Grid Connected PV System Using Single Phase, Single-Stage Current Source Inverter

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ABSTRACT

In this paper, a single phase current photovoltaic source for inverter-based for grid connection grid is proposed. The high power point is maintained by the Perturb & Observe Method, which is as simple as the operating concept. To connect the PV system with a transformer grid is required. Completing the transformer to make the system simpler and easier the high value inductor is mandatory. To improve power quality, system efficiency and reduce inductor size double compatible double filter is recommended. This also eliminates the harmonics of the second and fourth order side of the inverter dc. The current-based switching method of the current source converter network is proposed to make the dc-link inductor a magnet by shortening one leg switching bridge after the entire active switch cycle.

Key words- Photovoltaic (PV), Maximum Power Point Tracking (MPPT)

1. INTRODUCTION

Based on semiconductor technology, the basic principle of solar cells is given, that electricity will flow between two semiconductors when they are connected to each other and exposed to light (photons). This condition, known as photovoltaic technology Photovoltaic (PV) technology converts one form of energy (sunlight) into another form of energy (electricity) that does not use moving parts, does not consume ordinary fuels, creates pollution, and lasts for decades. The use of a widely available and reasonably reliable oil source, SUN.

1.1 PHOTOVOLTAIC CELL

PV cells are basically a semiconductor diode. The term photovoltaic is derived from the effect of photovoltaic. This semiconductor diode creates a p-n junction exposed to light. When illuminated by sunlight it produces electrical energy. PV cell is made of various semiconductor materials. Such as micro-crystalline, mono-crystalline silicon, poly-crystalline silicon, amorphous silicon, cadmium telluride and copper indium gallium selenide / sulfide. But mono-crystalline silicon and poly-crystalline silicon are mainly used for commercial purposes. The electromagnetic effect can be defined as the occurrence in which an electron is released from a conductor band as a result of the absorption of sunlight of a certain length of matter (solid or non-metallic solids, liquids or gases). A photovoltaic cell, whenever the sun's light strikes, a portion of the sun's energy is absorbed into the semiconductor material. When the absorbed power is greater than the band gap of the semiconductor, the electron from the valence band jumps towards the conductor band. For this, pairs of hole-electrons are created in the illuminated area of the semiconductor. So the electrons created in the conductor band are now free to move. So these free electrons are forced to move in a certain direction by the action of the electric field present in the PV cells. These flowing electrons emit current and can be attracted to proper use by attaching a metal plate to the top and bottom of a PV cell. This current and voltage (created due to its built-in electrical outlets) produce the required power. Figure 1 shows the structure of the indoor photovoltaic cell.

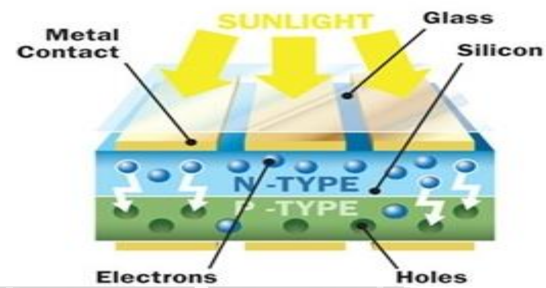

Fig. 1 Photovoltaic Cell Structure

1.2 CHARACTERISTICS OF A PV CELL

Photovoltaic Characteristics is a very important parameter. Demonstrates the functionality of the Photovoltaic Module. Parameters include Irradiance, Open Circuit Voltage (Ioc), Short Circuit Current (Isc), Maximum Voltage (VMPP), Maximum Current (IMPP), Power, Maximum System Voltage, Tolerance etc. These are the electrical parameters and are considered under standard Status Test (STC). Typical Testing Conditions (STC) are considered to have 1000W / m2 irradiance, spectrum AM 1.5 and a cell temperature of 25 ° C.

There are also Mechanical Parameters including Weight, Cell layout, Junction Box (size), Back side Cover Front Cover (Glass), Encapsulate Material (Ethylene vinyl acetate- EVA) size etc.

