MODULAR MEDIUM-VOLTAGE GRID CONNECTION CONVERTER WITH IMPROVED SWITCHING TECHNIQUES FOR SOLAR PHOTOVOLTAIC SYSTEMS

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Abstract: The photovoltaic cells are used in solar systems which are designed in high-frequency components. As high-frequency components are run faster (frequency is inversely proportional to the time (fα1/t)). Solar photovoltaic made up of amorphous material amorphous materials are similar to metallic glasses are metallic materials that have a non-crystalline structure most amorphous metals are alloys rather than pure metals these materials have atoms of varying sizes in random arrangement in the solid they exhibit a high viscosity in molten form which prevents proper molecular alignment, giving them better resistance to plastic deformation. The magnetic-link which made by amorphous material common magnetic link can almost maintain identical voltages at the secondary terminals. The magnetic link which made up of magnetic but this magnetic material suffer from an effect of leakage reactance or leakage inductance. Leakage inductance is an inductance an inductive component present in a magnetic link results from the imperfect magnetic linking high voltage and low voltage sides. whatever magnetic flux that does not link the high voltage side to low voltage side acts as leakage inductance is the main challenging issue. In this consider, a new concept of identical modular magnetic links is proposed for high power transmission and isolation between high voltage side and low voltage side.

Index Terms—Loss estimation, modular magnetic link, modular medium-voltage converter, new modulation techniques, solar photovoltaic (PV) power plants.

I. INTRODUCTION

With the rapid development of large-scale solar photovoltaic cells(PV) plant. A photovoltaic power station also was known as a solar park, is massive photovoltaic s/s designed for the supply of merchant power.
The sun deports its energy to us in two primary forms: heat and light. There are two master types of solar power systems, videlicet, solar thermal systems that bunker heat to warm up water, and solar PV systems that convert sunlight directly into electricity as shown in +Figure 1.

Fig 1. The difference between solar thermal and solar PV systems

When the PV faculties are exposed to sunlight, they give direct current (“DC”) Electricity. An inverter then changes the DC into alternating current (“AC”) electricity, so that it can course into one of the building’s AC dispersion boards (“ACDB”) without impressing the quality of power supply. PV cell plant sometimes also referred as solar forms or solar ranches especially when sited in agricultural areas. The medium voltage PV converter which enables solar PV power systems to be connected directly to the medium & high voltage lines, without using heavy weight and large size line filters boosters and step up transforms has become realistic. Booster is the one which is steps up the voltage from its input to its output boosters were made in assorted configurations to suit different applications.

1.1. Types of Solar PV System

Solar PV systems can be separated based on the end-use covering of the technology.

There are two mainsail types of solar PV systems: grid-connected (or grid-tied) and off-grid (or standalone) solar PV systems.

1.2. Grid-attached solar PV systems

The principal application of solar PV in Singapore is grid-attached, as Singapore's main island is well brooded by the national power grid. About solar PV systems are installed on buildings or mounted on the ground if the land is not a restraint. For buildings, they are either climbed on the roof or integrated into the structure. The latter is also known as Building Integrated Photovoltaics ("BIPV"). With BIPV, the +PV module commonly displaces +another building factor, e.g., window glass or roof/wall cladding, +hereby attending to a+dual purpose and offsetting some costs. The configuration of a grid-connected solar PV system is shown in Figure 2.

