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Mitigation of losses in PV System by using MPPT and Soft Switching Techniques

Raj Kumar Patel and Ashish Bhargava

Department of Engineering Technology

Bhabha Engineering & Research Institute

Bhopal, Madhya Pradesh

India

ABSTRACT

With the development of renewable energy resources power grid was modernized with improved efficiency, clean power, replenishing of energy and sustainability of generation of power. As we all know that the solar is the clean and green sources of energy they do not cause any harm to the environment. Therefore, increasing, day by day power demand can be fulfilled by the renewable energy sources because they do not pollute the environment and does not cause any harm to nature. In the conventional system, MPPT is responsible for extracting the maximum possible power from the photovoltaic and feed it to the load via the boost converter which steps up the voltage to the required magnitude.

Keywords: Green Energy, Power factor correction, Zero voltage transition.

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1. INTRODUCTION

Energy is needful in day to day life but no matter when and where it is to be used. Among various types of energy, electric energy is vital used. The production of energy is another thing which is to be kept in a mind while consuming it. If the energy which is to consume by the consumer is made from renewable source then it is better for nature because it doesn't cause any harm to the atmosphere. A renewable energy sources like Solar, Wind etc. MPPT and zero voltage transition (ZVT) DC-DC boost converter has been introduced here to improve the efficiency and power factor correction (PFC) The main aim of a MPPT technique is to automatically find the operating voltage of the panel that delivers maximum power to the load and aim will be to track the maximum power point of the photovoltaic module so that the maximum possible power can be extracted from the photovoltaic

2. HELPFUL HINTS

With the development of renewable energy resources power grid was modernized with improved efficiency, clean power, replenish of energy and sustainability of generation of power. As we all know that the solar is the clean and green sources of energy they do not cause any harm to the environment. Therefore, by increasing day by day power demand can be fulfilled by the renewable energy sources because they do not pollute the environment and does not cause any harm to the nature.

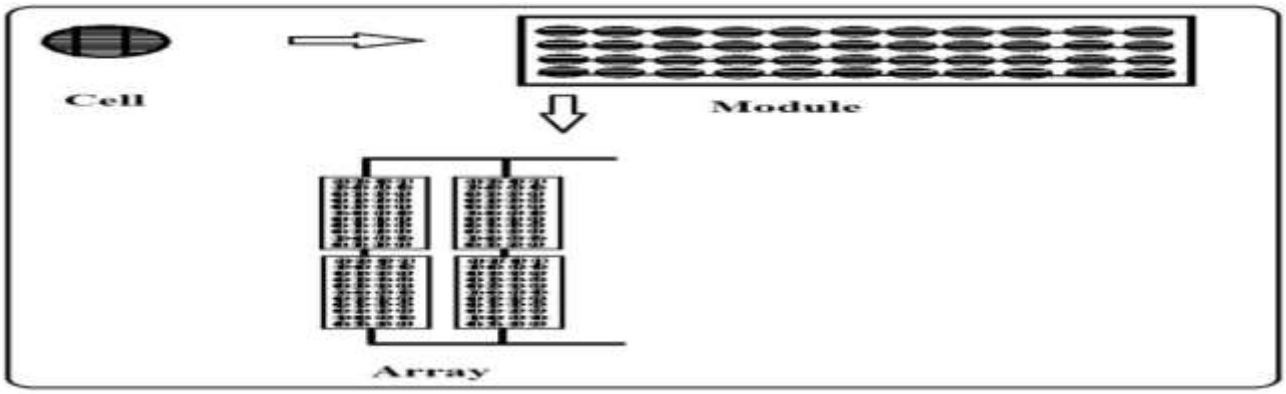

Figure1.1: Solar Cell

2.1 Units & Abbreviations

Design a converter that has

a. Reduced switching losses
b. Reduced conduction losses
c. Less EMI and
d. Reduced stress of voltage and current on the devices

All the results obtained from the comparative study are tabulated and shown in **Table No. 1**

