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Grid Interconnection of High Step up DC to AC Converter with Renewable Source Integration with Resonant Switched Capacitor

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ABSTRACT
In this paper a new high step up DC to AC converter is introduced with controlled with PWM technique. The output three phase AC voltage is interconnected to grid through LC filter. The converter is connected to low voltage renewable source like PVA or battery. The low voltage is stepped up to higher voltage using the proposed converter with coupled inductor and resonant switched capacitor. Because of the synchronous rectification Boost unit and multiple coupled-inductor-SC units the structure can therefore be easily extended for ultrahigh voltage gain. The power electronic switches are operated with soft switching with reduced voltage stress increasing the reliability of the converter. MOSFET power electronic switches are used to control the circuit output voltage with high switching frequency in the range of 100 kHz. This high switching frequency reduces the ripple in the DC voltage output reducing the harmonics in the AC voltage side of the converter. The AC voltage output of the converter is synchronized to the grid with feedback loop control using synchronous reference frame method. The complete modelling is carried out in MATLAB Simulink environment with discrete analysis of the circuit. The graphs are plotted with respect to time and are explained using GUI environment.

Keywords: Coupled-inductor, dc–dc converter, soft switching, switched-capacitor, PV Array, Micro Grid. SRF Controller MATLAB.

INTRODUCTION
VARIOUS low dc voltage sources and energy storage devices, such as photovoltaic (PV) cells, fuel cells, battery, and super capacitor, are usually need to be boosted to a high ac voltage level for industrial applications [1]. One solution is to use step-up multilevel inverters to convert them to a high ac voltage directly [2]. Another mean is to employ high step-up dc–dc converters to first boost them to a high dc level and then to connect with a full bridge. For high step-up dc-dc conversion, transformer-based switched-mode power supplies (SMPSs), such as Flyback and Forward converters, etc., are normally applied due to their simple structure. In recent years, many novel high step-up dc–dc converters have been developed by utilizing one or several of the following techniques: switched-capacitor (SC), also known as voltage-multiplier or charge pump, switched inductor, tapped inductor. Coupled inductor., high step-up zero-current switching (ZCS) converters implemented by resonant SC technique are presented in [4]–. A high stepup converter and a step-down version integrating buck/boost and SC techniques are presented in [8] and [9], respectively.

The proposes a high step-up converter based on switched-inductor structure. With the combination of SC and switched-inductor techniques, a series of single-stage SC inductor converters is introduced in Among these new techniques, the combination of coupled inductor and SC is most widely adapted for high voltage gain. Their common features are that the voltage conversion

ratio can be regulated in pulse width modulation (PWM) mode; less active switches and magnetic components are employed. For instance, only one active switch and one coupled inductors are employed in the converters of implement high voltage conversion ratio. In this thesis we will talk about two application of high advance up dc to ac converter they are ,(a) the displaying of grid associated PV frameworks, ,(b) dynamic model of the induction motor created utilizing Simulink/MATLAB that can be utilized to think about the transient conduct of a motor-drive. The goal of this work is to investigate the exhibition and dynamic conduct of grid associated PV frameworks, and drive application.

II DEVELOPMENT OF GRID INTERCONNECTION

2.1 INTRODUCTION

In this paper presents Modeling Simulation of grid associated Photovoltaic Energy System and execution study utilizing MATLAB/Simulink. The Photovoltaic energy framework is considered in three fundamental parts PV Model, Power modelling System and Grid interface. The Photovoltaic Model is between associated with grid through full scale control electronic gadgets. The recreation is directed on the PV energy framework at typical temperature and at steady burden by utilizing MATLAB.

The fundamental target of the section is the improvement of innovative learning, in light of Matlab/Simulink identified with grid associated control frameworks for energy creation by utilizing Renewable Energy Sources (RES), as spotless and productive hotspots for gathering both the earth prerequisites and the specialized necessities of the grid associated control inverters. subsequently, it is important to carry commitment to the advancement of certain innovations that permit the incorporation of RES in a power inverter with high energy quality and security. By utilizing these vivacious frameworks, the client isn't just a shopper, yet additionally a maker of energy. This reality will have an immediate effect from specialized, financial and social perspective, and it will add to the expanding of life quality.

