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ANALYSIS OF MPPT FOR SOLAR INVERTER USING PVSYST

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ABSTRACT

In the world of technological advancement, conventional resources of energy (fossil fuels, nuclear fuels, gas, etc.) are at the edge of extinction. To overcome this problem, non-conventional energy sources(solar energy, wind energy, ocean thermal energy, biomass or biogas, geothermal, tidal energy, etc.) play a vital role, in which solar energy is the most important energy source, which produces electricity by the photovoltaic effect. Solar photovoltaic (PV) cells are used to convert solar energy into unregulated electrical energy. These solar PV cells exhibit nonlinear characteristics and give very low efficiency. Therefore, it becomes essential to extract maximum power from solar PV cells using maximum power point tracking (MPPT). The power output from a PV panel depends on a few parameters, such as the irradiation received by the panel, voltage, panel temperature, and so forth. The power output also varies continuously throughout the day as the conditions affecting it change. In recent years, a large number of techniques have been purposed for tracking the maximum power point (MPP). Maximum power point tracking is used in photovoltaic (PV) systems to maximize the photovoltaic array output power, irrespective of the temperature and radiation conditions and of the load electrical characteristics. By using pvsyst software we can observe how the design configuration will be done and it also helps in which is the most efficient way to install the plant.

Keywords—Photovoltaic system, Maximum Power Point Tracking, Solar Cells, Solar Modules, etc.

I. INTRODUCTION

Solar power is an Alternative technology that will hopefully lead us from our petroleum-dependent energy sources. The major problem with solar panel technology is that the efficiencies for solar power systems are still poor and the costs per kilowatt-hour (kwh) is not competitive, in most cases, to compete with petroleum energy sources. Solar panels themselves are quite inefficient (approximately 30%) in their ability to convert sunlight to energy. However, the charge controllers and other devices that make up the solar power system are also somewhat inefficient and costly. Our goal is to design a Maximum Power Point Tracker (MPPT), a specific kind of charge controller that will utilize the solar panel to its maximum potential.

WHY DO WE GO FOR SOLAR?

1. Solar Power is good for the environment.
2. Solar Power can use Underutilized Land.
3. Solar Power can Causes Less Electricity Loss.
4. Solar Power Improves Grid Security.
5. Solar Power is a free source of energy.

WORKING OF TYPICAL SOLAR PV PLANT

Solar electricity is produced when the photons from the sun's rays hit the solar PV panels (also called PV modules).

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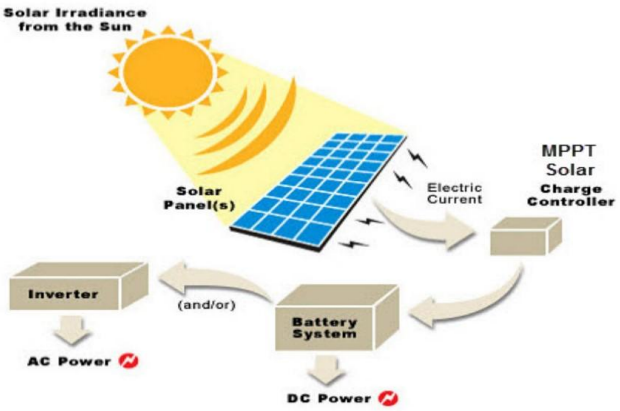
The photons generate electricity as per the phenomenon known as the photoelectric effect.

The solar panel generates Direct Current (DC).

A number of solar panels are connected in series and this arrangement is called an 'array' or 'string'. The DC electricity from the Solar PV array passes through an inverter, which converts the DC electricity into single-phase/three-phase AC power.