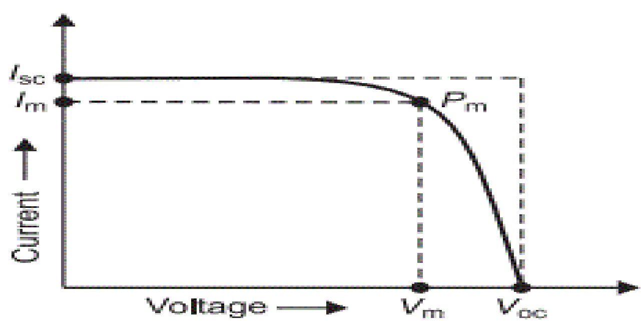

Fig. 2 P-V Characteristics of PV Cell

1.3 PHOTOVOLTAIC EFFECT

The result is that light energy is converted into electrical energy on certain semiconductor objects known as photovoltaic effect. This directly converts light energy into electricity without a central process. To understand the effect of photovoltaic let's consider a silicon crystal block. The upper part of the block is lined with donor dirt and the lower part is lined with acceptance or dirt. As a result the interaction of free electrons is much higher in the n-zone compared to the p-zone region and the concentration of the hole is much higher in the p-type region compared to the n-block region. There will be a high focus gradient for charging carriers across the block assembly line. Free electrons from the n-zone try to propagate in the p-type area and the pits in the p-type area try to propagate in the n-n-crystal area. This is because charging carriers naturally tend to vary from high focus area to low focus area. Each of the free electrons of the n-zone when it reaches the p-type space due to dispersion, leaves a positive donor ion behind it in the n-n zone. This is because each free electron in the n-zone is given one atom of a neutral donor. Similarly when a hole is distributed from a p-type to an n-type, it leaves a negative reception or ion behind it in the p-type area.

2. *INVERTER*

2.1 VOLTAGE SOURCE INVERTER (VSI)

The inverter where the input voltage remains unchanged is called the Voltage Source Inverter.Fig.3 and 4 show schematic diagrams of one phase and three phase voltage sources respectively. These topology require only one dc source and outbound power applications between selected IGBT devices. EDC and VS is a dc input supply and a large dc link capacitor (CDC) is installed in all supply areas. Capacitors and switches connected to the dc bus using short cables to reduce the inductance lost between the capacitor and the inverter switch. Needless to say, the physical composition of the right and wrong bus lines is also important to limit the missing inductances. S1, S2, S3 etc. fast and controllable switches. D1, D2, D3 etc. instant recovery diodes are connected to anti-parallel switches. 'A', 'B' and 'C' outlet terminals of the inverter are connected to an ac. The three-phase inverter has three loading terminals and a single phase inverter has only one pair of loading terminals.

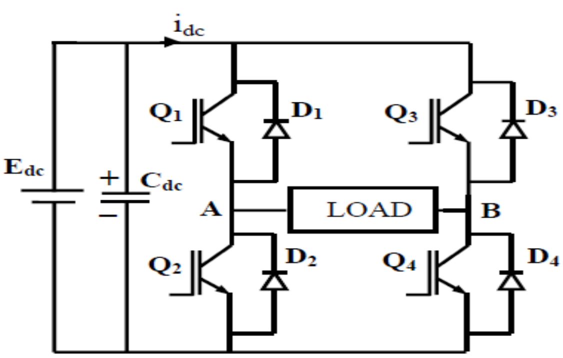

Fig. 3 Single Phase Voltage Source Inverter

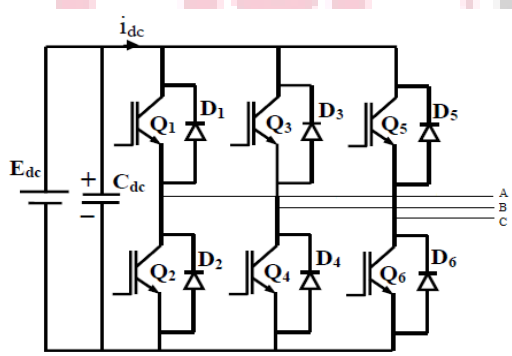

Fig. 4 Three Phase Voltage Source Inverter

2.2 CURRENT SOURCE INVERTER (CSI)

The inverter where the inverter remains unchanged is called the Current Source Converter. In other words input acts as the current source. The output current is always maintained regardless of the load on the inverter and the output voltage is forced to change. Figures 5 and 6 show a single phase and a Current Source Inverter configuration with three phases respectively.

