International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

IJIEMR Transactions, online available on 13th Jan 2019. Link :http://www.ijiemr.org/downloads.php?vol=Volume-08&issue=ISSUE-01

Title: **ANALYSIS OF A TRANSFORMERLESS QUASI-UNIPOLAR SPWM FULL-BRIDGE CONVETER**

Volume 08, Issue 01, Pages: 347-353.

Paper Authors

MR. P. KAMALAKAR

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

ANALYSIS OF A TRANSFORMERLESS QUASI-UNIPOLAR SPWM FULL-BRIDGE CONVETER

MR. P. KAMALAKAR
Department of Electrical and Electronics Engineering, MALLA REDDY ENGINEERING COLLEGE (Autonomous)

ABSTRACT

The unipolar sinusoidal pulse width modulation (SPWM) full-bridge transformer less photovoltaic (PV) inverter with ac bypass brings low conduction loss and low leakage current. In order to better eliminate the leakage current induced by the common-mode voltage, the clamping technology can be adopted to hold the common-mode voltage on a constant value in the freewheeling period. A full-bridge inverter topology with constant common-mode voltage (FB-CCV) has been derived and proposed in this paper, two unidirectional freewheeling branches are added into the ac side of the FB-CCV, and the split structure of the proposed freewheeling branches does not lead itself to the reverse-recovery issues for the freewheeling power switches and as such super junction MOSFETs can be utilized without any efficiency penalty. The passive clamping branches consist of a capacitor divider and two diodes, is added into the dc side of the FB-CCV, therefore, the weakness of active damping branch has been overcome, and the better clamping performance has been achieved in the freewheeling period. Successively, the high-recurrence common mode voltage has been stayed away from in the unipolar SPWM full-bridge inverter and the yield current courses through just three switches in the power flowing period. Furthermore, a clamping branch makes the voltage stress of the additional changes be equivalent to half input voltage. The operation and clamping modes are analyzed, and the aggregate misfortunes of influence gadget of a few existing topologies and proposed topology are verified by MATLAB/Simulink.

1. INTRODUCTION

RANSFORMERLESS grid-connected inverters have a lot of advantages such as higher efficiency, smaller size, lighter weight, lower cost and so on. [1]. The unipolar sinusoidal pulse width modulation (SPWM) full-bridge inverter has received extensive attentions owing to its excellent differential-mode characteristics such as higher dc voltage utilization, smaller current ripple in the filter inductor, and higher processing efficiency. However, the common-mode leakage current induced by the modulation strategy is brought in electrical systems.

In order to improve the common-mode performance of the unipolar SPWM full-bridge transformer less grid-connected inverter, a lot of in-depth research works, where the new freewheeling paths are constructed to separate the PV array from the grid in the freewheeling period, have been done. Several methods can be divided into the ac bypass and the dc bypass. The goal is to structure a simple, efficient, and reliable transformer less inverter topology for transformaerless photovoltaic (PV) grid-connected application. Based on the common-mode equivalent model of the full-bridge inverter derived, it is necessary that the potential of the freewheeling path is clamped to a half input voltage in the freewheeling period instead of only disconnecting the PV array from the grid. Depending on this rule, the switching frequency common-mode voltage can be completely avoided in the unipolar SPWM full-bridge inverter. The topologies are complying with the aforementioned conclusion; however, their clamping ability is different. In (the topology is shown in Fig. 1(a), and is named as HB-ZVR), if the potential of the freewheeling path rises, it can be clamped, while if the potential falls, it cannot be clamped. In Gonzalez et al. have brought a diode clamping branch into the input voltage side (shown in Fig. 1(b), named as H6 in this paper), and the potential of the freewheeling path can be seamlessly clamped to a constant voltage in the freewheeling period. In [30], when the potential of the freewheeling path falls, it can be seamlessly clamped, however, when the potential rises, it is not clamped effectively during the dead time between the high frequency main switch and the clamping one. Apparently, the leakage current suppression performance in these three kinds of topologies is different due to the clamping ability. The H6 topology has the best performance about leakage current suppression in existing single-phase full-bridge transformer see topologies

Transformer less grid connected inverters have a considerable measure of focal points, such as, high efficiency, small size, light weight, minimal cost, and so on. Be that as it may, there is a galvanic association between power grid and solar based cell array [1]. Contingent upon the inverter topology, this may cause variance of the potential between the PV array and the ground, and these variances may have a square 0 wave at switching frequency.