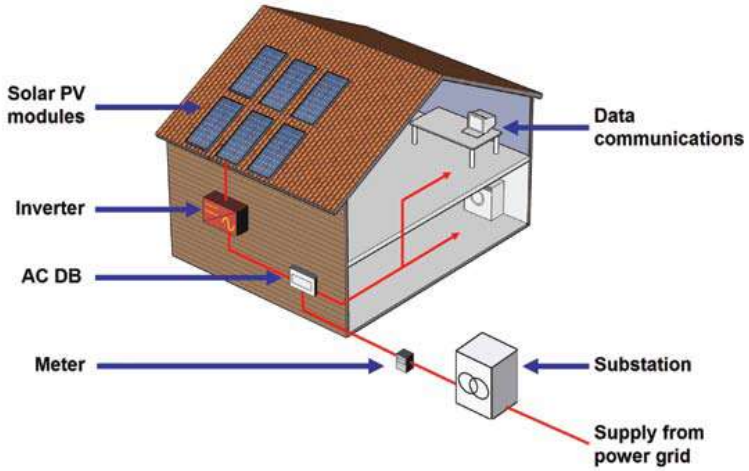

Fig: 2.A construction has two analog power supplies, one of the solar PV system and the early from the power grid.

The blended power supply courses all the loads affiliated to the primary ACDB.The proportion of solar PV supply to power grid issue motleyed counting on the sizing of the solar PV system. If the solar PV supply oversteps the buildings involve, excess +electricity will be spread into the grid. When there is no sunlight to give PV voltage at night, the power grid will supply all of the building's demand.

1.3. Off-power grid solar PV systems

Off-grid solar PV systems are relevant for areas less the power grid. Presently, such solar PV systems are commonly installed marooned sites where the power grid is far-off, such as rural areas or off-shore islands. But they may also be established within the city in positions where it is awkward or too costly to bug electricity from the power grid. An off-grid solar PV system demands deep cycle reversible batteries such as lead-acid, nickel-cadmium or lithium-ion batteries to depot electricity for use under conditions where there is petty or no output from the solar PV system, such as throughout the night, as shown in Figure 3 below.

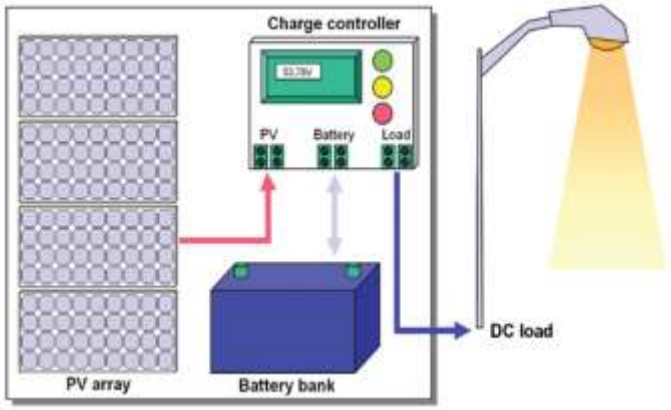

Figure.3. Off-grid solar PV system configuration

In this become known applications modular multilevel cascade converter circuit topology has gained considerable popularity due to its superior features the MMC (MODULAR MULTILEVEL CONVERTER) is built up by identical, but individually controllable sub-modules, therefore, the converter can act as a controllable voltage source, with a large number of available discrete voltage steps.

1.4. Solar PV Technology

his section affords an abbreviated description of the solar PV technology and the coarse xpert terms used.A solar PV is powered by many limpid or thin film PV modules. Single PV cells are coordinated to form a PV module. This accepts the form of a panel for gentle installation.

Fig: 4.Mono-Crystalline Silicon PV Cell

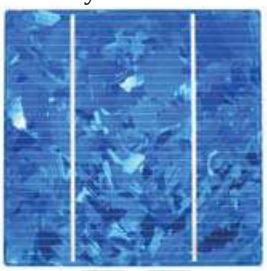

Fig: 5.Poly-Crystalline Silicon PV Cell

electrons to drive an electric current. There are two extensive families of technology used for PV cells, that is to say, crystalline silicon, which accounts for the majority of PV cell production; and thin film, which is newer and growing in quality Figure 6 illustrates some of these technologies