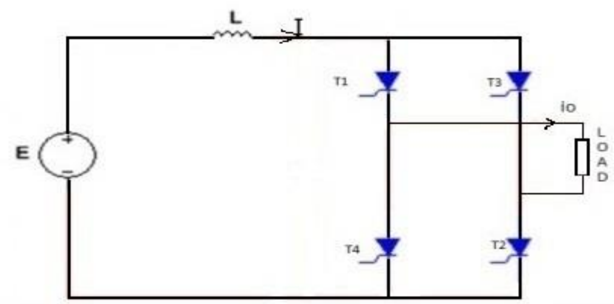

Fig. 5 Single Phase Current Source Inverter

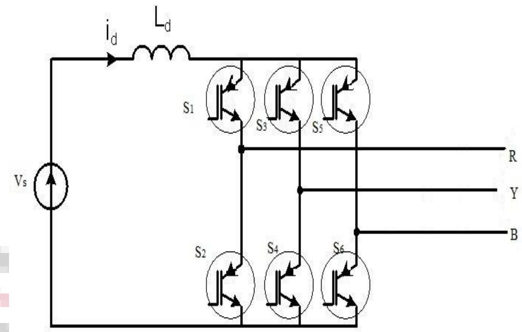

Fig. 6 Three Phase Current Source Inverter

2. DOUBLE TUNED RESONANT FILTER

In one phase of the Current Source Inverter (CSI), the output is not pure sinusoidal. Pulsating. It even produces harmonics in the current dc-link. These even harmonics have two major effects. One is on the ac side as the unusual harmonics of low order in current and voltage. Secondly even these harmonics affect the Maximum Power Point Tracker (MPPT) on the PV side. This may shorten Photovoltaic (PV) life. To reduce the effect of these dc-side harmonics on the ac side and on the PV. There are two proposed solutions.

One is to use a large amount of inductance to be used. These large value inductances are able to reduce the current dc-link ripple produced by these harmonics. Here we used an inductor with a value of 300mH. But in reality this in inductance of large value is not possible. Because it adds cost, size, weight and it can also be a loss. Another major effect is the slow response of MPPT. To overcome this, a second solution might be helpful.

Second In order to reduce the amount of large inductor, a dual compatible resonant filter is introduced. This is a Double Tuned Resonant Filter, usually set in a series with a low value mound. This filter is able to smooth the current dc-link through a small inductor. Even if the effect of second-order harmonic is important to the current dc-link, the harmonic of the fourth order can also affect the current dc-link, especially if the Current Source Inverter (CSI) works with high modulation indicators. The Basic Double Tuned Resonant Filter is shown in Figure 7.

