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Implementation of an Efficient Hybrid Boost Three Level DC–DC Converter

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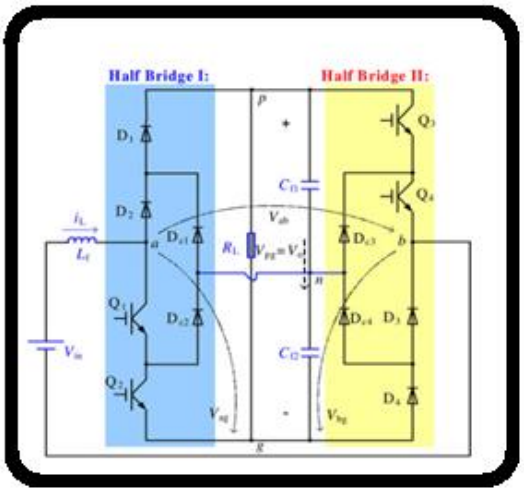
Abstract: ***To cope with mismatched current levels between parallel-connected low-current solar (PV) arrays and also the needed greater current from the grid, a manuscript hybrid boost three level electricity-electricity ripper tools is suggested in line with the traditional single phase diode-clamped three-level inverter. The operation principle from the suggested topology is examined, and so the pulse width modulation (PWM) control technique is acquired based on the switching functions concerning the output pulse voltages of both half-bridges. Therefore, the suggested ripper tools not only can operate rich in current gain, but additionally result in the duty cycles of power switches nearer to 0.5.***

Keywords: Pulse width modulation, Photovoltaic rays, Hybrid boost three level dc–dc converter, Half-bridges

1. Introduction

Both solar (PV) and wind power decades have grown to be important areas of alternative energy, because of worldwide exhausted fossil fuel and world's interest in clean energy. In grid-connected PV generation systems, just one-PV array are only able to supply lower electricity current, but greater current level is required for that grid-connected side. Regarding the parallel-connected PV configuration, probably the most important problems would be that the low electricity-bus current needs to firm rich in step-up gain. Therefore, high-step-up electricity-electricity converters are brought to match the current conversion between low-current parallel-connected PV arrays and also the required high-current grid-connected side, along with the maximum power point monitoring. Cascaded boost converters will also be accustomed to extend the current gain and duty cycles, only one apparent disadvantage is the fact that more separated inductors are required, and also the on / off switch from the last power stage cannot steer clear of the output current stress. Recently, many scientists have centred on step-up converters with combined inductor that has the transformer function to increase the current gain and duty cycles. Within this letter, a manuscript hybrid boost three-level electricity-electricity ripper tools is suggested using the topology established with no transformer or combined inductors into consideration. It consists of just one inductor, two output capacitors in series, along with other power semiconductor components, which are simple to be integrated. This suggested ripper tools not only can realize high step-up gain, but additionally avoid extreme duty cycles. The suggested ripper tools is appropriate for PV generation systems attached to the grid with parallel-connected low-current PVarrays.



Proposed hybrid boost three-level dc–dc converter.

Figure: An overview of proposed system

2. Methodology

Therefore, the mode of PV arrays in series continues to be adopted to counterbalance the differential current levels between electricity bus and grid side. Regrettably, low-current PV arrays will always be exposed to inevitable cloud, dust, shadow, and so forth, that will limit the output current from the total PV arrays, and so the efficiency from the entire PV generation system is going to be degraded. When converters operate rich in step-up gains, the ability switches in conventional boost two-level converters would sustain high output current completely. As the classical boost three-level converters could reduce 1 / 2 of the current stress, however the extreme duty cycles of power switches limit its current gains and switching frequency due to the shorter turn-OFF duration of the ability switches in every switching period. Even though the current stress of power switches is low, the output-electricity is restricted and also the input- current ripple is big because of the single phase structure. Therefore, the interleaved boost converters with switched capacitors are suggested. However more switched-