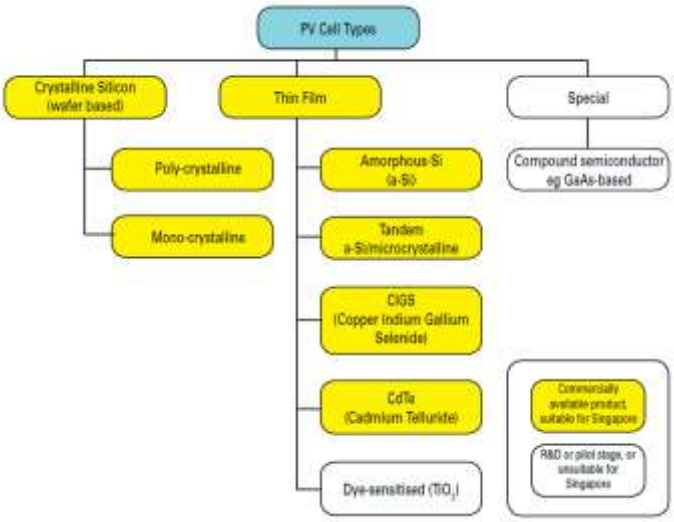

Fig .6. PV technology family tree

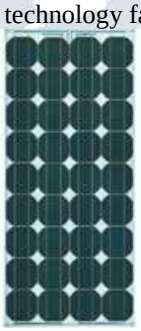

Fig: 7.Mono-crystalline CIGS thin film

Fig. 7 .Poly-crystalline

Fig: 8.Flexible amorphous thin film

CIGS thin film

Fig. 9. Common PV module technologies

A PV array comprises respective photovoltaic cells in series and parallel associations. Series connections are creditworthy for increasing the voltage of the module whereas the parallel a link is creditworthy for enhancing the current in the array. Generally, a solar cell can be patterned by a current source and an inverted diode connected in parallel to it. It has its series and parallel resistance. Series resistance is due to check in the way of the flow of electrons from n to p junction, and parallel resistance is imputable to the leakage current.

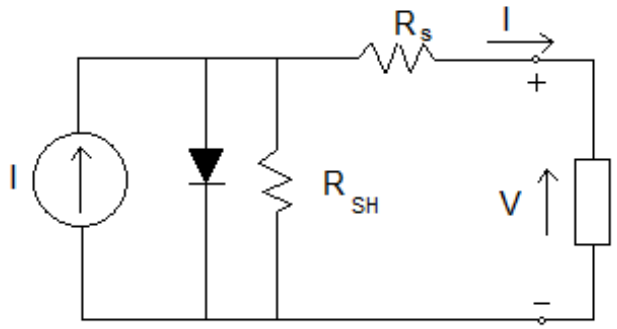

Fig. 10: Single diode model of a PV cell

The outturn current from the photovoltaic array is

$$I=Isc – Id$$

$$Id= Io (eqVd/kT - 1)$$

From above eq.