At the point when stimulated by a fluctuating potential, the stray capacitance to ground shaped by the surface of the photovoltaic (PV) exhibit may prompt the event of ground currents. A person, associated with the ground and touching the PV array, may lead the capacitive current to the ground, bringing on an electrical hazard. While the directed obstruction and emanated impedance will be brought in by the ground current, their maybe increase in grid current harmonics losses [5] and [7].

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

The Unipolar SPWM full bridge inverter has gotten broad considerations, inferable from its magnificent differential mode attributes, such as, higher dc voltage use, littler current swell in the channel inductor, also, higher handling effectiveness [6]. With standing, the switching frequency time-differing normal mode voltage (whose sufficiency is equivalent to a dc input voltage) is acquired. In this manner, a transformer (low recurrence or high recurrence) is expected to confine the PV array from the grid in grid connected applications, and in the meantime, the high-frequency normal mode voltage imperils the protection layer of the transformers, which expands its assembling taken a toll. Keeping in mind the end goal to expel this transformer from the unipolar SPWM full-connect framework associated inverter, a part of inside and out inquires about, where new freewheeling ways are developed to isolate the PV exhibit from the framework in the freewheeling time period, have been done.

2. STRUCTURE AND OPERATION PRINCIPLE

A. Construction of the FB-CCV

In order to guarantee that the common-mode voltage of the Heric is on a constant value in the freewheeling period, the procedure of deriving the freewheeling branches and passive clamping branches will be demonstrated in the following how a Heric topology, as shown in Fig. 1(c), can be transformed to a FB-CCV topology, as shown in Fig. 2(a). Step 1) First, the bidirectional freewheeling branches are extracted from the Heric topology, as shown in Fig. 1(a). Separate the bidirectional branches to form two unidirectional branches shown in Fig. 2(b). Step 2) Next, the positions of S5 and D5 are exchanged in the unidirectional branch B, as shown in Fig. 1(c). Step 3) Finally, find or build a clamping voltage source in the full-bridge inverter (for example, point 3 in Fig. 1(d)), than introduce two clamping diodes D7 and D8 into the inverter to connect the center points of the two unidirectional branches to the clamping voltage source. The direction of the clamping diodes can be determined using the back to back rule of D5 and D6, as shown in Fig. 1(d).

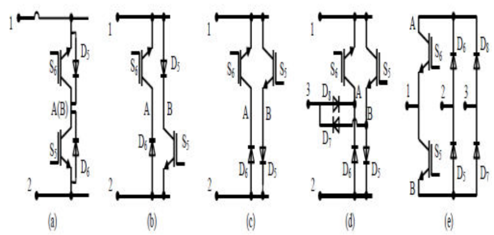

Fig. 1. Derivation of the freewheeling branches and passive clamping branches. (a) Bidirectional freewheeling branches. (b) Two unidirectional branches. (c) Two unidirectional branches. (d) Proposed freewheeling branches with passive clamping branches. (e) Bridge leg structure.

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

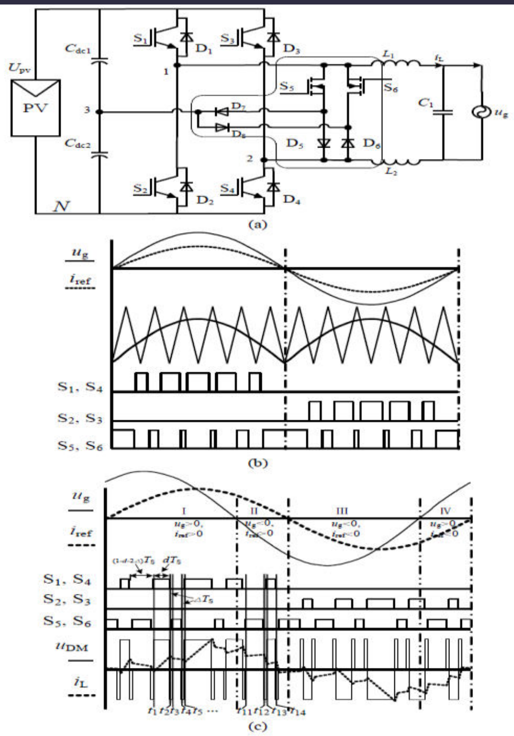

Fig. 2. Proposed transformer less PV grid-connected inverter. (a) FB-CCV topology. (b) Gate drive signal of the qSPWM with unity power factor. (c) Key operation waveforms of the FB-CCV with qSPWM.

