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MPPT Based Photovoltaic System with Zeta Converter for DC Load

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Abstract - *Only a small fraction of the available solar energy is used in practice. To harvest the solar energy, the most common way is to use photovoltaic panels which will receive photon energy from sun and convert to electrical energy. The efficiency of PV module is very low and power output depends on solar irradiation level and ambient temperature, so maximization of power output with greater efficiency is of special interest. In this project, advance DC- DC Converter use for a photovoltaic (PV) power-generation system is proposed. The topology used raises the efficiency for the dc/dc converter of the PV power conditioning system (PVPCS), and it minimizes switching losses by adopting a resonant soft-switching method. The proposed controller scheme utilizes PWM techniques to regulate the output power of dc-dc converter at its maximum possible value. This converter is able to turn on both the active power switches at zero voltage to reduce their switching losses and evidently raise the conversion efficiency. Output of DC DC converter is given to in novel cascaded inverter which maintain sinusoidal output with less harmonic distortion. The resulting system has high-efficiency, lower-cost, very fast-tracking speed. The circuit will be simulated using MATLAB Simulink.*

***Key Words*: PWM technique, Photovoltaic power conditioning system, Harmonic distortion, MATLAB, Simulink.**

1. INTRODUCTION

As the increase in population and industrialization, the energy generated is not sufficient enough to meet the energy demand by using non-renewable energy resources such as fuel and coal. It also polluted the environment and they are also responsible for increasing carbon emission, global warming, acid rain and other health hazardous issues. They are now on the path of extinction. So to meet the energy demand we have to move towards renewable energy resources such as wind and solar which are freely available, less maintenance cost and pollution free. The use of renewable resources is very convenient and efficient as they can be used in large as well as the small-scale production of energy. The balance between nonrenewable as well as renewable resources will bring a drastic change in future in the production of energy.

The DC-DC converters are widely used in renewable energy system as well as industrial drives applications. It's necessary to maintain constant output voltage. The buck-boost and have inverse polarity voltage and output current while SEPIC converter and Zeta Converter current and voltage had the same polarity as the input. The Smallest ripple current and voltage at output side occurred in Zeta converter. The Zeta converter is recommended for variable torque and Power Factor Correction purpose.

An another technique used in this project is MPPT technique. MPPT is the abbreviated form of Maximum power point tracking. The maximum power can be extracted from the panel using these techniques. The load characteristics can give the highest power transfer efficiency changes, as the amount of sunlight varies. The efficiency of the system is optimized to keep the power at a high efficiency. The process of finding this point is known as MPPT.

2. OBJECTIVES

The primary objectives of this study can be summarized as follows:

1) Design photovoltaic system.
2) Design MPPT techniques.
3) Controlling of Zeta converter.
4) Reduction of ripple at output of Zeta converter.
5) Maximum power tracking by MPPT technique.

3. EXISTING SYSTEM

Open loop system consists of dc-dc converter, solar system, load and PWM generator. For the analysis of Zeta converter, we can vary the four parameters such as irradiance, temperature, PWM and load. Here the gate pulse to the IGBT is directly given by the PWM Generator block by giving the proper duty ratio to it. By varying the duty ratio, the Zeta converter operates in buck and boost modes. For the practical system, it is neither efficient and nor useful for the constant voltage load. Because the irradiance and the temperature of the photovoltaic array are changes throughout the day. So the output of photovoltaic array changes which affect the output of the system across the load this can be eliminated by closed loop system with The closed loop system having the PID Comptroller and PWM generation technique in addition to the open loop system but the using this system only get output constant but output waveform not smooth in case of renewable energy source. This system can not be work as solar cell efficiency is less. The efficiency of solar cells depends on many factors such as insolation, temperature spectral characteristics of sunlight, dust, shadow, and so on. Variations in insolation on panels due to fast climatic changes such as cloudy weather and increase in ambient temperature can reduce the photovoltaic (PV) array output power. In other words, each PV cell produces energy pertaining to its environmental and operational condition. In addressing the bad efficiency of PV systems, some methods are proposed, among which is a new concept called —Maximum Power Point Tracking (MPPT). All MPPT methods follow the same Area which is maximizing the PV array output power by tracking the maximum power on every operating condition. Having a curious look at the suggested methods, P&O are the algorithms that were in the center of consideration because of their simplicity and ease of implementation. Hill climbing is disquiet in the duty ratio of the power converter, and the P&O method is disquiet in the operating voltage of the PV array. However, the P&O algorithm cannot compare the array terminal voltage with the actual MPP voltage, since the change in power is only considered to be a result of the array terminal voltage disquiet. As a result, they are not accurate enough because they perform steady-state oscillations, which subsequently waste the energy. By minimizing the disquiet step size, oscillation can be reduced, but a smaller disquiet size slows down the speed of tracking MPPs. Thus, there are some drawbacks with these methods, where they fail under rapidly changing atmospheric conditions which is the main drawback of them.