Schematic Diagram of Solar PV Plant

COMPONENTS USED IN SOLAR PV PLANT

1. Solar PV Cell
2. Mounting Structure
3. Solar Inverter
4. Grid Interface
5. Transformer
6. Cables & Connectors
7. Earthing and Lightning Protection

II. SOLAR INVERTER

Inverters are used for DC to AC voltage conversion. Central inverters are used in large applications. Many times they can be connected according to the "master-slave" criteria when the succeeding inverter switches on only when enough solar radiation is available or in case of main inverter malfunctions. Solar PV inverters are designed with a high efficiency of>95%. These inverters have built-in features of MPPT (maximum power point tracking) operations to maximize the delivery of power generated through solar modules into the grid. The inverter is having internal self-protection in case of any fault in the grid in addition to the in-built contactors/breakers with fuses for self-protection.

Solar Inverter

III. SELECTION CRITERIA FOR SOLAR PV INVERTER

1. Rated Power Output
2. Maximum PV input power
3. Efficiency
4. Operating Temperature
5. Maximum Open Circuit Voltage

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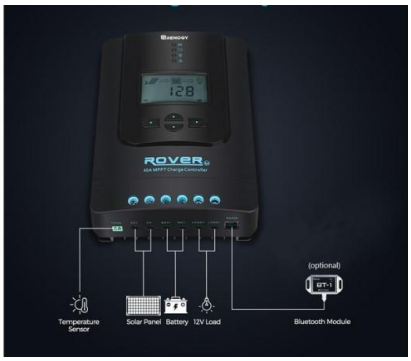
IV. AN OVERVIEW OF MAXIMUM POWER POINT TRACKING

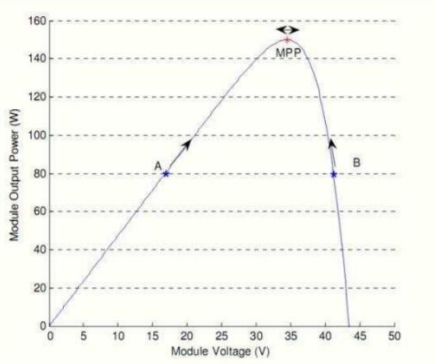
A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. A maximum power point tracking technique is used to improve the efficiency of the solar panel. According to the Maximum Power Transfer theorem, the power output of a circuit is maximum when the Thevenin impedance of the circuit (source impedance) matches the load impedance. Hence our problem of tracking the maximum power point reduces to an impedance matching problem. On the source side, we are using a buck converter connected to a solar panel in order to enhance the output voltage so that it can be used for different applications like a motor load. By changing the duty cycle of the buck converter appropriately we can match the source impedance with that of the load impedance.

V. WHAT IS MAXIMUM POWER POINT TRACKING (MPPT)

Maximum power point tracking (MPPT)or sometimes just power point tracking (PPT),is a technique used with variable power sources to maximize energy extraction as conditions vary. The technique is most commonly used with photovoltaic (PV) solar systems, but can also be used with wind turbines, optical power transmission, and thermophotovoltaics.



PPT Device



Solar panel Characteristic showing MPPand operating points

VI. WHY MPPT IS USED IN SOLAR INVERTER

What if we try to connect solar panels directly to the load? This is never really a good idea and here is why, when a solar panel is directly connected to the load, then much of the power that the solar panel has the potential to generate is not generated at its maximum capability. For instance, every solar panel has its own internal resistance which varies with output power.

When the solar panel is generating peak power the internal resistance(Rch) at this point is termed the characteristic resistance of the panel. When you connect the solar panel to the load ,then the closer the internal resistance of the load is to the characteristic resistance of the panel the more power can be extracted from the panel.

Characteristic resistance of solar panel can be found out by dividing max power voltage value by max power current value,

Rch=Vmp/ImpVmp and Imp can be be found in specification sheet of solar panel.

So output of the solar panel is not only dependant on both amount of light(Irradiance) it is receiving and the temperature of the panel(see the graphs below). But also Dependant on the value of resistance of the load.

