A 450V BOOST CONVERTER DESIGN BASED MPPT ALGORITHM USING PWM SWITCHING

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ABSTRACT

The estimation of power electronics has emerged since last few decades ago. The improvement in the power engineering has made many reward as per cost, performance and size point of view. In current years, the power electronics is used in many aspects of commercial, utility, military, transportation, aerospace, etc. A part of power electronics is DC-DC converter, and it has applicability in computers, spacecraft units, laptops, telecommunications and motor drives. The photovoltaic based energy generation is the modern way of generating the power and is adopted all over the world. But the use in power generation by the photovoltaic system varies with the climatic condition. To achieve pick up, DC-DC converter can be used. The technique called maximum power point tracking (MPPT) helps in effective optimization. This paper presents the survey over the obtainable energy most usual maximum power point tracking *optimization techniques efficiency, auxiliary optimization for future study is mentioned.*

Keywords: ***MOSFET, Solar panel, DC-DC Converter***

1.INTRODUCTION

Renewable energy is the energy which comes from natural resources such as sunlight, wind, rain, tides and geothermal. These resources are renewable and can be naturally replenished. India receives solar energy equal to about 500 trillion kWh per annum, more than sufficient to provide for the entire country's necessities. In India, the daily solar energy incidence vary from 4 – 7 kWh per m^2 and many regions in the country enjoy 250 to 300 light days per annum. The advantages of solar energy are that it does not generate any green house gases. It requires significantly lower operational work than conventional power production. A new topology 450V boost converter design based MPPT algorithm using PWM switching is proposed.

2. PROPOSED SYSTEM

2.1 BLOCK DIAGRAM

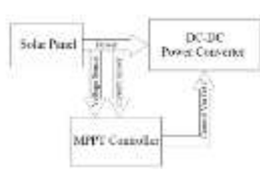

Figure 2.1: Design of Boost Converter using MPPT Controller

2.1.1 BLOCK DESCRIPTION

A solar panel is intended to absorb the sun's rays as a source of energy for generating electricity. The cells are joined electrically in series with one another. Modules are made in series to achieve desired output voltage and parallel to provide desired current. The yield of solar panel is given to the DC-DC converter which acts as a boost converter in which it converts a voltage greater than the input voltage. Switching conversion is extra power capable than linear voltage regulation, which dissipate unwanted power as heat. The higher efficiency of a switched mode converter reduces the heat dropping needed, increases battery endurance of portable equipment. After conversion it is given to the maximum power point tracker. MPPT is used maintain stable output and for rising efficiency. It is the technique commonly used with photo voltaic systems to maximize power taking out under all conditions and it is used for comparing both input and output power and produces a constant output. The output of maximum power point tracking is given to the load in which there will be production of electricity. By using this solar photovoltaic (PV) system power can be generated at greater efficiency without any slaughter of energy.

3. HARDWARE DESCRIPTION

This system encompasses a load coupled photovoltaic array with maximum power point tracking and can be busted down into the following constituent elements.

1. PV Cell, 2. BOOST converter, 3. MOSFET, 4. Maximum power point tracking, 5. Drive circuit

3.1 PV CELL

A photovoltaic cell or photoelectric cell is a semiconductor gadget that converts light to electrical energy by photovoltaic effect. If the energy of photon of light is superior than the band gap then the electron is emitted and the movement of electrons creates current. The silicon solar cells which give yield voltage of around 0.7V under open circuit condition. When many such cells are joined in series we get a solar PV module. Usually in a module there are 36 cells which amount for a open circuit voltage of around 20V.

Figure 3.1 Photovoltaic Panel

3.2 PV MODULE

Photovoltaic modules over and over again have a sheet of glass on the sun-facing side, allowing light to permit while protecting the semiconductor wafers. Solar cells are usually linked in series in modules, creating an preservative voltage. Connecting cells in parallel yields a higher current; on the other hand, problems such as shadow effects can shut down the weaker parallel string producing large power loss and possible damage because of the reverse bias applied to the shadowed cells by their illuminated partners. Though modules can be interconnected to create an array with the chosen peak DC voltage and loading current capacity, using independent MPPTs (Maximum Power Point Tracker) is preferable. Otherwise, shunt diodes can reduce shadowing power loss in arrays with series/parallel linked cells. When many cells are linked in series we get a solar PV module.Usually in a module there are 36 cells which amount for a open circuit voltage of about 20V.

Figure 3.2 : Connections Made in PV Panel

3.3 BOOST CONVERTER

Boost converter (step – up converter) is a DC-to-DC power converter with an output voltage higher than its input voltage. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in grouping Filters made of capacitors (sometimes in combination with inductors) are generally added to the output of the converter to reduce output voltage ripple. The basic diagram of a boost converter. The switch is usually a MOSFET, IGBT, or BJT.