4. PROPOSED SYSTEM

Proposed system consists Novel MPPT INC method and Zeta converter. The DC-DC converters are widely used in renewable energy system as well as industrial drives applications. It's necessary to maintain constant output voltage. The PWM is the most frequently consider method among the various switching control methods that is existing method using novel MPPT INC/. The buck-boost converter has inverse polarity voltage and output current while Zeta converter having non inverted output the proposed control system is capable of tracking the PV array maximum power and thus improves the efficiency of the PV system and reduces low power loss and system cost. Proposed system also consists parallel source with renewable system in case of non-availability of Electric supply.

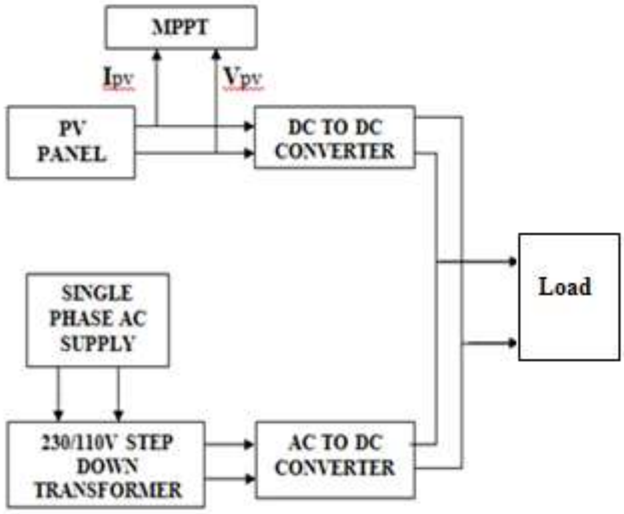
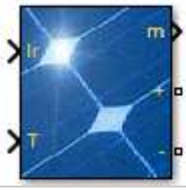


Fig.1. Basic scheme of Zeta converter

5. PHOTOVOLTAIC ARRAY



The PV Array block consist of an array of photovoltaic (PV) modules. Photovoltaic solar panels are made up of separate photovoltaic cells connected together, and then the **Solar Photovoltaic Array**, also known simply as a **Solar Array** is a system made up of a number of solar panels connected together. The PV Array block is a five parameter model using a diode (I0 and nI parameters), series resistance Rs, and shunt resistance Rsh to represent the irradiance and temperature-dependent I-V characteristics of the modules.

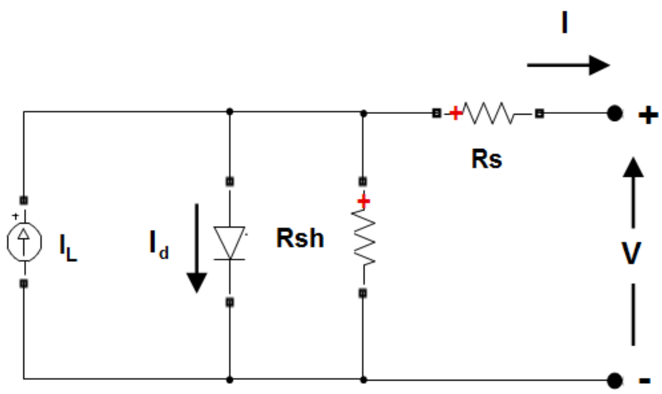


Fig. 2. Circuit diagram of PV Array

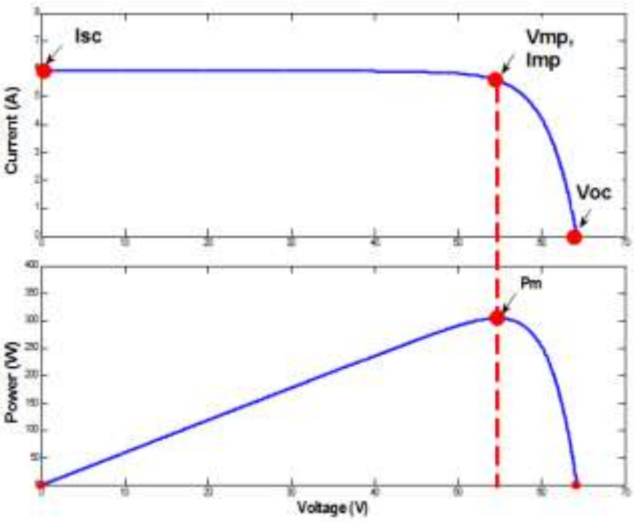


Fig. 3. I-V Characteristics of PV Array

Fig. 4. P-V Characteristics of PV Array

The diode I-V characteristics for a single module are defined by the equations

$$I_d = I_o[\exp(\frac{Vd}{Vt})-1]$$

$$V_T = \frac{kT}{q} \times nI \times Ncell$$

where:

I_d	= diode current (A)
V_d	= diode voltage (V)
I_0	= diode saturation current (A)
nI	= diode ideality factor, a number close to 1.0
K	= Boltzman constant = 1.3806e-23 J.K-1
Q	= electron charge = 1.6022e-19 C
T	= cell temperature (K)
Ncell	= number of cells connected in series in a module

Maximum Power (W) :-
Power obtained at maximum power point (Vmp, Imp). Pmax is computed as *Pmax* = *Vmp* × *Imp*. The default value is 305.226 W.