capacitor cells are needed to acquire a high current gain. Interleaved high-step-up ripper tools integrated with winding-mix-combined inductors and current multiplier cells is presented, however it sponges on more combined inductors which aren't simple to be integrated or developed in standardization. Additionally, the job cycles from the power switches inclines to at least one, because of the elevated current gain. Within this letter, a manuscript hybrid boost three-level electricity-electricity ripper tools is suggested using the topology established with no transformer or combined inductors into consideration. So we don't only enhance the electricity-bus current and electricity of PV generation systems, but additionally obtain narrower pulse voltages in the distinction between wider ones with the idea in line with the topology of merely one-phase diode-clamped inverter with two three-level legs, a manuscript hybrid boost three level ripper tools could be synthesized through the two boost three-level Converters I and II. The input electricity from the hybrid ripper tools could be enhanced by way of two converters' input sides in series, namely (Vin1 Vin2), and also the output electricity from the hybrid ripper tools may also be elevated through the parallel connected Outputs of Converters I and II. The synthesized procedure for the hybrid ripper tools through the mode of inputs in series and outputs in parallel is portrayed. The suggested hybrid ripper tools that is synthesized by Converters I and II comprises Half-Bridges I and II. The measured maximum efficiency from the suggested ripper tools is all about 93.1%. All experimental results verify the practicality from the suggested topology and validity from the PWM control method. The capacitor voltages could be balanced in dynamic and steady states through the suggested PWM control method and also the obstructing voltages from the power switches are 1 / 2 of the output electricity current.

3. An Overview of Proposed System

A manuscript hybrid boost three-level electricity-electricity ripper tools is suggested using the topology established with no transformer or combined inductors into consideration. It consists of just one inductor, two output capacitors in series, along with other power semiconductor components, which are simple to be integrated. This suggested ripper tools not only can realize high step-up gain, but additionally avoid extreme duty cycles. The traditional single-phase diode-clamped three-level inverter and you will find four power switches Qa1 - Qa4 with corresponding anti-parallel diodes Da1 - Da4. According to this topology, two classical three-level electricity-electricity converters (buck and boost converters) are deduced. However, two of these boost three level converters cannot operate individually, because of the unbalanced capacitor voltages. The output pulse voltages of two halfbridges are Vag and Vbg , and so the output pulse current Vab from the hybrid ripper tools can be defined as Vab = Vag - Vbg . The related states of power components for immediate Vab from the hybrid ripper tools I, which is also assumed the voltages across capacitors Cf 1 and Cf 2 are equal, namely VCf 1 = VCf - Once the power switches Q1 - Q4 are switched OFF, the capacitors Cf 1 and Cf 2 in series are billed together by both electricity current source Vin and also the energy kept in Lf through diodes D1 - D4. Then, the immediate Vab from the hybrid ripper tools is Vo.

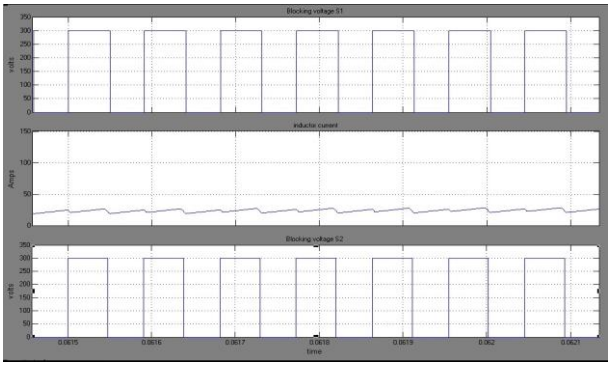


Figure 3.1: Blocking voltages across D1, D2, and the inductor current

While Cf 1 is billed by Vin, along with the energy stored inLf through diodes D2, D1, and Dc3 when only Q4 is switched ON. Once the power switches Q1 and Q2 are switched ON, the power is kept in Lf through diodes D4 and D3, while Cf 1 and Cf 2 are released together for that load. Then, the immediate Vab is zero. Furthermore, another two redundant states for Vab = is the fact that on / off switch pairs (Q1,Q4), or (Q3,Q4) are switched ON, correspondingly, the power is kept in Lf by Vin with the corresponding diodes, while Cf 1 and Cf 2 are released together for that load. Simultaneously, Cf 2 is released for that load, and also the immediate Vab is Vo/2, the current across Cf 1. Additionally, the redundant condition for that immediate Vab = Vo/2 is the fact that Cf 2 is billed by Vin and also the energy kept in Lf through diodes Dc2,D4, and D3 when only Q1 is switched ON. Meanwhile, Cf 1 is released for that load, and Vab may be the current across Cf 2. Based on the operation states from the hybrid ripper tools, energy Wst is kept in Lf. The assumption is the inductor current iL is continuous, and IL is its average current. To be able to verify the validity from the suggested topology and also the PWM control method, an experimental prototype is to establish within our laboratory.

