Common Ground Type Transformerless Inverters for Single Phase Solar Photo-voltaic Systems

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Abstract: It is the intention of a group of words that are multilevel inverters transformer less inverters for solar systems every one of the latest topologies was introduced based on the solar power systems principle and needs only four power switch and the unidirectional equipment (diode). One condenser and a tiny strainer at the final stage the main favor of the latest converter topologies was the minus pole of the solar power system is straightly attached to the grid and no discharge current. Reactive power damages the capacity The final AC voltage period is same to the starting DC-voltage a total detailing of the working principle with drone method, and examination imaginative comparisons are available to show the degree and quantification of the every topology in word to word form.

Index Terms—Transformer less inverter, flying capacitor, micro inverter, RB-IGBT inverters, photovoltaic system.

I. INTRODUCTION

The converters are used for the solar power systems. It is used for small power systems(upto 5km) by the using of electronics like diodes, and etc… the operating of the power systems is easy process and the price of the equipment is more but it is efficiently used. These type of controlling equipment's and the technological are very useful to the next generation people. In older days by the solar power the rare power producing is visible but in future the solar world will be designed by the latest version of equipment's. The solar systems is the most reliable in supply and the failure of grid is not very much possible it is the very hit view in the present and future global solar systems. The solar power systems can generate the DC supply so it is converted by using converters form dc supply to ac supply and step up the voltage level by the voltage regulator (T/F). by converting the power loss will be present and the core losses and iron losses are may weakens the efficiency and the power quantity so the voltage regulators are neglected in the converters or inverters the grid connected transformer less solar power systems

`Some days back there is a potent direction in the solar power system network to utilize voltage regulator less topologies in system to come two high ratio and less earth leakage current it is the low charge as tended to the equivalent to voltage regulator the different investigation to neglect the earth leakage current by the another technique in a transformer less electric converter removing the DC from AC side and/or fix the common mode voltage during the carefree duration the null state neglect topologies and group and the null state centre-point damped topologies in plus of the peak number of push button in the network path while the present state more the total on state resistance and therefore greater the total conductivity loss in the network the multi-level inverters is also used for decrease the earth leakage currents. Single earth type PV inverter can reliably decreases the earth current of the solar power system and has attracting a so much of interest from two academia and company it requires the six push buttons and a respective much large filter inductor. It is innovated by a charging capacitor, and it stores the charge when the first half cycle period and it is not able to charge in the another half cycle the output graphs and thus needs the condenser and the inductance then unfortunately gain the current tension in the push buttons the new common ground type core less inverter with only four push buttons category on a multilevel inverter concept the neutral of the network is straightly attached to the negative pole of the DC bus, which neglects the leakage current to increase the possibility of enlarging the circuit with same as concept and principle the double new common-ground type core less inverter are proposed in this paper.

To relative the basic inverter the four present push buttons are used which decreases the total on resistance of the push buttons in the current paths and eliminates the total conduction losses in separate to control the inverter the unipolar sinusoidal pulse width modulation is required which reduces the switching losses. In this paper section II is discuss about the principle of flying capacitor it is come by the addition of various switching devices and the flying capacitor.

1.1. SPACE VECTOR MODULATION

The space vector intonation technique is based on the reconstruction of the sampled reference voltage with the help of switching space vectors of a voltage source inverter in a sampling period. Each multilevel inverter has several changing states which generate Different voltage vectors and can be used to modulate the reference. In SVM, the +reference signal is generated from its closest signals. Some vectors have redundant +switching states, meaning that they can be made by more than one switching state this feature is used for the balance of capacitor voltages. Multilevel SVM must manage this behavior to optimize the search of the modulating vectors and apply an appropriate switching sequence.

1.2. SPACE VECTORS

The space vector modulation (SVM) is also described using symmetrical three-phase +Systems in the -ß reference frame. The three-phase reference voltages are represented as a single reference phasor with constant length and angular speed. It substitutes the demanded voltage space vectors by the nearest real voltage space +vectors in an appropriate combination in each sampling interval. The basic principles of the SVM is shown in Fig. 3.28 cuff [33] for the three-level inverter, which involves 27 different inverter switch states (= number of level)3 [33]. Using a three to two-dimensional Transformation, the desired output averaged over the switching period, and the inverter states are constituted as vectors. The visualization and calculation of +switching periods are then performed using simple vector math.