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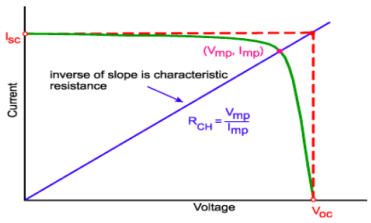
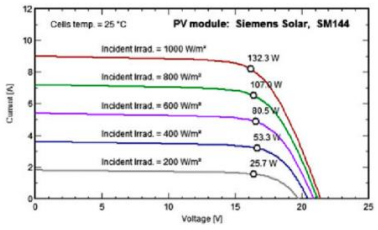
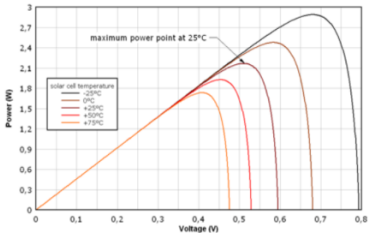


V-I Characteristics of Solar Panel



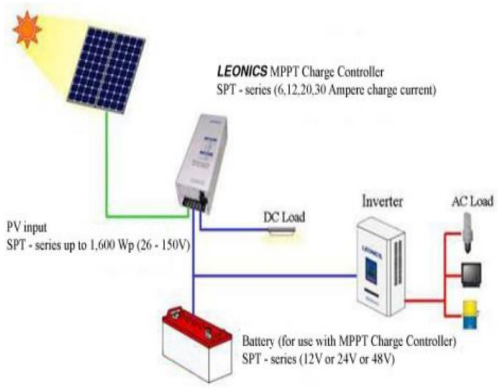
Graph Between Voltage And Current



Graph Between Voltage and Power

VII. HOW DOES AN MPPT DEVICE WORK?

MPPT isolates the Load from the panel and shows the panel a resistance value that maximizes the power withdrawn from the panel. MPPT is a DC-DC converter with various internal resistance and it will switch to the internal resistance level that will maximize the power from the panel for a given amount of solar and load resistance. MPPT will also protect your battery from overcharging and undercharging.



Schematic Diagram of solar PV plant with MPPT

VIII. SOFTWARE USED

PVsyst 7.2 is a PC software package for the study, sizing, and data analysis of complete PV systems. It deals with grid-connected, stand-alone, pumping, and DC-grid (public transportation) PV systems, and includes extensive metro and PV systems components databases, as well as general solar energy tools.

PVsyst Software is a comprehensive solar design tool used by thousands of engineers globally. PVSyst is the standard for large and utility-scale solar installations. It makes grid-connected PV systems easier to design.

PVsyst is the most widely used solar simulation software for energy yield estimation and For the optimal design of solar power plants.

Main Features of pvsyst software are:

1. system design
2. system sizing
3. simulation, reports and economic evaluation

STEPS IN THE DEVELOPMENT OF A PROJECT

1.First Contact with PVSyst

2.Defining the Project

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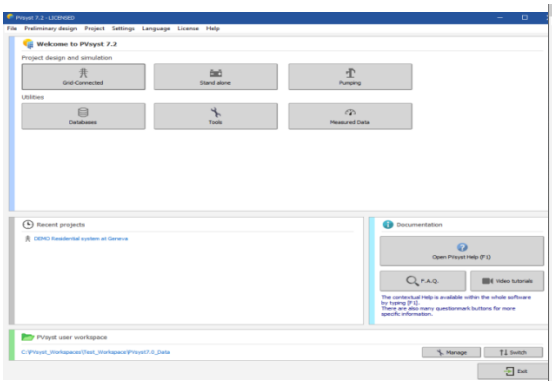
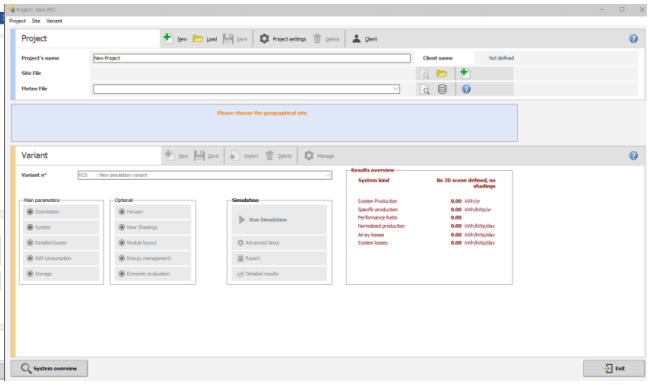
3.Saving the Project