Cells per module (Ncell) :-
Number of cells per module. The default value is 96.

Open circuit voltage Voc (V) :-
Voltage obtained when array terminals are left open. The default value is 64.2 V.

Short-circuit current Isc (A) :-
Current obtained when array terminals are short circuited. The default value is5.96 A.

Voltage at maximum power point Vmp (V) :-
Voltage at maximum power point. The default value is 54.7 V.

Current at maximum power point Imp (A) :-
Current at maximum power point. The default value is 5.58 A.

Irradiances (W/m2) :-
This parameter is available only if Display I-V and P-V characteristics of is set to one module @ 25 deg. C& specified irradiances or array @ 25 deg. C & specified irradiances. Enter a vector of irradiances in W/m^2.

Tcell (deg. C) :-
This parameter is available only if Display I-V and P-V characteristics of is set to array @ 1000 W/m2 & specified temperatures. Enter a vector of temperatures in degrees C.

TABLE 1
TECHNICAL SPECIFICATIONS OF ONE
Sun power SPR-305E-WHT-D PV MODULE:

PARAMETERS	VALUE
Parallel string	66
Series connected module per string	5
Maximum power (w)	305.226
Open circuit voltage Voc (v)	64.2
Short circuit current ISC (A)	5.96
Voltage at maximum power point Vmp(v)	54.7
Current at maximum point Imp(A)	5.58
Temperature (degree)	25℃
Sun irradiance	1000 W/m^2

6. SIMULATION & RESULT

Firstly, checking the output of the Sun power SPR-305E-WHT-D PV Module without MPPT or DC- DC Boost converter. In this the temperature and irradiation of PV Array is kept constant i.e. 25°C and 1000 W/m² respectively. The 'm' terminal is a Simulink output vector containing five signals. The voltage measurement is connected across the positive and negative terminal of PV Array. The characteristics of above simulation is as follows.

Total voltage of the module can be calculated by

Total voltage = $V_{mp} * N_{series}$

= 54.7*05

=273.5 v

Total current of the module can be calculated by

Total current = $I_{mp} * N_{parallel}$

= 5.58*66

= 368.28 Amp

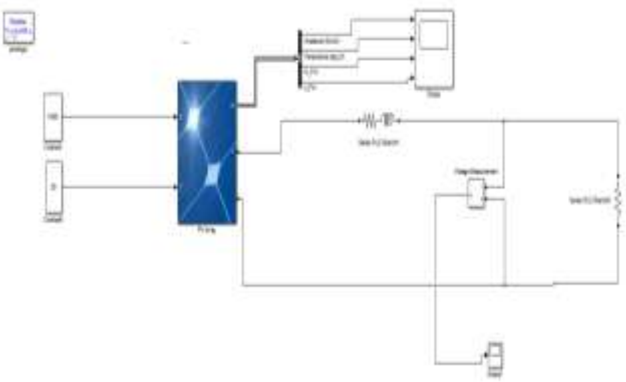


Fig. 5. circuit diagram of PV Array without boost converter

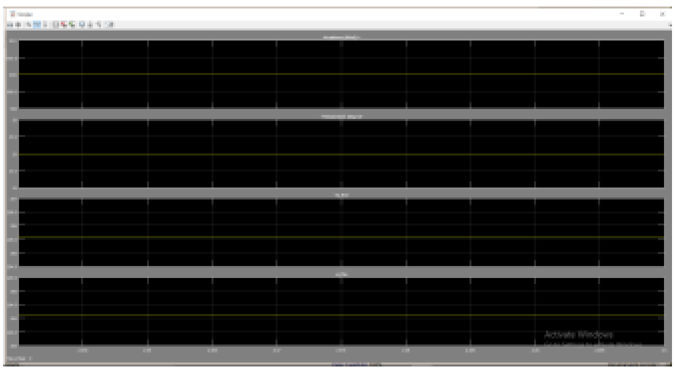


Fig. 6. Waveform of PV Array

7. CONCLUSION

Design PV with parallel system is explain.

If one of the system failed continuity of supply is done thought alternate source. Firstly, checking the output of the Sun power SPR-305E-WHT-D PV Module without MPPT or DC- DC Zeta converter & proposed output of zeta converter with parallel system will be observed. Output with zeta converter will be show less ripples in current and voltage. The buck-boost converter has inverse polarity voltage and output current while zeta converter having non inverted output. The proposed control system is capable of tracking the PV array maximum power and thus improves the efficiency of the PV system and reduces low power loss and system cost.

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