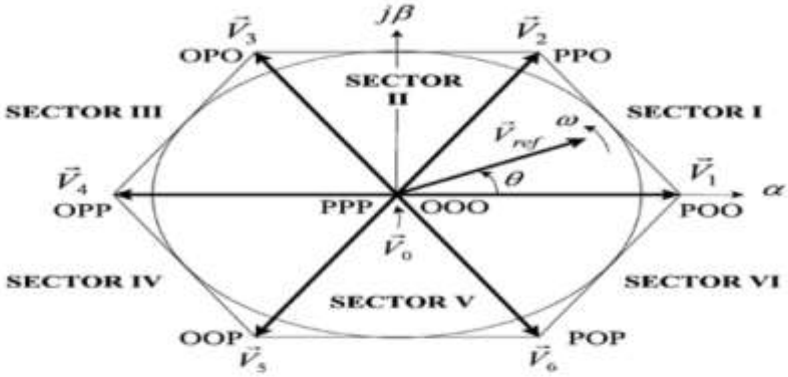

Fig:1.Space vector diagram for the two-level inverter

The voltage common to all three phases can be found at the neutral point of a balanced star connected load. It is known as the zero sequence component. By allowing the neutral point voltage to vary, one phase leg can be held continuously high or low for a 60-degree interval while the other two switch. The correct phase to phase waveforms is still formed. This has two significant advantages. Firstly, the inverter's full potential modulation depth can be used since the phase to phase voltages are maximized. Secondly, the switching losses are lowered, since the average switching frequency falls to two-thirds of its original value. If suitable zero sequence space vectors can be identified for multilevel inverters, the simplicity of multilevel modulator implementations using phase-shifted triangular carriers can be retained.

The SVM approach is perhaps the most powerful because it allows more freedom to control and optimize the switching patterns than any other modulation approach; at the same time, for inverters with a higher number of levels it becomes too cumbersome for real-time implementation.

Space Vector	Switching State (Three Phases)	On-State Switch	Vector Definition
$\vec{V_0}$	[PPP] [OOO]	S1, S3, S5 S4, S6, S2	$\vec{V_0} = 0$
$\vec{V_1}$	[POO]	S1, S6, S2	$\vec{V_1} = \frac{2}{3} V_d e^{j0}$
$\vec{V_2}$	[PPO]	S1, S3, S2	$\vec{V_2} = \frac{2}{3} V_d e^{j\frac{\pi}{3}}$
$\vec{V_3}$	[OPO]	S4, S3, S2	$\vec{V_3} = \frac{2}{3} V_d e^{j\frac{2\pi}{3}}$
$\vec{V_4}$	[OPP]	S4, S3, S5	$\vec{V_4} = \frac{2}{3} V_d e^{j\frac{3\pi}{3}}$
$\vec{V_5}$	[OOP]	S4, S6, S5	$\vec{V_5} = \frac{2}{3} V_d e^{j\frac{4\pi}{3}}$
$\vec{V_6}$	[POP]	S1, S6, S5	$\vec{V_6} = \frac{2}{3} V_d e^{j0\frac{5\pi}{3}}$

