panels changes which is a problem for the system powered by photovoltaic systems. Grid-connected PV systems can cause problems on the grid, such as injecting more harmonics or reducing the stability. The main objective is to develop a power electronics interface for a three-phase grid connected PV with SIMULINK model. The current and voltage is calculated and compared with other existing models.

Keywords: photovoltaic, grid, DC, AC cells, current and voltage etc.

I.INTRODUCTION

Energy demand is increasing day by day due to increase in population, urbanization, and industrialization, renewable energy resources are alternatives to our traditional energy sources which are limited and will expire. Clean energy resources such as solar, wind and hydro became more and more popular mainly because they produce no emissions and are inexhaustible. The photovoltaic (PV) energy effect can be considered an essential sustainable resource because of solar radiant energy abundance and the sustainability thus grid connected photovoltaic system is widely used, although solar energy is available abundantly and free of cost, the cost of the photovoltaic cells is very high. Hence the initial investment on solar energy will be very high. The basic element of a PV system is the solar cell which converts the solar irradiance into direct current. Grid interconnection of PV system requires an efficient converter to convert the low DC voltage into AC.

The technical requirements from both the utility grid side and the PV system side need to be satisfied to ensure the safety of the PV installer and the reliability of the utility grid to utilize the generated power effectively. An interface system must be developed to make the interconnection between the PV system and the grid. To ensure that the system will work as desired and to investigate its impact in different conditions; the system must be modeled and simulated.

II.SOLAR CELL

The Photovoltaic cell is the semiconductor device that converts the light into electrical energy. The voltage induces by the PV cell depends on the intensity of light incident on it. The name Photovoltaic is because of their voltage producing capability.

The electrons of the semiconductor material are joined together by the covalent bond. The electromagnetic radiations are made of small energy particles called photons. When the photons are incident on the semiconductor material, then the electrons become energised and starts emitting.

The energises electron is known as the Photoelectrons and the phenomenon of emission of electrons is known as the photoelectric effect. The working of the Photovoltaic cell depends on the photoelectric effect.

Types of PV Panels PV is not only used as standalone-systems but also in microgrids [8]. PV panels can be differentiated on the basis of their efficiency and the amount of space taken by them, i.e. installation size. There are different types of PV panels available in the market such as :

1. Monocrystalline Panels
2. Polycrystalline Panels
3. Hybrid Panels

Monocrystalline Panels

In this type, the cells are aligned in a particular direction, which means when the sun is incident on the cells at the correct angle; they exhibit high efficiency and work best when sun directly shining on them.

Polycrystalline Panels

In these panels, the individual crystals are not all perfectly aligned together which reduces their efficiency as compared to monocrystalline panel. However, this misalignment can be a benefitting factor because the cells work better even when light is incident from other angles.

Hybrid Panels

The extra amorphous layer behind the monocrystalline cells is able to extract more energy from the incident sunlight, especially under low light conditions. They have the highest efficiency and take up less space. These, however are more expensive than monocrystalline and polycrystalline panels.

III.CONSTRUCTION OF PHOTOVOLTAIC CELL

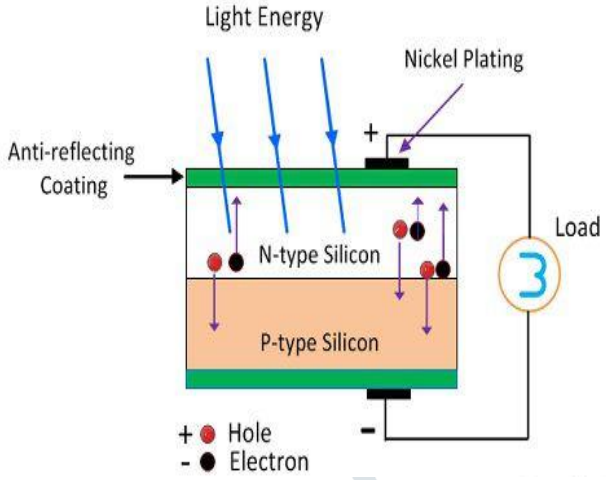
The semiconductor materials like arsenide, indium, cadmium, silicon, selenium and gallium are used for making the PV cells. Mostly silicon and selenium are used for making the cell.

Consider the figure below shows the constructions of the silicon photovoltaic cell. The upper surface of the cell is made of the thin layer of the p-type material so that the light can easily enter into the material. The metal rings are placed around p-type and n-type material which acts as their positive and negative output terminals respectively.

The multi-crystalline or monocrystalline semiconductor material makes the single unit of the PV cell. The mono-crystal

cell is cut from the volume of the semiconductor material. The multicells are obtained from the material which has many sides.

