

# Modelling of Grid Connected PV System Using Multilevel Inverter

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**Abstract** – Multilevel inverters are one amongst the preferred solutions for medium-voltage and high-power applications and have found successful industrial applications. The present techniques Five-level Active Neutral purpose Clamped inverter (5L-ANPC) is one amongst the most standard topologies among five-level inverters. A Six-Switch 5L-ANPC (6S-5L-ANPC) topology is employed for improvement of leakage current. Leakage current is that the current that flows through the protecting ground conductor to ground. within the absence of a grounding connection, it is the current that would be due any conductive part or the surface of non-conductive components to ground if a conductive path was offered (such as a human body). There are always extraneous currents flowing within the safety ground conductor. Within the planned analysis, we tend to planned PV with multilevel inverter used for the optimization of leakage current and power quality.

**Keywords:** Multilevel inverter, Flying-Capacitor (FC), PV, Microgrid

## I. Introduction

The need for cleaner surroundings and therefore the continuous increase in energy desires makes localized renewable energy production more and more necessary. This continuously-increasing energy consumption overloads the distribution grids additionally because the power stations, so having a negative impact on power convenience, security and quality [9]. One in all the solutions for overcoming this can be the Distributed Generation (DG) system. DG systems using renewable energy sources like solar, wind or hydro have the advantage that the power is made in close proximity to wherever it's consumed. This way the losses because of transmission lines are not present.

In the last decade solar power technologies became less costly and a lot of efficient, that have created it to an attractive resolution, being cleaner and a lot of environmentally friendly energy resource than traditional ones like fossil fuels, coal or nuclear. yet, a PV system continues to be way more expensive than traditional ones, because of the high producing prices of PV panels, however the energy that drives them –the light-weight from the sun- is free, out there nearly everywhere and can still be present for many years, long after all non-renewable energy sources are depleted.

One of the main benefits of PV technology is that it has no moving elements. Therefore, the hardware is extremely robust; it's an extended life and low maintenance necessities. And, most significantly, it's one resolution that provides environmentally friendly power generation [10]. Nowadays, PV panels are not only utilized in area applications, however they're present in everyday life: powering wrist watches, little calculators, supply loads in remote sites and, last however not least, they're connected to the public grid, generating the green power of the longer term. [11].

## II. PV (Photovoltaic)

The first typical photovoltaic cells were made within the late 1950s, and throughout the 1960s were in the main used to offer electrical power for earth-orbiting satellites. within the 1970s, enhancements in producing, performance and quality of PV modules helped to reduce prices and opened variety of opportunities for powering remote terrestrial applications, as well as battery charging for navigational aids, signals, telecommunications instrumentation and different crucial, low-power desires.

A typical silicon PV cell consists of a thin wafer consisting of AN ultra-thin layer of phosphorus-doped (N-type) silicon on high of a thicker layer of boron-doped (P-type) silicon. AN electrical field is made close to the highest surface of the cell wherever these 2 materials are in contact, known as the contact. Once daylight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, leading to a flow of current once the cell is connected to an electrical load. Despite size, a typical Si PV cell produces concerning 0.5 – 0.6 V DC under open-circuit, no-load conditions. This (and power) output of a PV cell depends on its efficiency and size (surface area), and is proportional to the intensity of daylight putting the surface of the cell. To Illustrate, under peak daylight conditions, a typical industrial PV cell with a area of 160 cm<sup>2</sup> (~25 in<sup>2</sup>) can produce concerning 2 watts peak power. If the daylight intensity were 40 % of peak, this cell would manufacture concerning 0.8 watts.

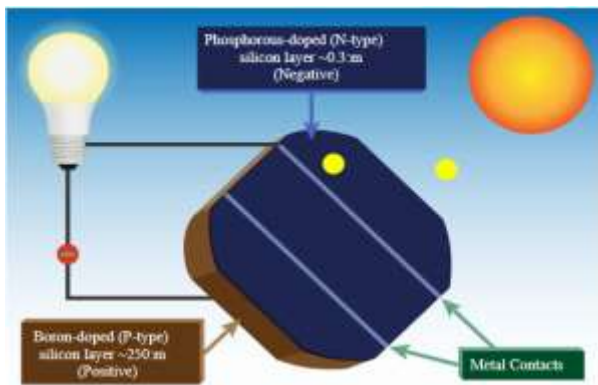


Fig.1 Diagram of a photovoltaic cell

### III. Proposed Methodology

#### III.1. MULTILEVEL INVERTER

Multilevel inverter has been attracting lot of attention in high power and high/medium power applications. It's easier resolution than running direct power lines for various voltages. The unique structure of multilevel inverter permits them to achieve high voltages with low harmonics while not use of transformers.