Table No.1 Comparative Study

Sr. No.	Specifications	Hard Switching Converter	Soft Switching Converter
1	*Vpanel*	15.6 Volt	15.6 Volt
2	*Ipanel*	2.56 Ampere	2.56 Ampere
3	*Ppanel*	40 Watt	40 Watt
4	*Vout_load*	25.52 Volt	27.48 Volt
5	*Iout_load*	1.276 Ampere	1.26 Ampere
6	*Pout_load*	32.56 Watt	34.64 Watt
7	Efficiency	90%	95%

3. ABBREVIATIONS AND ACRONYMS

When we install a solar panel or an array of solar panels without a MPPT technique, it often leads to wastage of power, which ultimately requires more number of panels for the same amount of power requirement . Also, whenever a battery is connected directly to the panel, it results in premature failure of battery or loss capacity owing to lack of a proper end-of-charge process and higher voltage. So, absence of a MPPT method results in higher cost. The main aim of a MPPT technique is to automatically find the operating voltage of the panel that delivers maximum power to the load. When a single MPPT is connected to large number of panels, it will yield a good result but in case of partial shading, the combined power output curve will have multiple maxima which might confuse the algorithm. In recent years, many algorithms have been introduced to track maximum power point . They differ from one another in aspects like complexity, efficiency and cost. Some of them are.

1. Perturb and Observe
2. Incremental Conductance
3. Parasitic Capacitance
4. Constant Voltage and
5. Constant Current

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3.1 Equations

Calculation of each circuit element values is shown very clearly.

Input Inductor Lin: The numerical value of the input inductor , must be decided first because its value sets the peak input current which the converter switches have to withstand and therefore this current is necessary to decide the rating of other power circuit components. The maximum current without ripple is
Iin_pk = 2.6 Ampere

The maximum peak-peak ripple current is

$\Delta Irpp = Iin\_pk$. ΔI = 0.7 Ampere

Therefore, the maximum peak input current with ripple is 0.7894 A.

The duty ratio of the converter when the maximum current occurs is

Dpk= 0.50

The input inductor value is calculated as follows

Lin=0.00067 H

Where FSW is the switching frequency

Output Capacitor Co: The output capacitor acts as an energy storage element. It stores energy when the input voltage and current are near their peak and provides this energy to the output load when the line is low. The point of reference for selection of this capacitor is the endurable ripple in the output voltage. The peak charging current of the capacitor is

$C0$= 0.0002 F

3.1.1 Design of the Auxiliary Circuit and Main Switch

Base Values Vb: The base voltage is defined as:

$Vb=Vo$ = 21.0766 V

The base current is defined as:

= 2.2367 Ampere

Therefore, the base impedance is defined as:

Zrb= 8.01 ohm

3.2. Other Recommendations

- Work may be done on further reducing the voltage during turn-off transition of the main switch or making it zero without increasing the circuit complexity.
- Improvement to this project can be made by tracking the maximum power point in changing environmental conditions. Environmental change can be change in solar irradiation or change in ambient temperature or even both. This can be done by using Simulink models to carry out MPPT instead of writing it code in embedded MATLAB.

3.3. Units

Converter Specification for Design are shown in table 2..

Table 2: Converter Specification for Design

Sr. No.	Parameter	Specification	Value
1	Output Power	Pout	40 W
2	Output Voltage	Vout	27 V
3	Input Voltage	Vin	10-20 V
4	Switching Frequency	fsw	10 KHz
5	Output Voltage Ripple	Vrp	5%
6	Input Current Peak Ripple	**Δ**Irpp	30%

4. CONCLUSION

The conclusions of the research work reported in this paper are as follows,

- The main switching losses of conventional converter are much greater than those of the soft-switched converter.
- The auxiliary switch losses are zero in both converters since no auxiliary switch in conventional converter and in the new converter it is soft switched.
- The diode conduction losses remain same in both the cases.

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