The output voltage and current obtained from the single unit of the cell is very less. The magnitude of the output voltage is 0.6v, and that of the current is 0.8v. The different combinations of cells are used for increasing the output efficiency. There are three possible ways of combining the PV cells.



IV.RESEARCH METHODOLOGY

The system is composed mainly as following: Photovoltaic array converts the sun irradiance and generates dc voltage and current, the DC-DC boost converter controlled by maximum power point tracking using (P&O) algorithm to track the maximum power point of the array

then the three phase Inverter converts the dc voltage to AC for grid interfacing or supply to the local load. The performance of simulation of this topology was performed using the MATLAB Software. The parameters are used in simulation. In this section, comparison of different parameters such as inverter voltage, common mode voltage (CMV), leakage current and the performance of proposed topology under changes of reactive and real power are discussed.

MOSFET

A cross section through an n-MOSFET when the gate voltage VGS is below the threshold for making a conductive channel; there is little or no conduction between the terminals source and drain; the switch is off. When the gate is more positive, it attracts electrons, inducing an n-type conductive channel in the substrate below the oxide, which allows electrons to flow between the n-doped terminals; the switch is on. The metal–oxide–semiconductor field-effect transistor (MOSFET, MOS-FET, or MOS FET) is a transistor used for amplifying or switching electronic signals. The basic principle of this kind of transistor was first patented by Julius Edgar Lilienfeld in 1925. Twenty five years later, when Bell Telephone attempted to clear the junction transistor, they found Lilienfeld already holding a patent which was worded in a way that would include all types of transistors. Bell Labs was able to work out an agreement with Lilienfeld, who was still alive at that time.

LAYOUT OF THE PROPOSED METHOD

The main idea of the proposed method is to use the huge amount of the available data in an efficient and intelligent manner, while preserving the temporal information. This can be achieved by first dividing the long historical time series of the calculated PV power into segments. The results generated from using the representative segments can either be utilized directly to evaluate the performance of the feeder or can help identify the groups of segments that require further analysis.

Efficiency calculation According to the actual in-plane irradiation G and the module temperature T, a PV array always offers a certain DC-power PMPP. However, under steady-state conditions, the inverter can only extract

$P_{DC} = \eta_{MPPT} \cdot P_{MPP}$ and converts it to $P_{AC} = \eta \cdot P_{DC}$

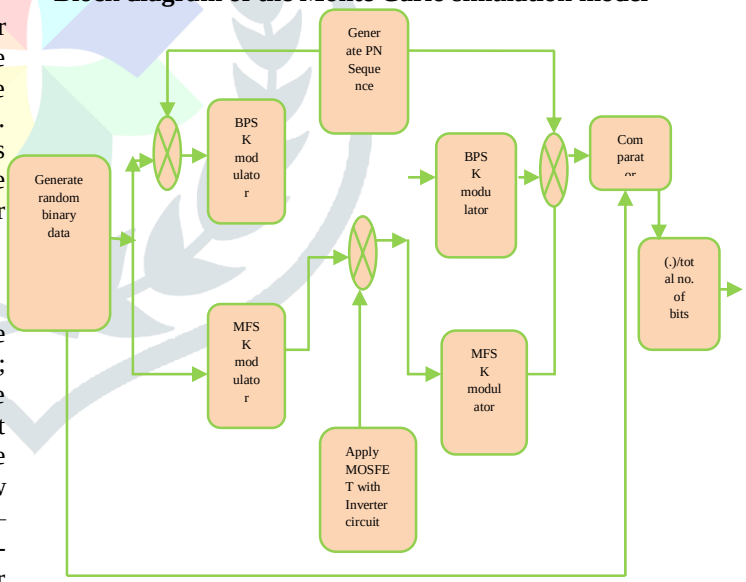
Actually the inverter efficiency is a ratio of AC power and DC power. The total efficiency of a grid- connected inverter can be defined as:

$$\eta_{tot} = \eta \cdot \eta_{MPPT} = \frac{PAC}{PMPP}$$

PROPOSED STEPS

Step 1: Start the work.
Step 2: Select voltage, current and other components to design model.
Step 3: Apply AC and DC converter in circuit.
Step 4: To develop a power electronics interface for a three-phase grid connected PV with SIMULINK.
Step 5: Apply Monte Carlo model and MOSFET to design inverter circuit.
Step 6: Calculate the current and voltage.
Step 7: Ccompare proposed working model with other existing models.