1.3. SWITCHING SEQUENCE

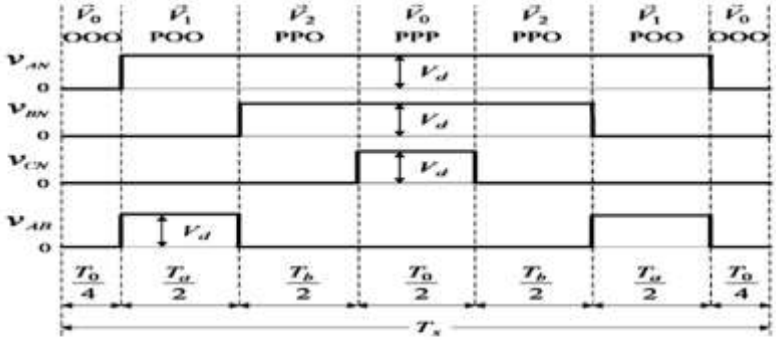

Fig.2.Seven-segment switching sequence for V_{ref} in sector I

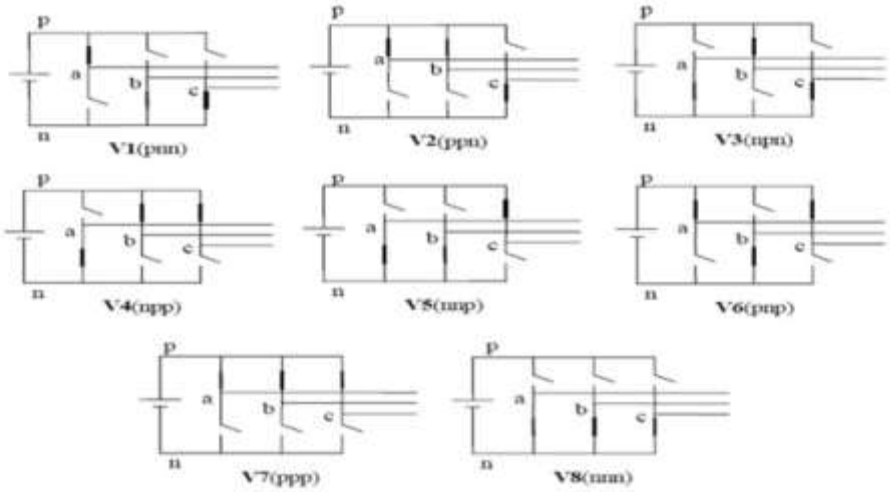

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Fig.3.Eight switching state topologies of a voltage source inverter

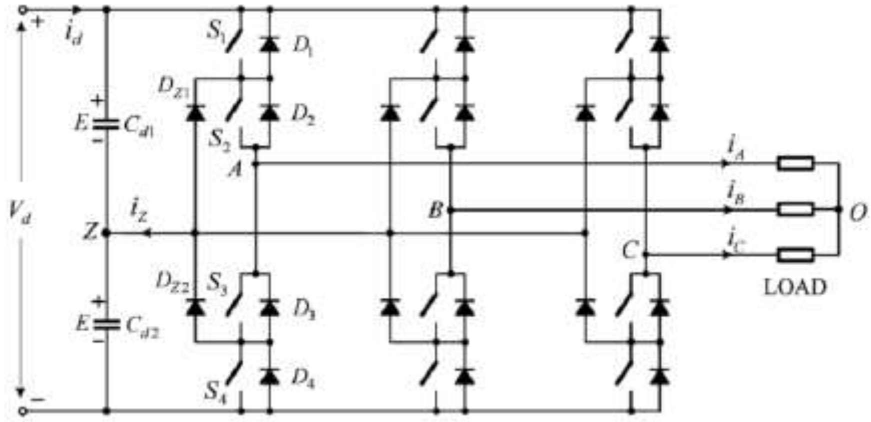

Fig.4.Three-level NPC inverter

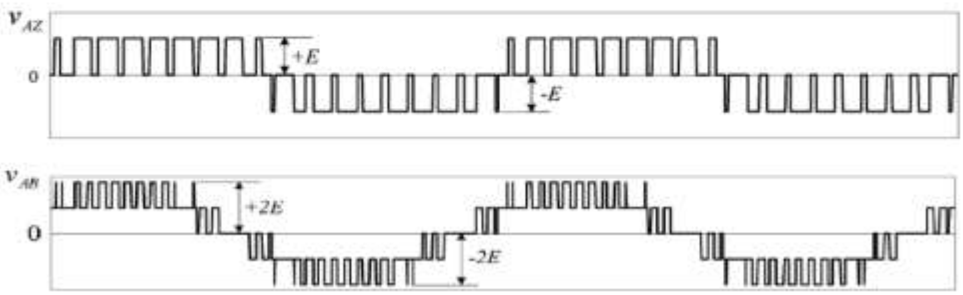

Fig.5.Output voltage waveforms of the NPC inverter

The line-to-line voltage waveform produced by the SVM inverter contains even order harmonics which can be eliminated by modified SVM scheme. As the switching sequence design is not unique for a given set of stationary vectors and dwells times, switching discontinuity can give discontinuous space vector modulation.