The quantity of circulated age (DG) units, including both sustainable and non-renewable sources, for little rustic networks not associated with the grid and for little power assets (up to 1000 kW) associated with the utility system has developed. There has been an expansion in the quantity of sources that are common DC sources, for example power devices and photovoltaic clusters, or whose AC recurrence is either not steady or is a lot higher than the grid recurrence, for example smaller scale gas-turbines. These generators fundamentally require a DC/AC converter to be associated with the grid. Albeit a few generators can be associated straightforwardly to the electric power grid, for example, wind power driven no current induction generators, there is a pattern to embrace control hardware based interfaces which convert the power right off the bat to DC and afterward utilize an inverter to convey the ability to the 50Hz AC grid.

2.2MODELLING OF GRID

Photovoltaic frameworks were first utilized as remain solitary frameworks to give power to country zones where no different wellsprings of energy were available. The advances in the innovation and the worries about an unnatural weather change are empowering the two utilities and clients to grow the utilization of grid-associated PV frameworks. Be that as it may, the discontinuous idea of the yield intensity of these frameworks may force a few difficulties on the task of the electric system. The point of introducing grid associated photovoltaic frameworks can be utilized to examine the effects of these frameworks on the electric system.

A grid-associated photovoltaic power framework will decrease the power bill as it is conceivable to sell surplus power delivered to the nearby power provider. Grid associated PV frameworks are relatively simpler to introduce as they don't require a battery framework. Grid interconnection of photovoltaic (PV) control age frameworks has the benefit of successful use of produced control in light of the fact that there are no capacity misfortunes included.

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2.3 GRID INTERCONNECTION WITH HIGH STEP-UP DC TO AC CONVERTER

Power inverters are gadgets which can change over electrical energy of DC structure into that of AC. Inverters can come in a wide range of assortments, various parameters like value, control rating, effectiveness and applications. The DC/AC control inverter is ordinarily to take DC power provided by a sunlight based board (or) battery, for example, a 24 volt pva, and change it into a 200 watt AC power source working at 50 Hz, it has copies the power accessible at a normal family unit electrical application. The errands of Power inverters are utilized for day today life fuelling machines in Domestic applications. At the point when the inverter yield is unadulterated sinusoidal and its associated with the grid. In any case, to coordinate the recurrence, stage and abundancy of the grid and inverter yield. Inverter yield is relies on the PWM (Pulse Width Modulation) sign to the gating of the inverter switches. The PWM heartbeats are produced with the assistance of Arduino Atmel 328 controller. Hysteresis current controller is utilized to modify the inverter recurrence up to the grid recurrence. In this controller is actualized by just and it gives great unique reaction and great yield current guideline.

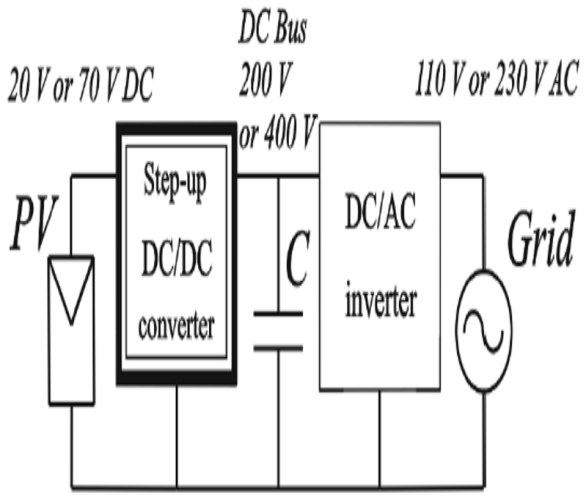

Fig 2.1: Grid Interconnection with high step up dc to ac converter.