Block diagram of the Monte Carlo simulation model



V.RESULTS & DISCUSSION

This includes the final results of the research work that is to be implemented in the MATLAB. The different figures of the research works are given below:

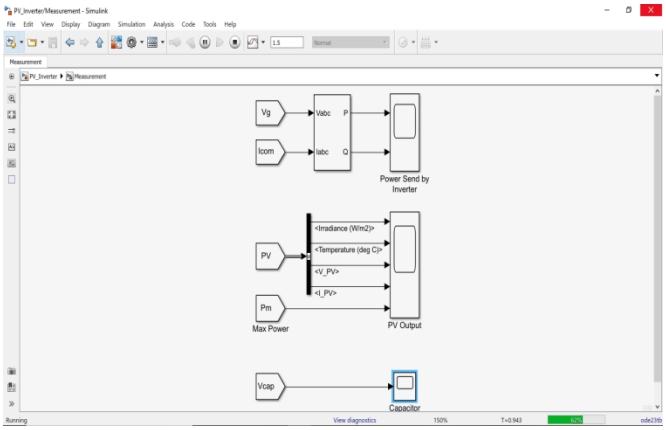


Figure 1: Simulation Diagram for Proposed System

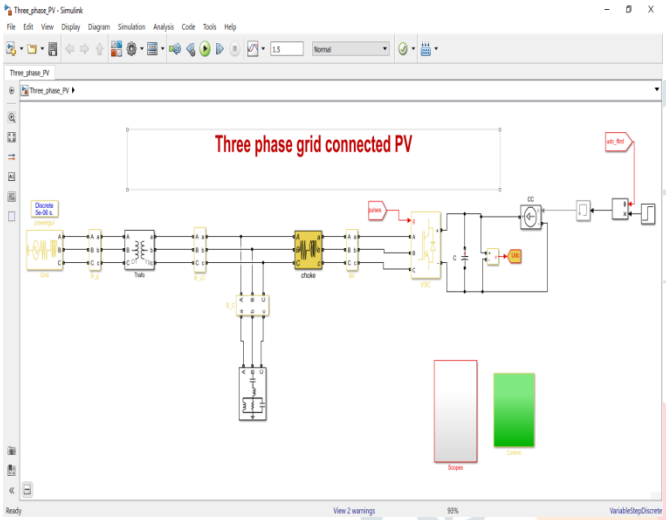


Figure 2: Three Phase Grid Connected PV

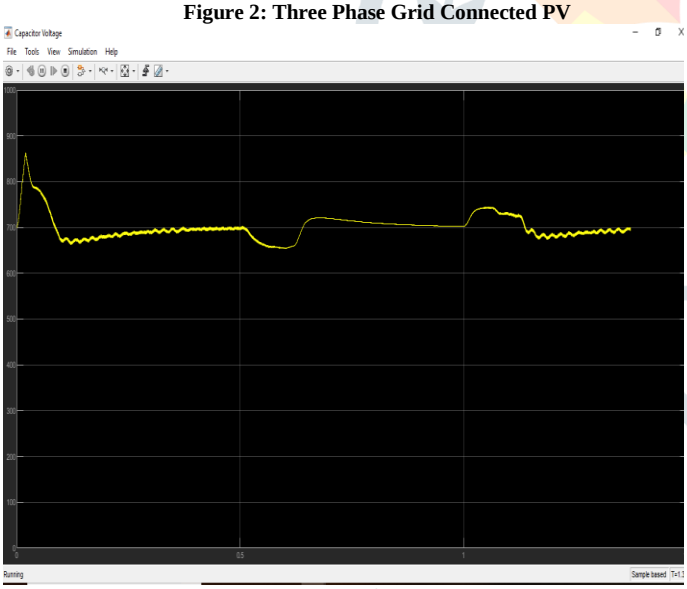


Figure 3: Capacitor Voltage of three phase System

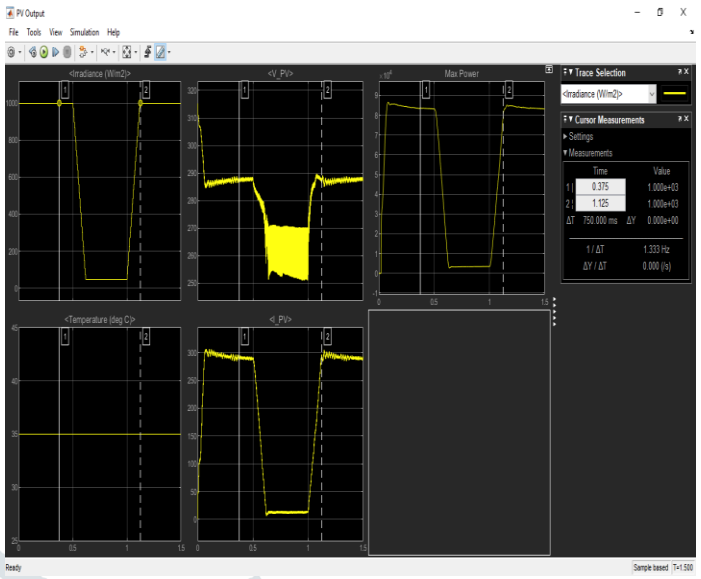


Figure 4: PV Output of three phase System

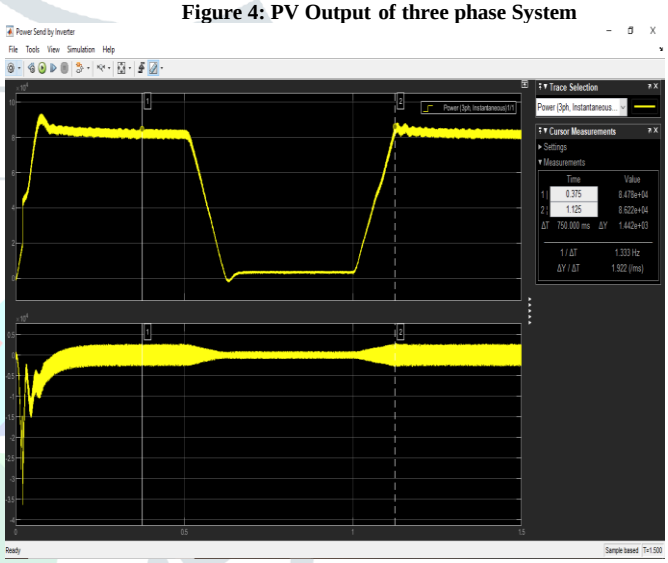


Figure 5: Power Send by Inverter

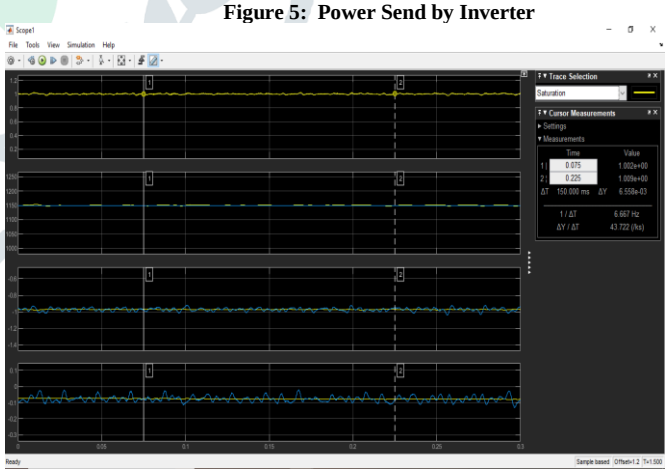


Figure 6: Scope-1 Output

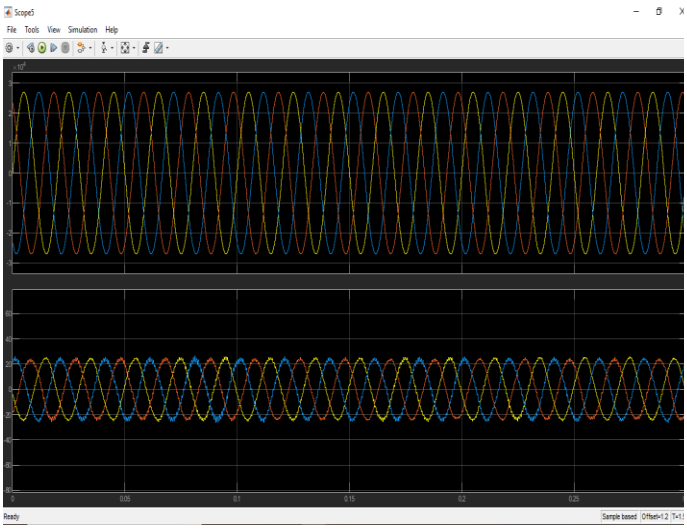


Figure 7: Scope-5 Output

VI.CONCLUSION & FUTURE SCOPE

The photovoltaic (PV) energy effect can be considered an essential sustainable resource because of solar radiant energy abundance and the sustainability thus grid connected photovoltaic system is widely used, although solar energy is available abundantly and free of cost, the cost of the photovoltaic cells is very high. Hence the initial investment on solar energy will be very high. The basic element of a PV system is the solar cell which converts the solar irradiance into direct current. Grid interconnection of PV system requires an efficient converter to convert the low DC voltage into AC. The Gate Diffusion Input requires twin well CMOS or silicon on insulator (SOI) process for fabrication. Depending on the weather and the day time, the amount of electrical energy generated by the solar panels changes which is a problem for the system powered by photovoltaic systems. Grid-connected PV systems can cause problems on the grid, such as injecting more harmonics or reducing the stability. The main objective is to develop a power electronics interface for a three-phase grid connected PV. The current and voltage and to compare proposed working model with other existing models. Here the maximum current is produced along with voltage.

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