II.LITERATURE

School of Engineering, Macquarie University, NSW-2109, Australia, Department of Electrical and Computer Engineering, Miami University Oxford, OH 45056, USA It presents a new single-phase transformerless inverter providing common ground for grid- connected photovoltaic (PV) systems. It consists of 5 switches, one diode, one capacitor, one small inductor and a small filter at the output stage. A simple Unipolar Sinusoidal Pulse-Width Modulation (SPWM) technique is used to operate the proposed inverter to minimize losses, output current ripple, filter requirements and improve its electromagnetic compatibility (EMC). The proposed topology shares a common ground with the grid and a capacitor is utilized as a virtual DC bus to provide the negative power cycle of the inverter. The capacitor is charged Regardless of any switching cycle using a dedicated switch which can in turn reduce the size of capacitor in relation to the switching frequency.

When no transformer is used in a grid connected photovoltaic (PV) system, a galvanic connection between the grid and PV array exists. In these conditions, dangerous leakage currents (common-mode currents) can appear through the stray capacitance between the PV array and the ground. In order to avoid these leakage currents, different inverter topologies that generate no varying common-mode voltages, such as the half-bridge and the bipolar pulse width modulation (PWM)full-bridgetopologies

III. PROPOSED PV-STORAGE SYSTEM ARCHITECTURE

a) Principle of operation

The common ground type transformer less inverter is getting in this paper on the principle of a flying capacitor to create a negative supply voltage to the inverter during negative cycle changing and discharging process is established when the push button is ON state the flying capacitor is attached to the input voltage and takes supply up to the input supply is charged the input voltage is appears at the output side when the equal voltage magnitude to stable the constant voltage across the output side this process is continuously repeated.

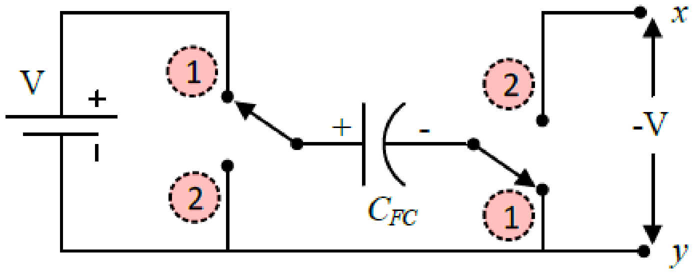

Fig.6. Illustration of the charging and discharging of the flying capacitor (*CFC*) to create a negative bus voltage in the inverter during the negative cycle.b) flying capacitor inverter topologies

The above concept is divided into the new inverter circuit using slightly present push buttons such as IGBI, MOSFET.at different positions the flying capacitor CFC are possible using the different combination or together of switches and diodes only three main topologies are introduced here it increases the output with sufficient input (efficiencies reliability in nature and more power produced the cost and weight of the system is low only check the system performance and safety requirements.

Type -1

Two push buttons are in series during the +ve cycle

It is come with the two switches in straight (series) during both positive and negative cycles. In this charging elements are switch “s1” and diode “D” s2 and s4 means they create the negative polarity the positive cycle is created by switch “s3” the negative cycle is created by s2 to reduce the overall losses we using standard unipolar