2.4 CONCEPT OF SYNCHRONOUS REFRENCE FRAME THEORY

This method of reference current generation is developed in time domain. This theory is extensively used due to simplicity of calculations and uses only algebraic calculation. The three phase load current (iLa, iLb, iLc) are transformed into the two instantaneous active (iLd) and reactive (iLq) components in a rotating synchronous frame with the positive sequence of the system voltage. The basic working principle of SRF method uses a direct (d-q) and inverse (d-q) park transformation method, which allow the evaluation of a specific harmonic component of the input signals. The reference frame transformation is evaluated by converting a three-phase a-b-c stationery reference frame system to the synchronous reference frame system d-q-0 whose two-phase direct axis (d) and quadratic axis (q) component rotate in space at synchronous speed ωe , which is the angular electrical speed of the rotating magnetic field of the three phase supply given by ωe=2πf is the angular frequency of the supply. If the θ is the transformation angle, then the current transformation from a-b-c to d-q-0 frame is calculated as per formulae given below

$$[i_{Ldqo}] = [T][i_{Labc}] \qquad 3.1$$

$$\text{Where } T = \sqrt{\frac{2}{3}} \begin{bmatrix} \cos\theta & \cos\left(\theta - \frac{2\pi}{3}\right) & \cos\left(\theta + \frac{2\pi}{3}\right) \\ \sin\theta & \sin\left(\theta - \frac{2\pi}{3}\right) & \sin\left(\theta - \frac{2\pi}{3}\right) \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \qquad 3.2$$

we consider two axis namely d and q axis. q axis leads the d axis by 90 degrees. So, this becomes our reference frame (dq axis). Also, we consider that this reference frame is rotating synchronously same as that of system frequency. If we refer below the image, phasor is rotating at speed" w". The reference frame rotates with the same speed "w". Therefore, relative speed between the rotating phasor and the frame is Zero (0). Hence, we observe a dc quantity and can be resolved along the d and q axis. The benefit what we achieve here

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using SRF is we deal with dc quantities. For control applications, dc quantities are easily controllable without having steady state errors.

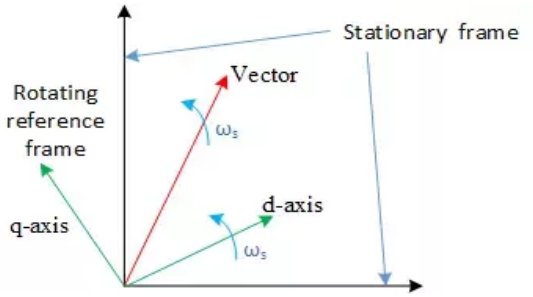

Fig 2.2: Reference frame.

III SIMULATION RESULTS & DISCUSSION

The complete design related to the project is created in Matlab & Simulation using Sim Power System Toolbox and. This designing is conducted in two stages:

1. To high step up dc to dc voltage using resonant switching capacitor coupled inductor and soft switching.
2. To grid interconnection with high step-up dc to ac converter.

1.1.1 3.1 SYSTEMPARAMETERS

PARAMETERS	VALUES
Irradiation	1000
Temperature constant	35°
Capacitance C1 and C2	100µf and 180µf
Ac voltage source	220V
Frequency	50HZ

The Proposed model of high step up dc to ac converter with grid load is shown in fig, no 3.1.It is a combination of resonant switching capacitor and magnetic coupling inductor three phase bridge level inverter. PWM generator SRF with PLL. It is very clear the from fig no. 3.2 when 120 dc voltages injected to resonant switching circuit then output voltage is generated 700 constant dc voltages. Again 700 constant dc voltage is converted from dc to ac through three level inverter and finally output power produced in a grid is approx.2200VA this active power is a shown in fig no. 3.5.