Classical multilevel inverter can be classified into three types:

- 1) Diode clamped inverter.
- 2) Flying capacitor inverter.
- 3) Cascaded H-bridge inverter

##### A. Diode Clamped Multilevel Converter

The first invention in multilevel converters was the so-called neutral purpose clamped inverter. It had been at the start planned as a 3 level inverter. It's been shown that the principle of diode clamping will extended to any level. A diode clamped leg circuit is shown in Figure 2.

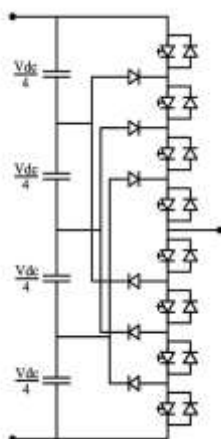


Fig.2 Diode clamped multilevel inverter

##### B. Flying Capacitor Multilevel Converter

As an alternate for the diode clamped inverter is that the capacitance clamped inverter planned by Meynard and Foch that shared several of the benefits. The structure of the capacitance clamped inverter is comparable thereto of the diode clamped converter. The most difference is that the

diodes used for the clamping are replaced by capacitors. A Flying capacitor device leg circuit is shown in Figure 3.

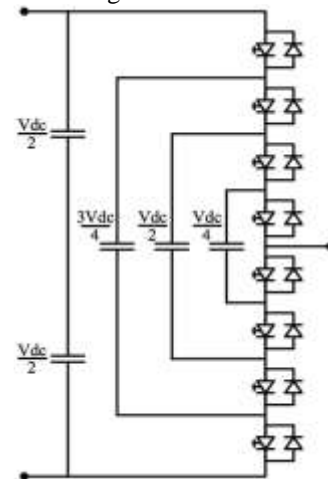


Fig.3 Flying capacitor multilevel inverter

##### C. Cascaded Multilevel Inverter

The CMLI produce a curved voltage from totally different sources of DC. The inverter relies on the full-bridge inverter (cell), that enables increase range of levels  $2m+1$  (where  $m$  is that the number of cells that build the inverter). This sort of inverter avoids the utilization of interlocking diodes, capacitors voltage equalization float additionally a low THD are often obtained by controlling the gate trigger of the various voltage levels.

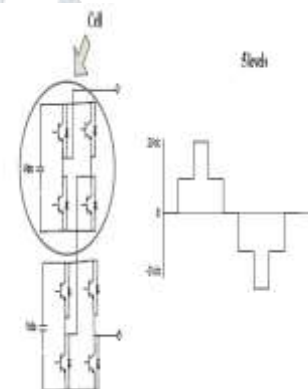


Fig.4 Symmetrical multilevel inverter

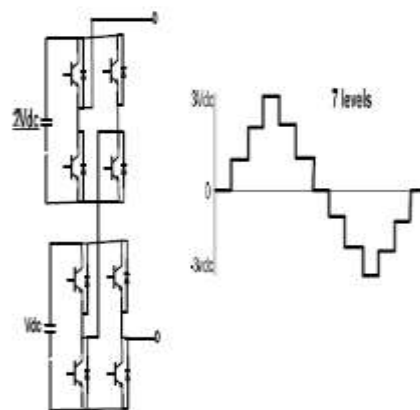


Fig.5 Asymmetrical multilevel inverter in binary configuration

#### III.2. Buck Boost Converters

It is a sort of DC to DC convertor and it's a magnitude of output voltage. it should be more or less than up to the input

voltage magnitude. The buck boost converter is up to the fly back circuit and single inductor is employed within the place of the transformer. There are 2 sorts of converters within the buck boost converter that is buck converter and also the different one is boost converter. These converters will turn out the vary of output voltage than the input voltage. The subsequent diagram shows the essential buck boost converter.

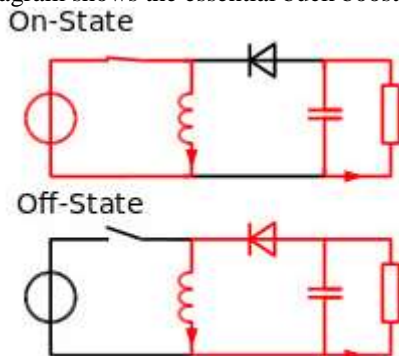


Fig.6 Buck Boost Converter

### IV. Simulation Results

Simulink provides a graphical editor, customizable block libraries, and solvers for modeling and simulating dynamic systems. It is integrated with MATLAB®, enabling you to incorporate MATLAB algorithms into models and export simulation results to MATLAB for further analysis.