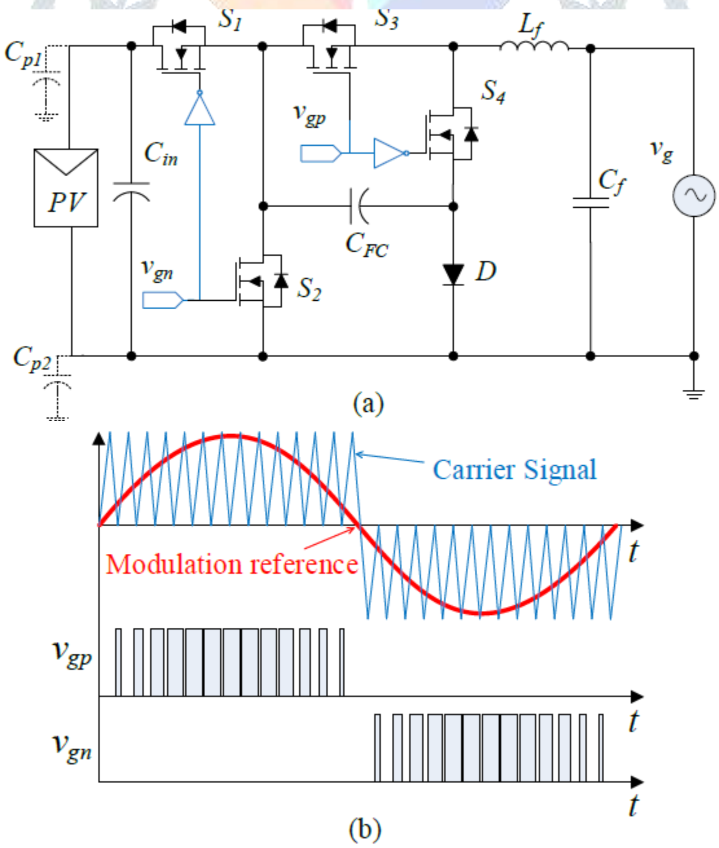

Fig7.Type-I flying capacitor transformerless grid-connected single-phase inverter topology with two switches in series during positive cycle

Type 2 Single switch in series during positive cycle

In the type1 the circuit element will be charged but in the type 2 they will discharge through the switch s2 here only one switch carries the load current during first half cycle the next half cycle remains constant the switches are modulated by each other the switch s1 and the diode "d" will be always charges the switch s3 create positive and the negative cycle are created by s2 by discharge through s4

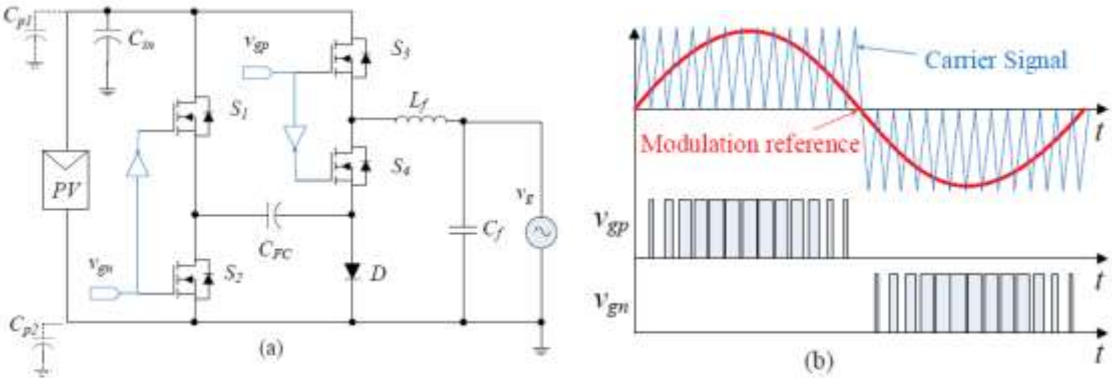

Fig. 8 Type-II flying capacitor transformerless grid-connected single-phase inverter topology with a single switch in series during the positive cycle.

Type 3 H-bridge type

As compared to the type 1 and type 2 topologies the diode of extra is neglected and the different mixing of switches and a flying capacitor positive and negative cycle are both carried through a single switch and the positive cycle is created by s4 and negative cycle is created by s2 the s1 switch is always give charge supply to the flying capacitor to charge flying capacitor positive and negative cycle are switching high frequency with the switches s1 and s4 the network can be analyzed from both common ground as well as positive terminals by using the MOSFET and IGBTS the configurations of the common ground and common positive is illustrated.