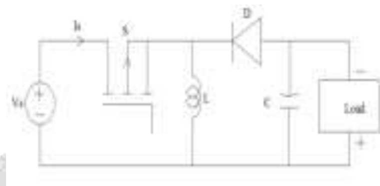

Figure 3.3: Circuit Diagram of MOSFET Switching

3.3.1 Concept of Interleaved Boost Converter

The idea of interleaving, or more usually that of increasing the effective pulse frequency of any periodic power source by synchronizing several smaller sources and operating them with relative phase shifts. Interleaving procedure actually occurs in different areas of modern technologies in different forms. Take a typical automobile engine as an example. In the field of power electronics, application of interleaving technique can be found back to very early day particularly in high power applications. In high power applications, the voltage and current stress can easily go ahead of the range that one power device can handle. One of such example can be found in the application of Superconducting a Magnetic Energy Storage System (SMES).

3.4 DC-DC Converter

The double-stage inverter for grid-connected applications includes a DC-DC converter to intensify the voltage and a DC-AC inverter to control the current injected into the grid.

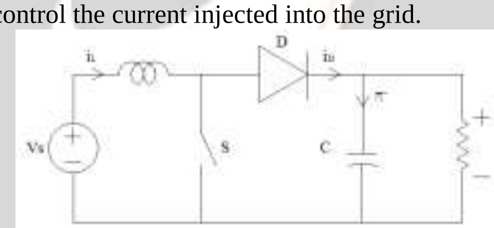

Figure 3.4: DC-DC Converter

DC-DC converter section, based on an inaccessible full bridge boost converter, is designed to take low input voltage in the range 10-45 V. The output voltage is in the range 350-430 V, suitable to in a straight line supply the DC bus of a standard single-phase inverter.

3.4.1 Efficiency Factor

In power electronics system, the efficiency of DC-DC converter is determined by output power and input power. i.e.,

η=Output power/Input power

Where, η =Efficiency

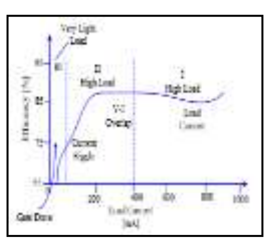

Figure 3.5: DC-DC Converter Efficiency Curve

The portable devices like laptops, mobile phones, etc., requires low voltage and to have better battery life, DC-DC converter is required. Also, the DC-DC converter improves the load efficiency. The efficiency variation in DC-DC converter is represented. At region I or high load state the losses of the leading power taken as current load losses caused by its conduction. The condition II or light load condition, where the power losses take position by RMS losses and current ripples. The region III represents dreadfully light load condition.

4. MOSFET

The MOSFET is self-possessed of a channel of n-type or p-type semiconductor materials, and is thus called as NMOSFET or a PMOSFET. Regrettably, many semiconductors with improved electrical properties than silicon Such as gallium arsenide do not form good gate oxides and thus are not apt for MOSFETS. The gate terminal is a stratum of poly silicon (polycrystalline silicon) or aluminium sited over a channel, but alienated from the channel by a thin layer of insulating silicon dioxide. A basic diagram of the N-channel improvement MOSFETS is shown in figure. Drain and source connections are made to higher conveyance high doped regions. The metal gate is electrically isolated from the P-type substrate by a layer of non-conducting silicon oxide (Si02).

Figure 4.1: Converter Used in Solar Panel

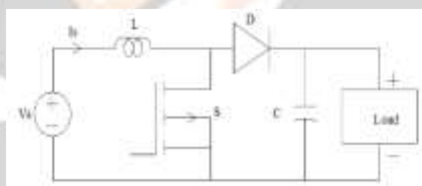

Figure 4.2: Boost Converter

Figure 4.3: Switching Control in Converter

In put into practice, a reasonably large current in the order of 1-2A can be required to charge the gate capacitance at turn ON to ensure that switching times are small. Due to gate leakage current, Nano-amps are required to hold the gate voltage once the device is ON. A negative voltage is often useful at turn OFF to let go the gate for speedy switch OFF. It is apparent that faster switching speeds can be obtained with well-designed gate driver circuits.

4.1 Features of Power MOSFET

Power MOSFET has lower switching losses but its on-resistance and conveyance losses are more. MOSFET is a voltage-restricted device. MOSFET has Positive temperature equivalent Process of MOSFET easy. If a MOSFET shares amplified current co-efficient for resistance. This makes primarily, it heats up faster its resistance increases and this increased resistance causes this current to modify to other devices in parallel.

