International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-11, September 2019

# Enhanced Boost Converter Fed Asymmetrical Cascaded -MLI for 3Φ Induction Motor

**M. Selvaperumal,. D.Kirubakaran**

***Abstract***: ***modern days more research works are going in the field of a non conventional source based power supply generation for interfacing low potential into high potential. Coupled inductor based Enhanced Boost Converter is proposed in this article. The passive clamp circuit is used to recycle the leakage energy and increase potential gain and less loss. Thus the proposed converter has maximum potential gain and efficiency due to coupled inductor and clamp circuit. This dc-dc converter output is given to hybrid multilevel inverter. The proposed Enhanced Boost Converter fed hybrid multilevel inverter is developed for interfacing low potential dc source into high potential AC.***

***Keywords***: ***boost converter, current limiter, Passive element, nine-level inverter and harmonic.***

## I. INTRODUCTION

Many Enhanced Boost Converter are developed for interfacing minimum potential level to another by using non conventional source applications. Basic boost converter has less potential gain, more potential stress, and diode reverse recovery problem, etc. Interleaved boost converters were proposed to improving the potential gain. Active clamp circuit based boost converterwas proposed for reducing the potential stress and improve the gain. The potential multiplier is also proposed to improving the potential gain in . Thus many topologies were proposed to improve the potential gain But each method has some advantages and some disadvantage and also not able to produce enough potential gain. Coupled inductor based converter is proposed for high step applications. Different inverter topologies were developed for reducing the harmonic and increase the potential rating in . Asymmetrical topology is proposed for reducing the dc power supply and H-bridge count. In this method, the potential source is taken unequally This topology is used to reduce the system cost, size, and control system complexity. Hybrid multilevel inverter topology is also proposed for reducing the components and potential source of the inverter. Bi-directional switches are used in the hybrid MLI to reduce the components count and improve the system performance .In this article coupled inductor based Enhanced Boost Converter fed three phases multilevel inverter is proposed. The circuit operation and simulation results will be present in the following section.

**Manuscript published on 30 September 2019.**
*Correspondence Author(s)
**M.Selvaperumal**[1] Research scholar, Department of Electrical and Electronics Engineering, Sathiyabama University Chennai, India.
**Dr.D.Kirubakaran** [2]**Professor** and Head of the department of Electrical and Electronics Engineering, St.Josph's Institute of Technology, Chennai, India.



## II. CIRCUIT DESCRIPTION

Enhanced Boost Converter fed three phases asymmetrical nine level multilevel inverter circuit diagrams. The proposed circuit has input PV cell, Enhanced Boost Converter, 3 Φ MLI &IM.

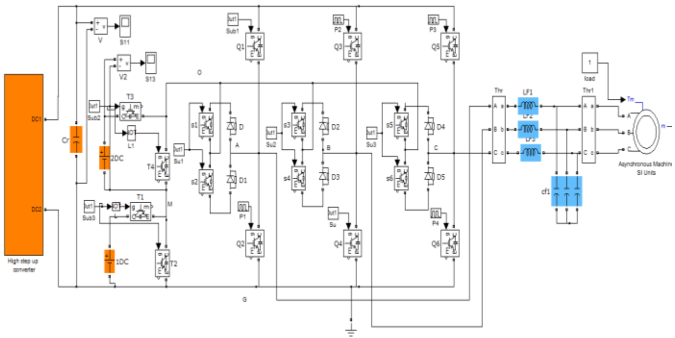


**Figure 1 proposed circuit diagram with an LC filter**

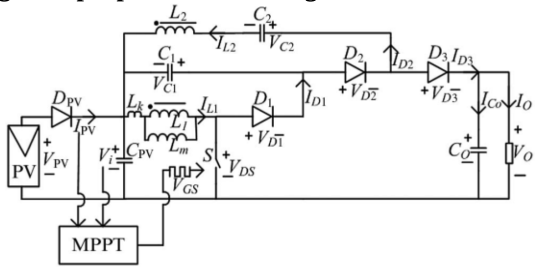
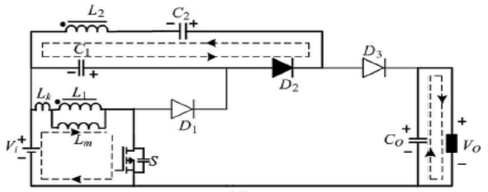



**Figure 2 Enhanced Boost Converters**

The proposed high-gain dc-dc converter configuration is shown in Fig. 2. It consists of one passive clamp network, a coupled inductor ($L1$, $L2$), and an intermediate capacitor and load. The symbol $V_{PV}$ represents the PV potential applied to the circuit. The step-up converter is used to convert low potential into a high potential with the help of coupled inductor. MPPT technique is used for getting maximum power from the solar cell. P&O algorithm is used in the MPPT technique. The operating modes for continuous conduction mode (CCM) are shown in Fig. 3. Various operating modes are explained below. The detailed converter operation and analysis is explained.