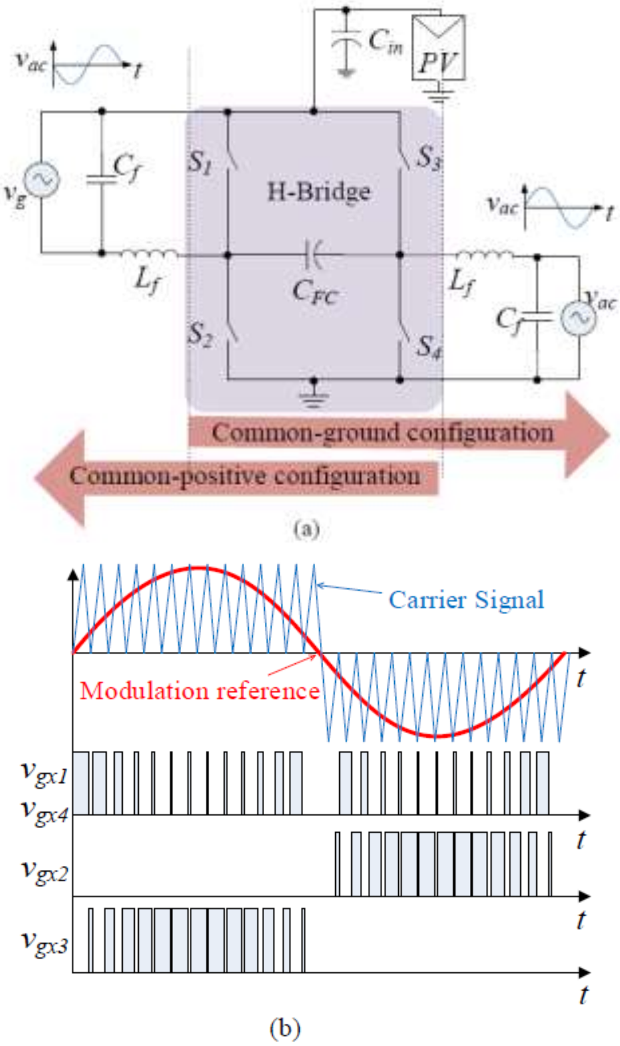

Fig.9 Type-III: H-bridge transformerless inverter (Siwakoti-H Inverter) (a) illustrating its configuration in both common positive and common ground configurations, and (b) unipolar SPWM modulation signal for the switches.

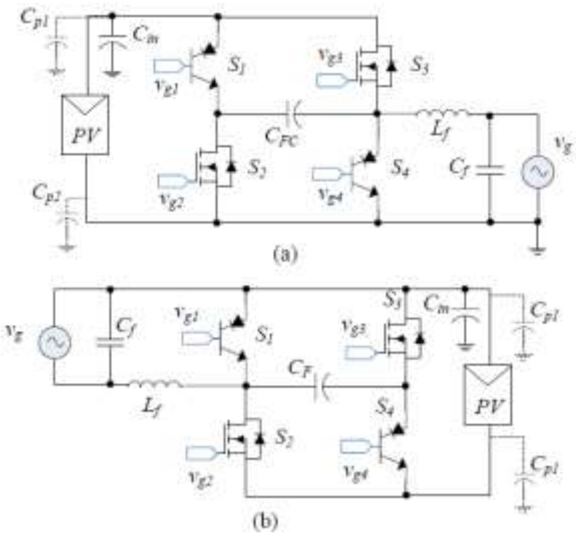

Fig.10. Realization of the H-bridge grid-connected single-phase transformerless inverter using RB-IGBT and MOSFET: (a) common negative bus configuration, and (b) common positive bus configuration.

B. comparison with different conventional topologies

Table-2 presents a detailed comparisons of several key futures of the proposed inverter with conventional transformer less inverter topologies. The no of active and passive components required to design the inverter, input voltage requirement, no of switching devices in the load current path, leakage current & output filter requirements are concisely shown here for comparison in addition the max efficiency claimed is also mentioned to leak the outstanding feature of the proposed inverter topology.

Noticeably, from table 2 we can see that proposed topologies uses the least active and passive components compared to the conventional topologies in addition, the voltage stress experienced by the switching operations. In the proposed inverter is uniform, and they are equal to the input dc-link voltage is requirement for 230v 1 ph applications is 400v unlink in case of NPC, active NPC & flying capacitor, which requires 800v & moreover, the calculated efficiency of the inverter beats 99% and reaches to 99.25% at a full load of 1kw, these features along with the possibility to improve two industry standard half bridge modules for better integration and cost reduction for mass production makes the proposed type 1 topology stand out for practical applications.