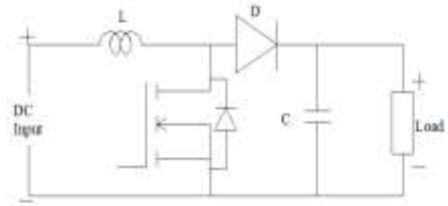

Figure 4.4: Boost Converter Based Switching

In MOSFET secondary break down does not happen, because it has positive temperature co-efficient. Power MOSFETS in higher voltage ratings have more conduction losses.

5. MAXIMUM POWER POINT TRACKING

A typical solar panel converts only 30 to 40 percent of the occurrence solar irradiation into electrical energy. Maximum power point tracking method is used to develop the efficiency of the solar panel. According to Maximum Power Transfer theorem, the power output of a circuit is highest when the Thevenin impedance of the circuit (source impedance) equals with the load impedance. Hence our problem of tracking the maximum power point reduces to an impedance identical problem. In the source side we are using a boost convertor linked to a solar panel in order to develop the output voltage so that it can be used for dissimilar applications like motor load. By changing the duty cycle of the boost converter aptly we can equal the source impedance with that of the load impedance.

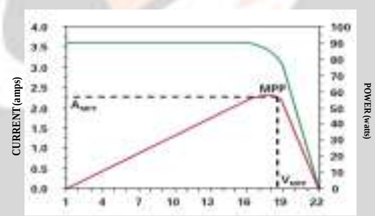

Figure 5.1: MPPT Efficiency Curve

5.1 Flow Chart

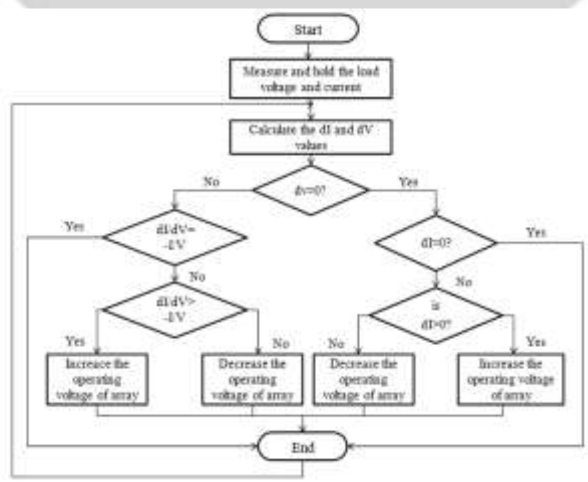

Figure 5.2: MPPT Flow Chart

This algorithm has remuneration over perturb and observe in that it can determine when the MPPT has reached the MPP, whereas perturb and observe oscillates around the MPP. Also, incremental conductance can trail rapidly increasing and decreasing irradiance conditions with higher exactness than perturb and observe. One snag of this algorithm is the increased difficulty when compared to perturb and observe.

5.1.1 Perturb and Observe Algorithm

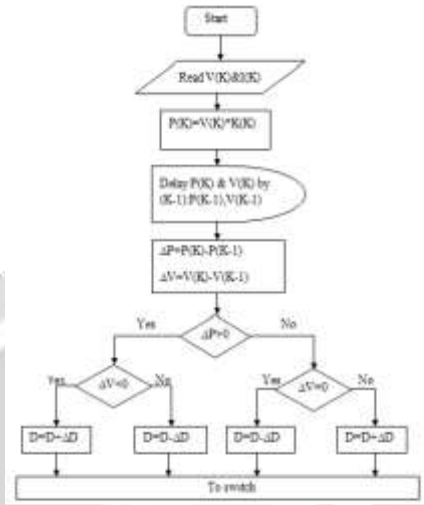

Figure 5.3: Perturb and Observe Flow Chart

6. CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

The Photovoltaic systems are present a better solution to the main issue of environment i.e., electrical power demand. To meet this power demand, many efficiency augmentation mechanisms of PV systems are obtained. Among these mechanisms, the Maximum Power Point Tracking is most trustworthy and it is best apt for PV system. The use of DC-DC converter in among the grid and PV module can bring efficiency optimization. This paper gives the existing MPPT mechanisms for power efficiency improvement.

6.2 FUTURE SCOPE

Development to this project can be made by tracking the maximum power point in varying environmental conditions. Environmental change can be change in solar irradiation or modify in ambient temperature or even both. This can be done by using Simulink models to bring out MPPT as an alternative of writing it code in embedded MATLAB functions. In the Simulink models the solar irradiation and the temperature can be put as erratic inputs in its place of constant values.

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