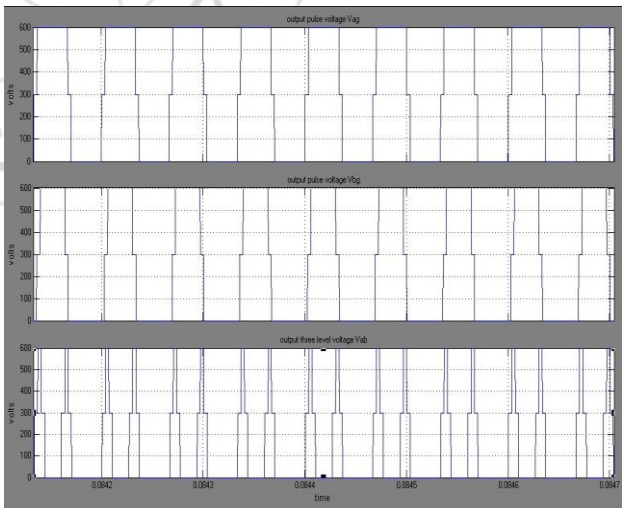


Figure 3.2: output voltages of three level converters

The measured efficiency from the suggested ripper tools is portrayed once the output power is 180 W, the efficiency is all about 82%, and also the maximum efficiency is all about 93.1% at 360 W.

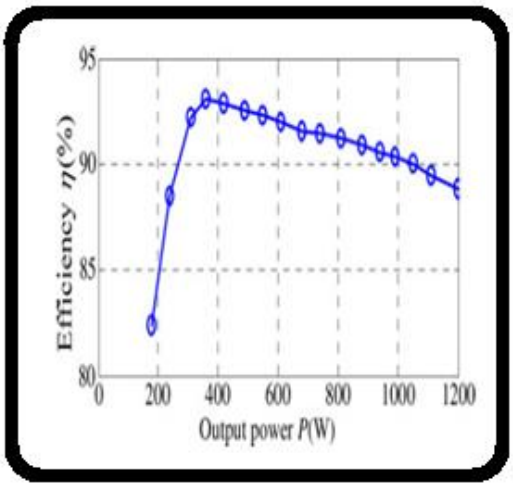


Figure 3.3: An overview of measured efficiency of proposed system

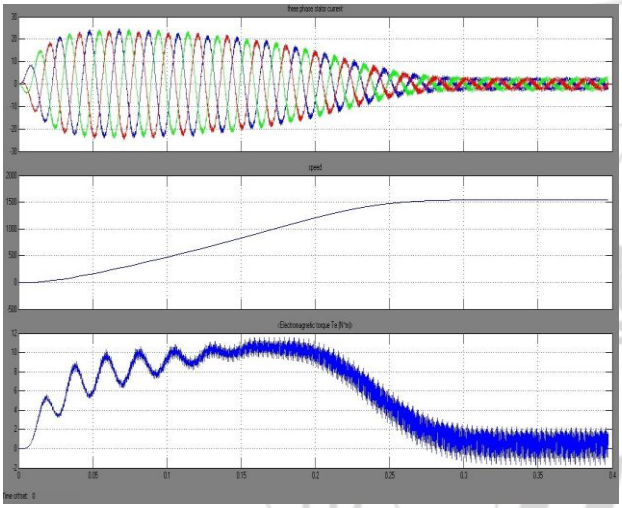


Figure 3.4: output waveforms stator current, speed &electromagnetic torque of induction motor

4. Conclusion

To cope with mismatched current levels between parallel-connected low-current solar (PV) arrays and also the needed greater current from the grid, a manuscript hybrid boost three level electricity-electricity ripper tools is suggested in line with the traditional single phase diode-clamped three-level inverter. It can't only operate with transformer less high current gain, but additionally result in the duty cycles from the power switches nearer to .5 using the growing current gain, rather than the ultimate duty cycles. Just one inductor, two capacitors in series, and individuals power switches and diodes, which are simple to be integrated, are adopted to determine the topology with transformer less high current gain Furthermore, voltages over the capacitors in series are very well balanced both in steady and dynamic states, and also the obstructing voltages from the power switches are 1 / 2 of the output electricity current. Finally, single-kW prototype is to establish within our laboratory, and also the measured maximum efficiency from the suggested ripper tools is all about 93.1%. All experimental results verify the practicality from the suggested topology and validity from the PWM control method. The capacitor voltages could be balanced in dynamic and steady states through the suggested PWM control method and also the obstructing voltages from the power switches are 1 / 2 of the output electricity current. Therefore, the suggested ripper tools are appropriate for PV generation systems attached to the grid with parallel-connected low-current PV arrays.

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