IV. RESULTS AND DISCUSSION

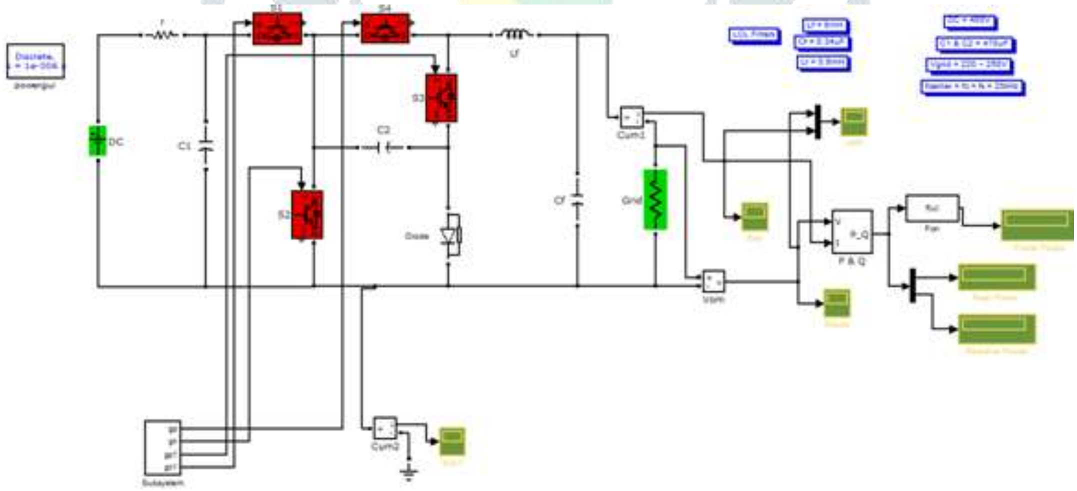

Fig.11. proposed system simulation model

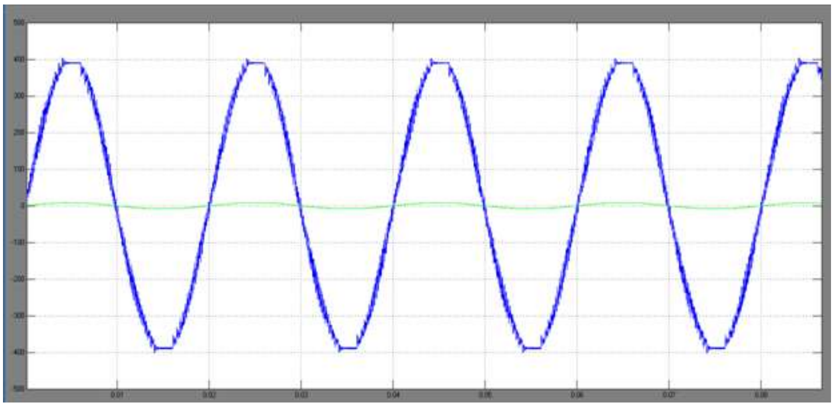

Fig.12. output voltage and current for type-1.

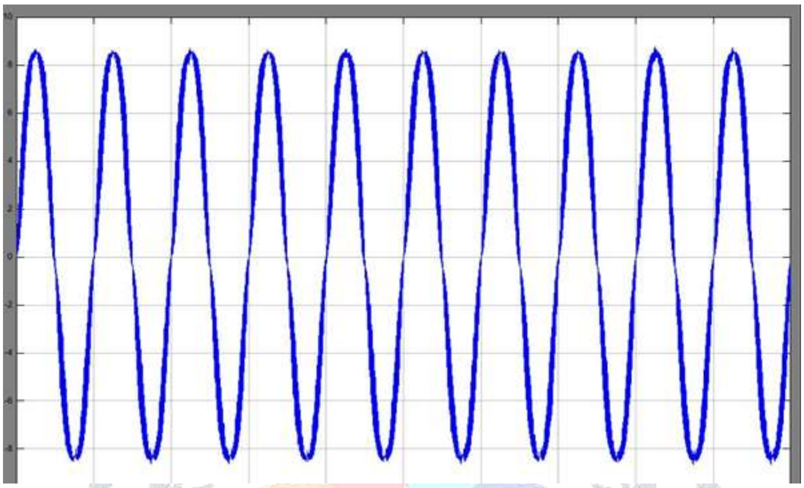

Fig.14 common mode current for type-1.