4.Creating First(basic) Variant for the Project

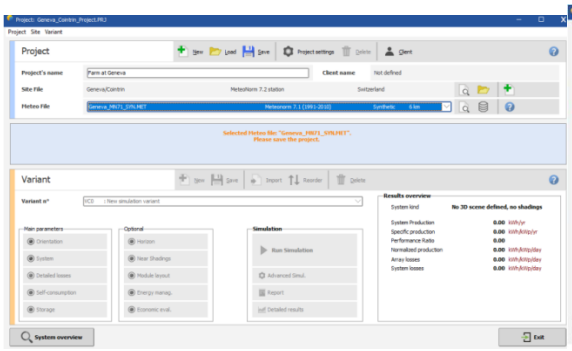
5.Executing the First Simulation



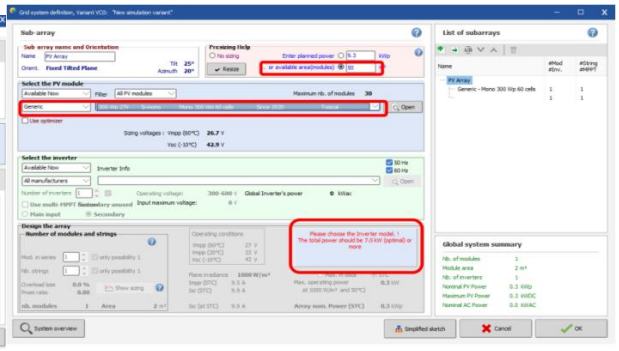
First Contact with PVSyst



Defining the Project



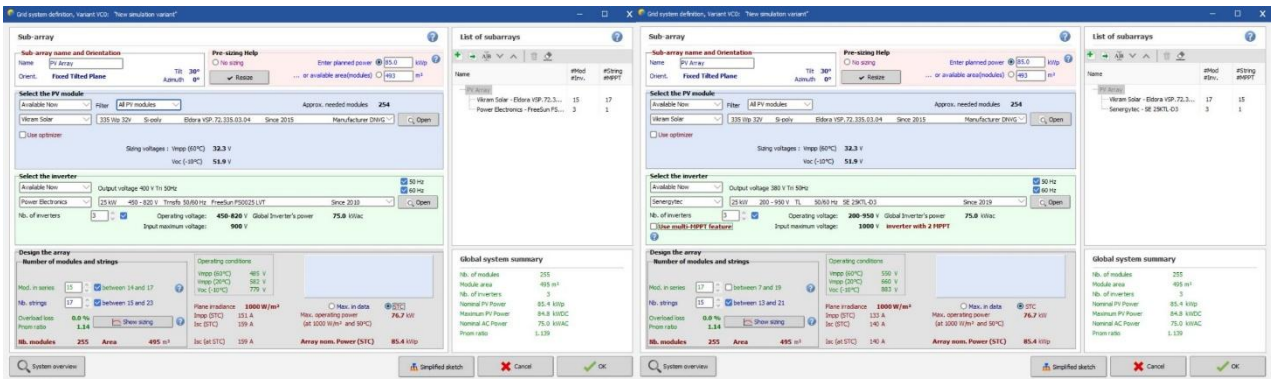
Saving the Project



Creating First(basic) Variant for the Project

IX. RESULTS

From the simulation results, we can observe that by taking one type of solar PV module with different types of solar inverters with the same rating the operating voltages of MPP and Currents of MPP have been changing, and also how many strings are required for installing capacity and per string how many solar modules are required also we can observe from the report and it gives the design configuration for installing suitable and efficient solar PV plant.



The above two diagrams show the different design configuration of a solar PV system with different solar inverters.

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X. CONCLUSION

MPPT technology is a necessity for all on-grid string inverters these days. Without one, a string inverter will not be able to perform well. Although MPPT has drawbacks, they're also the most economical option.

Only MPPT in string inverters can ensure that a solar array is generating maximum power. The choice is always yours: String inverters are still the most popular options on the market.

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