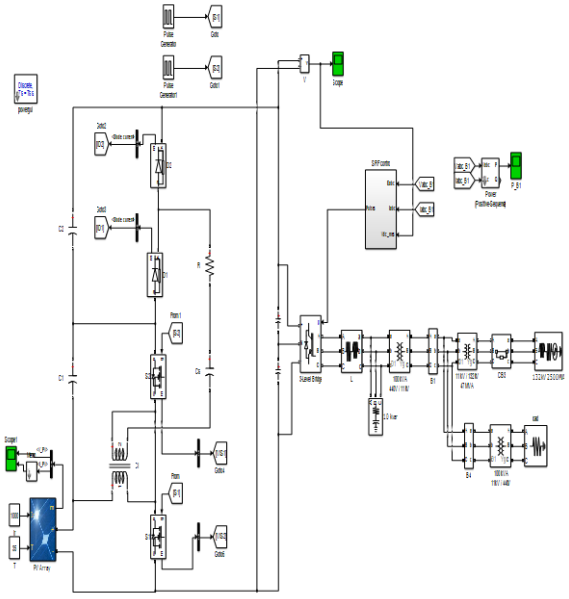

Fig 3.1: Grid interconnection of high step up dc to ac converter.

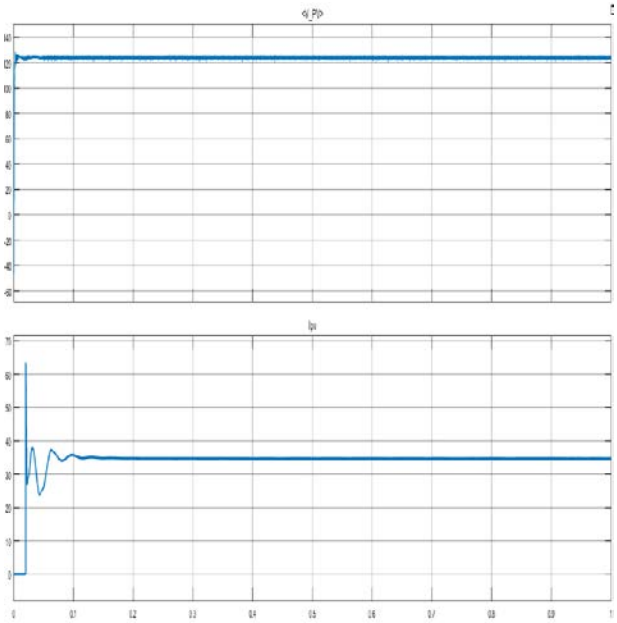

Fig 3.2: Voltage and current of photovoltaic array.

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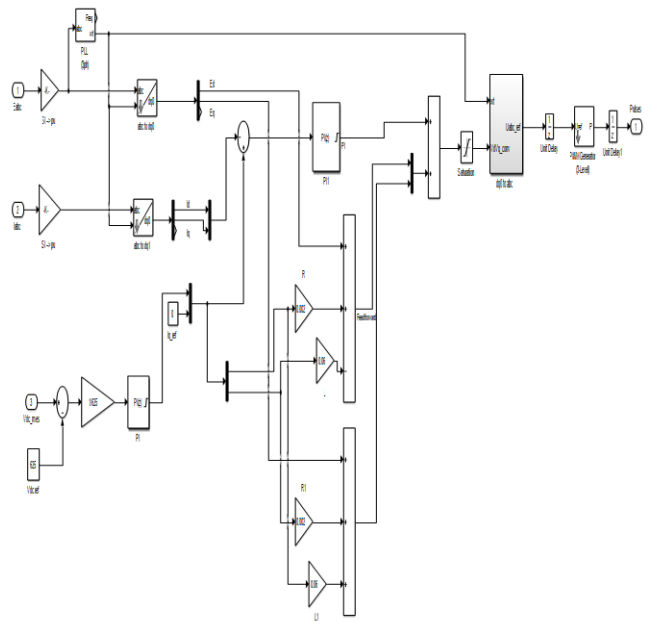

Fig 3.3: Control structure of synchronous reference frame with PLL.