$$I = Isc – Io (eqVd/kT - 1)$$

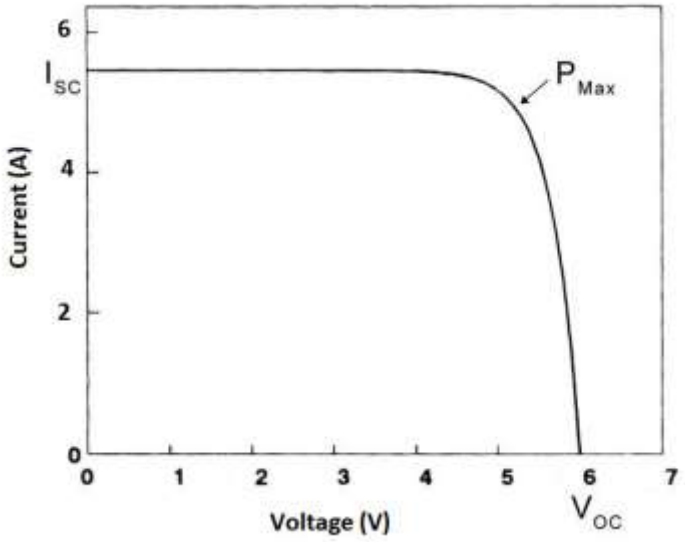

Fig.11. I-V characteristics of a solar panel

1.4.1 An overview of Maximum Power Point Tracking

A distinctive solar panel exchanges only 30 to 40 percent of the accidental solar irradiation into electrical energy. Maximum power point tracking proficiency is used to better the efficiency of +the solar panel. Allowing to Maximum Power Transfer theorem, the power yield of a circuit is maximum +when the Thevenin impedance of the circuit couples with the load impedance. Therefore our problem of tracking the maximum power point abridges to an impedance +matching problem. In the source side, we are employing a boost convertor associated to a solar panel to increase the output voltage so that it can be ill-used for unlike applications like a motor load. By converting the duty cycle of the boost converter suitably, we can match the source impedance with that of the load impedance.

1.4.2 .Different MPPT techniques

there are different techniques used to track the maximum power point. Few of the most popular techniques are:

1) Perturb and Observe (hill climbing method)
2) Incremental Conductance method
3) Fractional short circuit current
4) Fractional open circuit voltage
5) Neural networks
6) Fuzzy logic

II. LITERATURE

Photovoltaic energy has grown at an average annual rate of 60% in the last 5 years and has surpassed 1/3 of the cumulative wind energy installed capacity, and is quickly becoming an important part of the energy mix in some regions and power systems. This has been driven by a reduction of cost of PV modules. This growth has also triggered the evolution of classic PV power converters from conventional single phase grid-tied inverters to more complex topologies in order to increase efficiency, power extraction from the sun, reliability, while not impacting the cost. This paper presents an overview of the existing PV energy conversion systems, addressing the system configuration of different PV plants, and the PV converter topologies that have found practical applications for grid-connected systems.

III.PROPOSED PV-STORAGE SYSTEM ARCHITECTURE

The h-bridge modules of the MMC converter association with PV arrays may act as detached dc sources and extend a new route to design medium voltage multilevel converters. The leakage currents due to the establishment of stray capacitances between PV arrays. Stray capacitance is unintended, and unwanted capacitance in a circuit capacitance doesn't exist only within capacitors, in fact, any two surfaces at different electrical potential, and that are close enough together to generate an electric field have capacitance, and thus act as a capacitor.

High-frequency transformer the applications for high-frequency high voltage transformers are enhancing with new uses for alternative energy propagation such as wind turbines, for hybrid autos and a wide array of other industrial applications of high transportation frequency Transformers-based isolated dc/dc converters are commonly used in MMC PV inverters to avoid the leakage currents and safety issues.

A method to create multiple imbalanced sources for an asymmetrical multilevel converter from a single source for an asymmetric multilevel converter requires various imbalanced dc-supplies.

A method to create multiple imbalanced sources for an asymmetrical multilevel converter from a single source through a transformer was proposed where the dc power of the auxiliary faculties are only added through the transformer.

The dc power of the master module is supplied directly from the source without ensuring any electrical isolation electrical isolation is a method of corrosion control conductors are prone to corrosion from stray current that originates from dissimilar

metals electrical isolation is accomplished using a mechanical switch that isolates a part of a circuit from the primary electrical power system as and when required.

Several papers in the lit proposed the use of common dc-link to minimize the voltage imbalance problem, a medium voltage solar PV inverter with a common dc link was proposed. A high frequently common magnetic coupling as a replacement of common dc-link was introduced in to overcome the restriction of MPTT and complication of the PV converter operation.

The high frequency common magnetic link was used to generate multiple isolated & balanced power supplies from a single power supply a prototype is nothing but a basic network with specified cut off frequency from the other networks high frequency common magnetic link was effectively utilized with solar PV & wind energy conversion systems the design & implementation of high power high-frequency inverter is considered as a problem due to unavailability of required semiconductor devices. Common magnetic link as a replacement of common dc link may be overcome the voltage imbalance problem.