Remark: It should be mentioned that the freewheeling branches and passive clamping branches can be rearranged as bridge leg structure, as shown in Fig. 2(e). We can define that S5 and S6 make up the active freewheeling leg, D5 and D6 make up the passive freewheeling leg, and D7 and D8 make up the passive clamping leg. According the aforementioned steps, the capacitors *C*dc1 and *C*dc2, in series, are introduced into the dc side of the Heric to build the clamping voltage source, and the freewheeling branches and passive clamping branches shown in Fig. 2(d) are introduced into the Heric also, finally, the FB-CCV topology is constructed, as shown in Fig. 3(a). The drive signals of qSPWM are shown in Fig. 3(b), and the key operation waveforms of the FB-CCV with qSPWM are shown in Fig. 3(c), respectively. In the positive half period of the grid-in current, the operation style of S1 and S4 is in unipolar SPWM modulation, S2 and S3 are always off, and the switches S5 and S6 are complementary with the switches S1 and S4 with a dead time to avoid the short-circuit paths from S1, S5, D5, S4, and S1, S5, D7, respectively; in the negative half period of the grid-in current, the operation style of S2 and S3 is in unipolar SPWM modulation, S1 and S4 are always off, and the switches S5 and S6 are complementary with the switches S2 and S3 with a dead time to avoid the short-circuit paths from S3, D6, S6, S2, and D8, S6, S2, respectively. In the qSPWM style, there are two freewheeling modes in the freewheeling period. One is dead-time mode, such as the time intervals [*t*2, *t*3] and [*t*4, *t*5] in Fig. 3(c); another is zero-vector mode, the time interval [*t*3, *t*4], as shown in Fig. 3(c) also. Especially, the potential of the zero-vector freewheeling path is defined as the potential of points 1 and 2 as shown in Fig. 3(a), and the zero-vector freewheeling path can be freely clamped to the midpoint of the input voltage (it is the point 3) through the diodes D7 and D8 in the zero-vector freewheeling stage.

3. PROPOSED SYSTEM

A. Objective*:* The main objective of this paper is to analyze the transformer less PV inverter systems that are grid connected working under both voltage and current synchronization control. A comprehensive PV model cell will be implemented that takes into consideration the datasheet parameters provided by the manufacturer.

B. Background*:* There are two main concepts that need to be introduced before proceeding with the research, these are solar Energy and Grid Connected PV Systems.

C. Solar System*:* Energy is the most fundamental and basic of all assets. All the energies we use on earth originate from splitting or combination of nuclear cores or from vitality put away in the Earth. The issue with both splitting and combination is the perilous symptom that radioactive control may have. Therefore a large portion of the vitality devoured on the planet is emphatically dependant on exceptionally restricted non-inexhaustible assets, especially petroleum product. As the world vitality request increments and assets start to wind down the scan for option energy sources has turned into a vital issue.

A great deal of research has been done in the range of boundless vitality assets, for example, wind control era and sun powered vitality change. Of these the best and innocuous vitality is sun powered vitality. The utilization of sun powered vitality rather than petroleum product ignitions specific in territories of straightforward applications like low to medium water warming or battery charging can decrease the heap of destructive discharges to the condition. This vitality can be reaped by utilization of photovoltaic (PV) clusters. The photovoltaic era frameworks can either be worked as confined frameworks or be associated with the framework as a piece of an incorporated framework, with other electrical era; they shape the dispersed era framework. As inexhaustible dispersed era, PV has a few focal points on the off chance that it is contrasted with other sustainable power source eras. PV era plant needs not a particular geographic or geo-morphological prerequisite, for example, on the wind what's more, miniaturized scale little hydropower era. In opposite, PV era plant can be inherent any territory where the sun light is accessible; permits the adaptability to decide the place of the plant as indicated by its principle allocation. Moreover, the module-based creation of PV2 plant parts that empowers one to fabricate and modify the extent of PV plant from little limit and afterward extend it to take after the request development is additionally one of preferences of this sort of era framework. These realities make the PV modules an intriguing decision for the advancement of electrical appropriated era frameworks.