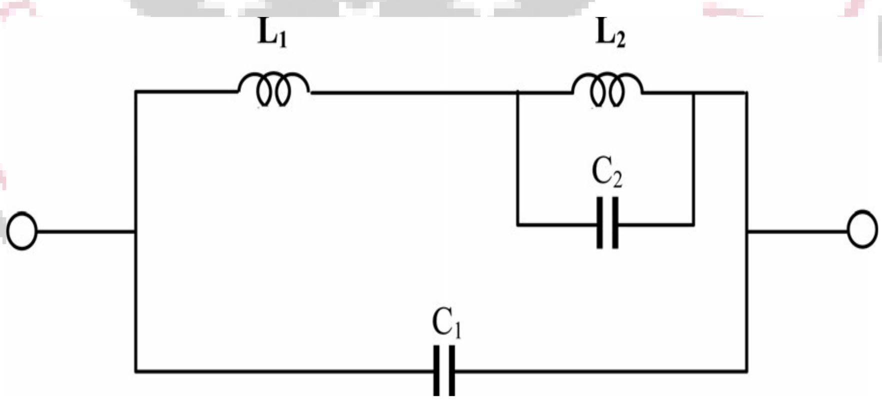

Fig. 7 Double Tuned Resonant Filter

3. RESULTS

4.1 WITHOUT USE OF DOUBLE TUNED RESONANT FILTER

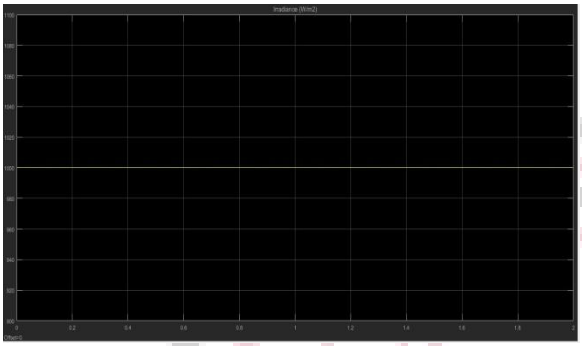

Fig. 8 Irradiance

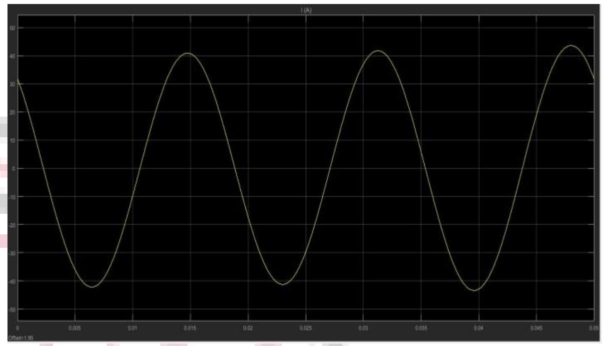

Fig. 9 Grid Current

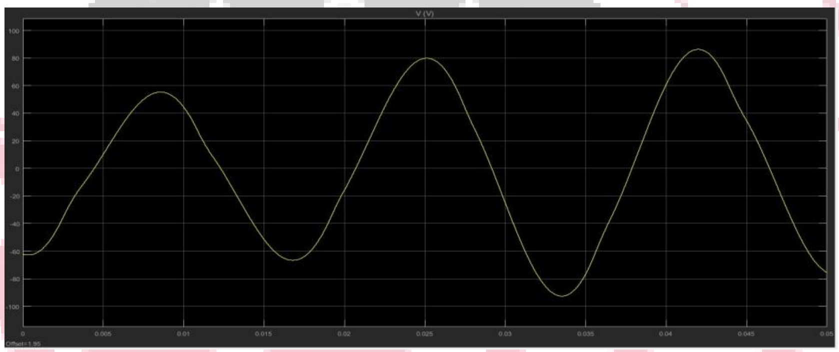

Fig. 10 Grid Voltage

3.2 WITH USE OF DOUBLE TUNED RESONANT FILTER

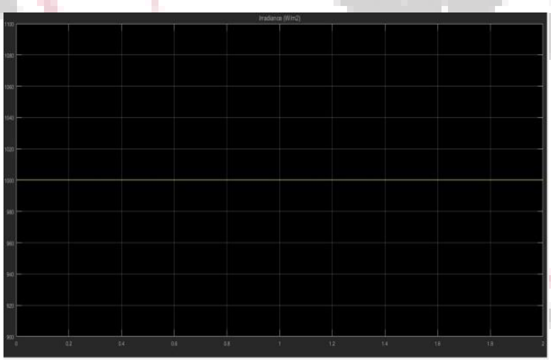

Fig. 11 Irradiance

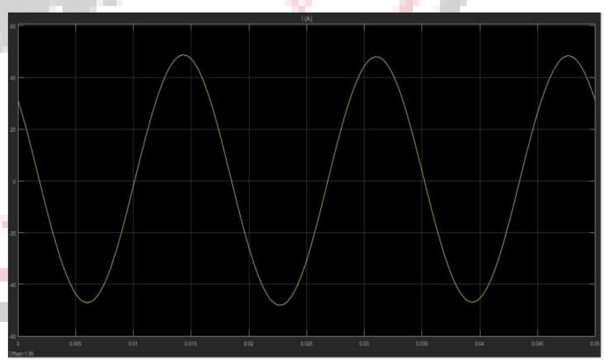

Fig. 12 Grid Current

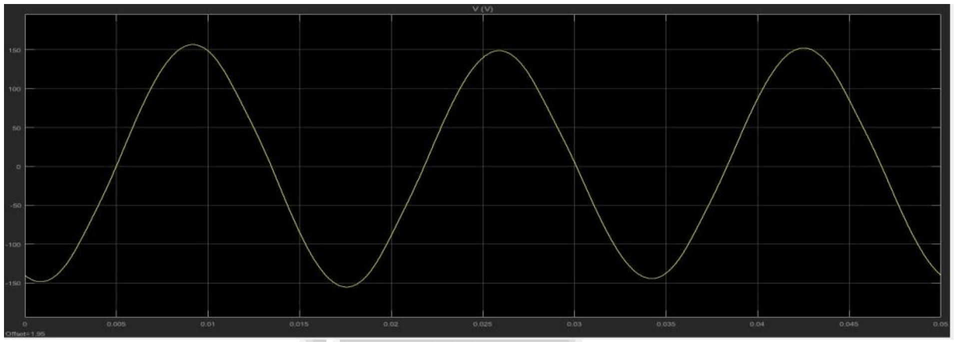

Fig. 13 Grid Voltage

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