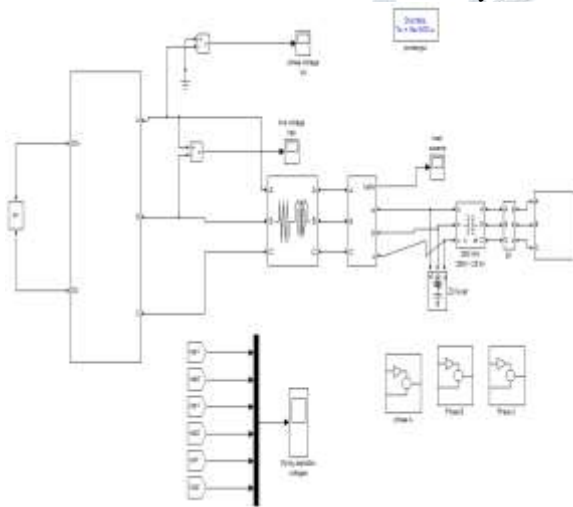


Fig.7 Proposed Model

Figure 7 shows the proposed model, to have analyzing and modeling of transformer less PV inverter systems regarding the leakage current.

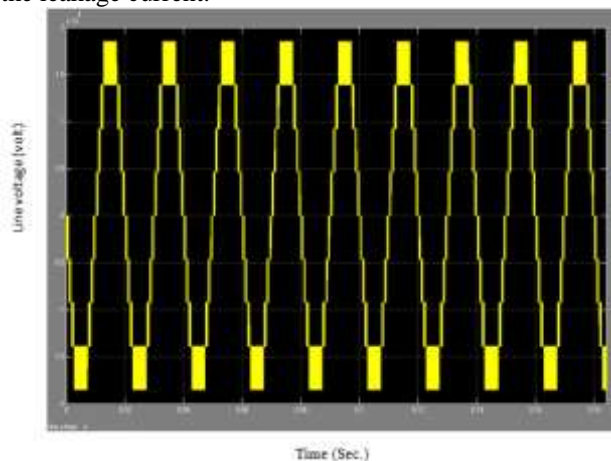


Fig.8 Line voltage vab  
Figure 8 shows line voltage. It shows Vab. In this figure x axis shows time and y axis shows line voltage.

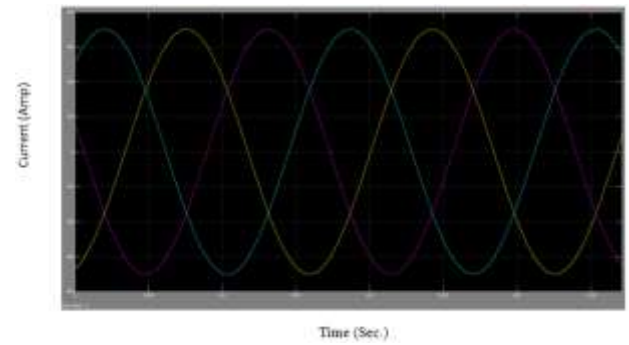


Fig. 9 Load current  
Figure 9 shows load current. In this figure x axis shows time and y axis shows load current.



Fig.10 Flying capacitor voltage  
Figure 10 shows flying capacitor voltage. In this figure x axis shows time and y axis capacitor voltage.

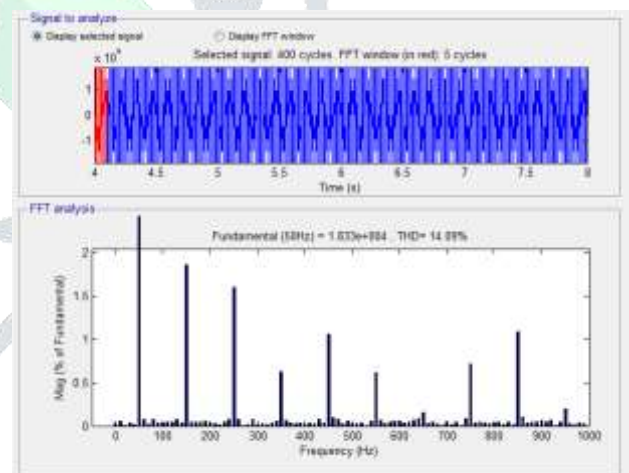


Fig.11 FFT Analysis

Figure 11 shows FFT Analysis. In this FFT analysis graph x axis shows frequency in hertz and y axis shows magnitude in percentage of fundamental. At the 50 Hz frequency the THD (Total harmonic distortion) value is 14.09%.

### V. Conclusion

The major task of this analysis was the investigation and verification of transformer less topologies and control methods that might minimize the leak current of PV inverter topologies so as to comply with the quality necessities and



build them safe for human interaction. During this analysis planned techniques PV with multilevel inverter using for optimization of the leakage current in transformer-less grid tie PV inverter. During this planned work the buck boost convertor is employed for offers higher output voltage. It's a sort of DC to DC convertor and it's a magnitude of output voltage. It's going to be more or less than capable the input voltage magnitude. As we know that a structure inverter is an electrical device that converts a DC power provides into an AC power provide. Multilevel inverter converts range of DC provides into AC provide. The DC supply will come from anywhere like solar energy or wind energy.

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