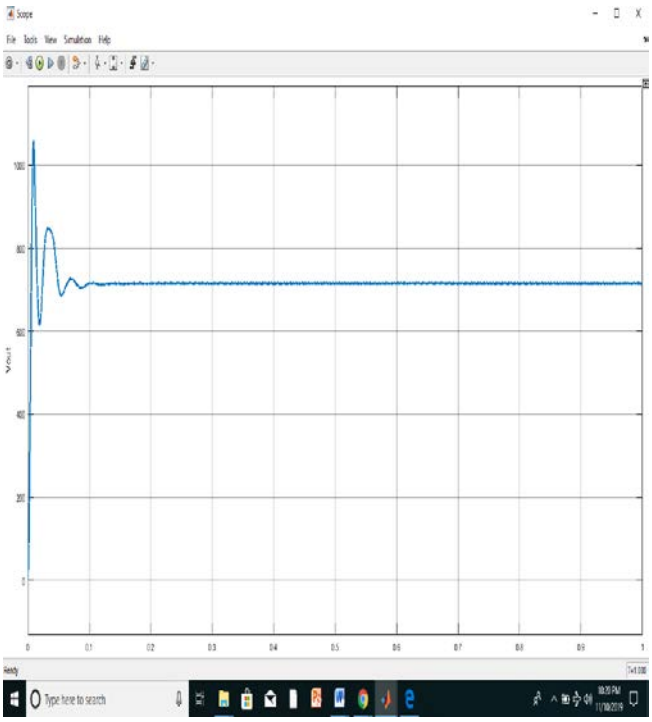

Fig 3.4: Output voltage of high step up DC-DC converter.

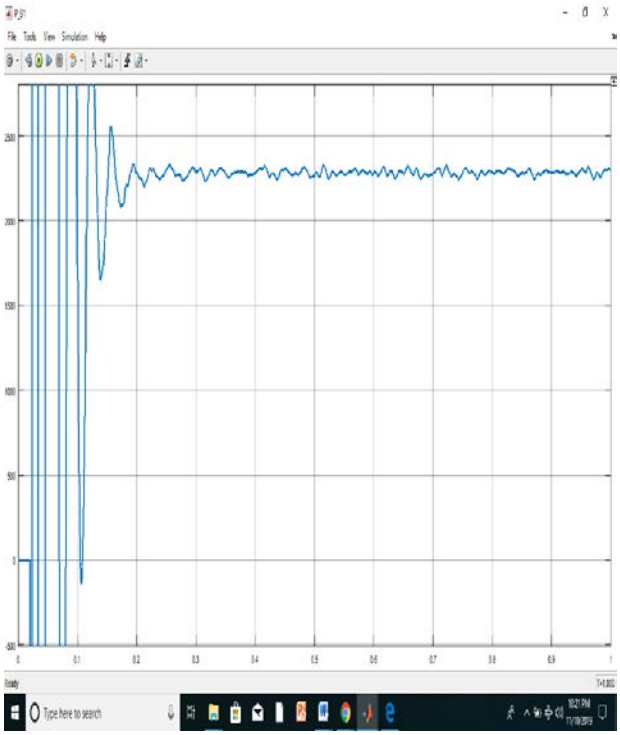

Fig 3.5: Output power of DC to AC inverter to grid.

IV CONCUSION

This paper presents a no isolated high step-up dc–dc power converter implemented by the combination of coupled-inductor and SC techniques for Grid application. The proposed converter can be extended for ultrahigh voltage gain by employing multiple CLSC units. The novel converter output voltage can be extended for Grid application. The drop inductance of the coupled inductor is utilized to get soft-switching of the diodes employed in the proposed converter. The voltage stress on the main switches is the same as that in the conventional boost converter with the same input voltage and duty ratio. In this converter used low-voltage-rated MOSFETs with small on-state resistance to improve the efficiency. In this converter high step-up pulse width modulation dc-dc converter combining both coupled-inductor and switched capacitor (SC) techniques is fed to a grid and the performance of the gird is analyzed by using MATLAB/SIMULINK R2016 software.

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