For high power high-pitched voltage applications the leakage inductance limits the power handling capacity leakage inductance is a transformer that consequences from the fallible magnetic linking of one winding to some other any magnetic flux that does not link the primary winding to the secondary winding behaves as an inductive impedance in series with the prime high-frequency transformers & thereby it is critical to design a high power system with a conventional magnetic link.

3.2. Some identical four winding high-frequency magnetic links used in parallel.

Pulse width modulation is modulation technique used to encode a message into a pulsing signal pulse width modulation is a technique that used to reduce the overall harmonic distortion in a load current it uses a pulse wave in a rectangular/square form that results in a variable average form. Bus clamping method PWM methods are used to reduce the switching loss of the inverter switching losses are the energy dissipated in each transition needs to be multiplied by the frequency to obtain the switching losses. The BC PWM methods reduce the harmonic distortion and pulsating torque in motor drives at high speeds. Third harmonic injected JDBC PWM techniques are proposed to improve the frequency spectra & reduce the converter switching losses to access the practical feasibility of the proposed new concepts the proposed new ideas eliminates the requirement of step-up-transformers to integrate solar PV systems into medium voltage grids the application of the transformer less compact lightweight, & environmentally friendly directly integration technology will substantially reduce installation and maintain cost & improve the system performance.

IV. RESULTS AND DISCUSSION

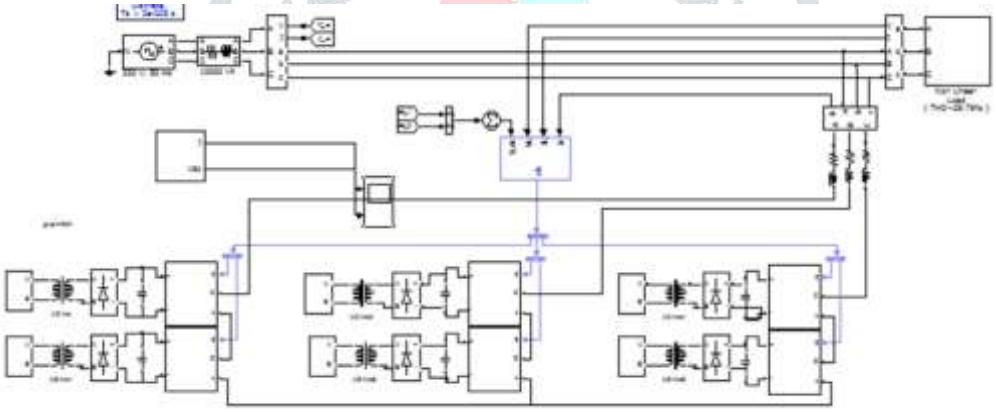

Fig:12. Proposed Simulation Diagram

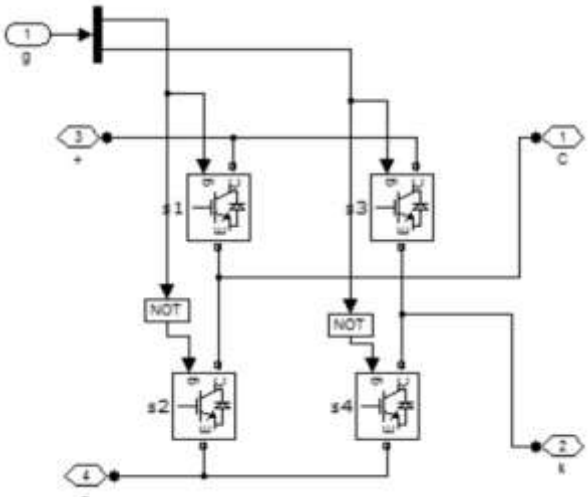

Fig:13. Proposed Converter Diagram

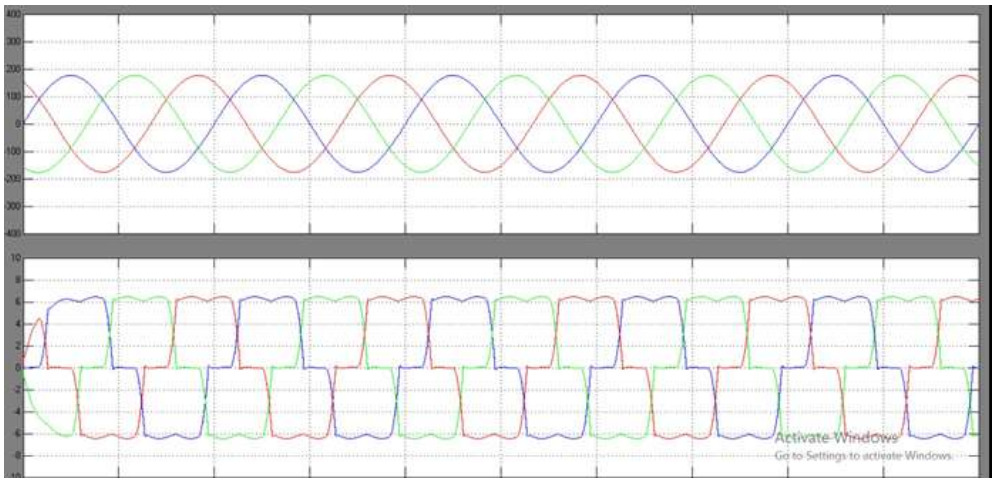

Fig:14. phase Voltages

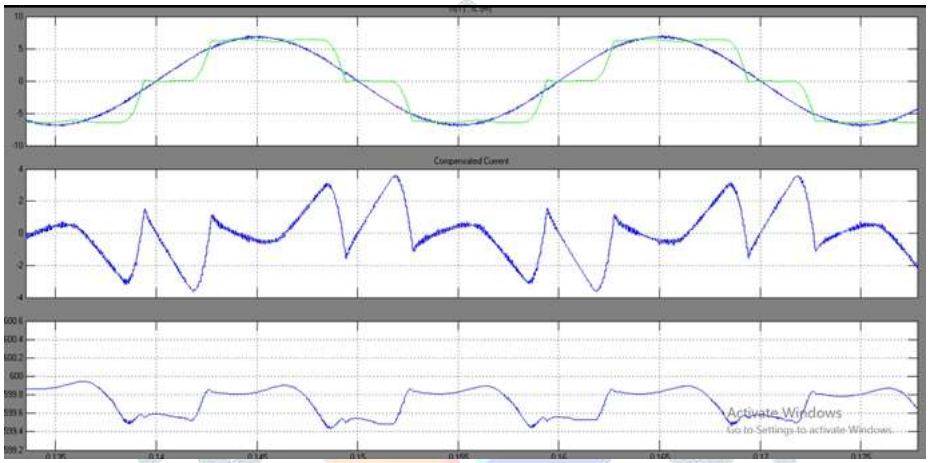

Fig:15. Load Current, Inductor Current and Load Voltage

V. CONCLUSION

A totally modular medium –voltage converter was proposed in this paper for solar pr power plants product identical four windings low-power magnetic cores as a permutation for the common high-power core were used, which ensured the system modularity and significantly lessened the core leakage inductances although the additional power conversion stage and high –frequency magnetic-links may add considerable losses to the system, still the overall performance was comparable with the traditional step-up transformer and line filter –based system. However, the line filter and step-up-transformer less grid integration enabled substantial savings in system cost this paper also introduced two new modulation schemes, i.e., THSDBCPWM and THTDBCPWM the proposed modulation schemes provided the lowest. THD and switching losses compared with the conventional systems. The proposed modulation connives can also be applicable for other converter circuits.

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