D. Grid Connected Systems:

The constantly expanding energy utilization over-burdens the conveyance matrices also as the power stations,

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

thusly having a negative effect on power accessibility, security and quality. One of the answers for conquering this is the Circulated Generation (DG) frameworks. DG frameworks utilizing sustainable power sources like sunlight based or wind have the preferred standpoint that the power is delivered in close nearness to where it is expended limiting the misfortune because of transmission lines. In the most recent decade sun based vitality advances have turned out to be more affordable and more productive, which have made it an alluring arrangement being cleaner and all the more ecologically

CONCLUSION

A quasi-unipolar SPWM full-bridge inverter topology with two unidirectional freewheeling braches and a passive clamping branch has been proposed in this paper. The proposed inverter has the following characteristics: (i) The quasi-unipolar SPWM differential-mode voltage is a combination of unipolar and bipolar SPWM, and is more close to the unipolar SPWM. (ii) There are two operation modes in the freewheeling period: the dead-time freewheeling mode and zero-vector freewheeling mode, which guarantee that the high-frequency common-mode voltage is on a constant value in whole switching period. (iii) The freewheeling paths have two kinds of combinations: MOSFET + diode, or full MOSFETs, meanwhile, the full MOSFETs type freewheeling path can reduce the conduction loss further. The proposed inverter is an optimized topology with high conversion efficiency and low leakage current. These merits are verified and compared by a universal prototype. It can be concluded that the proposed topology is extremely suitable for transformer less single-phase grid-connected inverter with lower switching frequency.

REFERENCES

[1].R.Gonzalez, E.Gubia, J.Lopez, and L. Marroyo,“ Transformer less single phase multilevel-based photo voltaic inverter ,”IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2694–2702, Jul. 2008.

[2]. H. F. Xiao, S. J. Xie, C. Yang, and R. H. Huang, “An optimized transformer less photovoltaic grid-connected inverter,” IEEE Trans. Ind. Electron., vol. 58, no. 5, pp. 1887–1895, May 2011.

[3]. B. Yang, W. H. Li, Y. J. GU, W. F. Cui, and X. N. He, “Improved transformer less inverter with common-mode leakage current elimination for a photovoltaic grid-connected power system, IEEE Trans .Power Electron” vol. 27, no. 2, pp. 752–762, Feb. 2012.

[4]. B. N. Alajmi, K. H. Ahmed, G. P. Adam, and B. W. Williams, “Single phase single-stage transformer less grid-connected PV system,” IEEE Trans. Power Electron., vol. 28, no. 6, pp. 2664–2676, Jun. 2013.

[5]. V. A. Samuel, Z. Pter, and M. Regine, “Highly efficient single-phase transformer less inverters for grid-connected photovoltaic systems,” IEEE

Trans. Ind. Electron., vol. 57, no. 9, pp. 3118–3128, Sept. 2010.

[6].R. Gonzalez, J. Lopez, P. Sanchis, and L. Marroyo, "Transformer less inverter for single-phase photo voltaic systems," IEEE Trans. Power Electron., vol. 22, no. 2, pp. 693–697, Mar. 2007.

[7].O. Lopez, R. Teodorescu, and J .Doval-Gandoy," Multilevel transformer less topologies for single-phase grid-connected converters,"inProc.32nd Annu. Conf. IEEE Ind. Electron. Soc., Nov. 2006, pp. 5191–5196.

[8].R.Gonzalez, E.Gubia ,J.Lopez, and L.Marroyo,"Transformer less single phase multilevel-based photo voltaic inverter," IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2694–2702, Jul. 2008.

[9].A. M. Hava and E. Un, "Performance analysis of reduced common-mode voltage PWM methods and comparison with standard PWM methods for three-phase voltage-source inverters," IEEE Trans. Power Electron., vol. 24, no. 1, pp. 241–252, Jan. 2009.