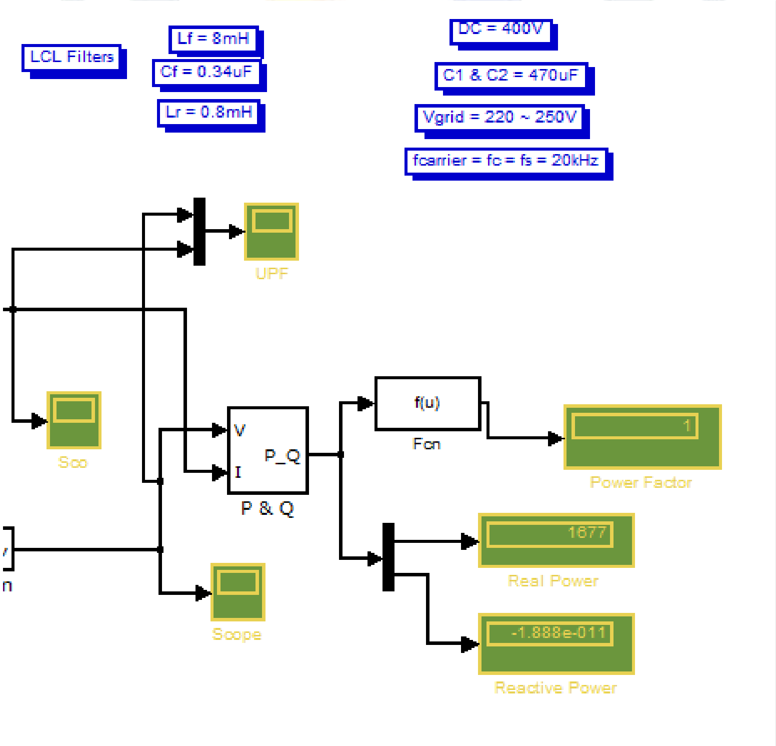

Fig. 15overall results for type-1.

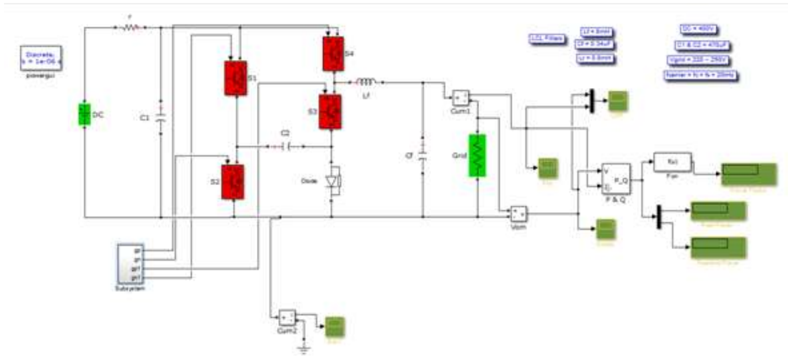

Fig.16 proposed simulation circuit for type-2.

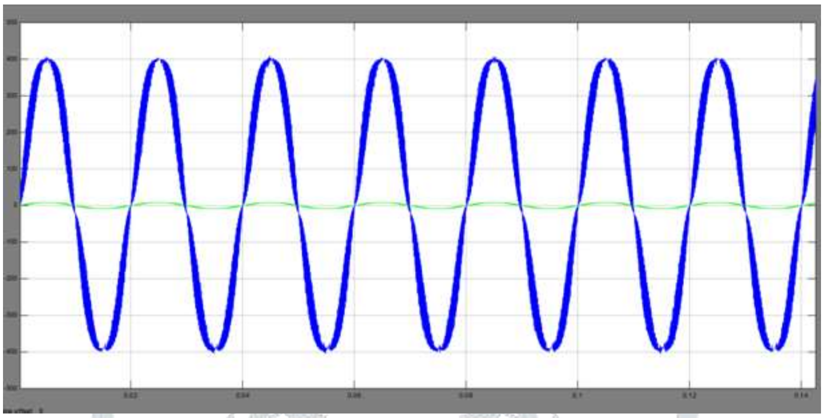

Fig. 17 output voltage and current for type-2

CONCLUSION

This paper unveils three new single-phase transformerless inverters for a grid-connected PV system. The operating principle of these inverters is based on the flying capacitor principle, and it utilizes a minimum number of active and passive components. Besides a common ground for the grid and source, which effectively eliminates the leakage currents, the three new topologies have three levels of the output voltage, which reduces the output current ripples, EMI, and filter requirements. Also, only a few switches (≤2) are in series during the active state, which helps in reducing the conduction loss in the system. Further, a uniform voltage stress across all switches in the Type-I topology allows the implementation of industry standard half-bridge modules, which saves the overall cost and volume of the system. The expected performance demonstrated by each 1-kVA laboratory prototypes are promising for a practical grid-connected PV system.

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