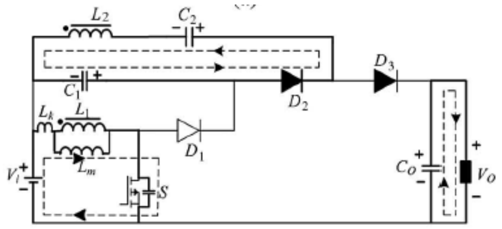
*Converter operation 0 [t0 − t1]:* S is Switch ON at the start of the operation. I flows through the S and the primary side of L1, energizing LM of L. The I direction is as shown in Figure 3(a). D1 and D3 are reverse biased, where as D2 is forward biased during converter operation mode 0. C2 is charged through D2 by L2 and C1. If V=V(C2)=V(L2)+V(C1), D2 turns OFF.




(a)

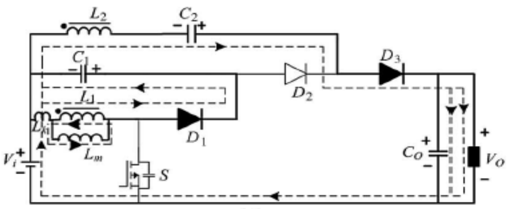
**Figure 3a. Converter operation modes during continuous conduction mode: (a) Mode 0 (b) Mode 1 (c) Mode 2 (d) Mode 3 and (e) Mode 4.**

***Converter operation** 1 [t1 − t2]: in this S is switch off. The $C_p$ of the S is charged by the $I_H$ L1, D2 remains forward biased.*



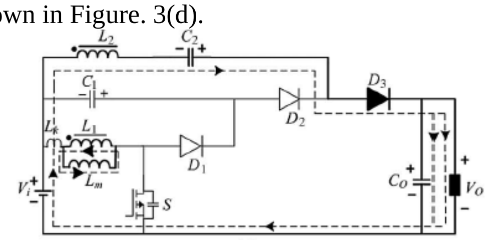

(b)

***Converter operation 2 [t2 − t3]:*** The Converter operation D1 and D3 forward bias condition. D2 is reverse biased and current becomes zero value. The leakage energy stored in the primary side of the L1 is recovered and stored in the C1 through D1. The energy is transferred from the input side to the output side through diode D3 as shown in Figure 3(c).



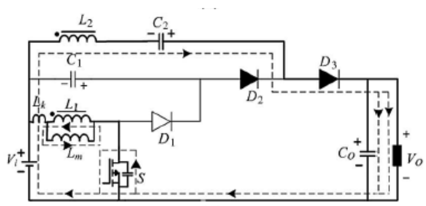

(c)

***Converter operation 3* [*t*3 − *t*4]:** converter operation begins after the completion of recovery of the leakage energy from *L*1. The *D*1 now becomes reverse biased while diode *D*3 remains forward biased in this converter operation. The "I" flows from the input to the output to supply the load as shown in Figure. 3(d).




(d)

***Converter operation 4* [*t*4 − *t*0]:** This mode begins by turning ON switch *S*. The leakage inductor energizes quickly using the full magnetizing current while the parasitic capacitance across the switch discharges. The diodes *D*1 and *D*2 are in reverse biased condition. This mode ends when diode *D*3 becomes reverse biased and current flow through inductor *L*2 changes direction.




(e)

The inverter consists of three dc sources 1:2:4 ratios, bi-directional switches, and two-level inverter. $4V_{DC}$ supply is derived from a solar cell with the help of a Enhanced Boost Converter. It required output potential level is achieved by turn on the corresponding switch and source. The switching process are as shown in Table-1.

**Table 1: 3- phase nine level inverter switching pattern**

| source | q1 | q2 | q3 | q4 | q5 | q6 | s1 | s2 | s3 | s4 | s5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4Vdc | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 3Vdc | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 2Vdc | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| Vdc | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0Vdc | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| -Vdc | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| -2Vdc | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| -3Vdc | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| -4Vdc | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

It inverter line-to-ground potentials $V_{ag}$, $V_{bg}$, and $V_{cg}$ in terms of switching function $S_a$, $S_b$, and $S_c$ are given by

$$\begin{bmatrix} V_{ag} \\ V_{bg} \\ V_{cg} \end{bmatrix} = \frac{4V_{dc}}{N-1} * \begin{bmatrix} S_a \\ S_b \\ S_c \end{bmatrix}$$

where $N = 5$ is the maximum number of potential levels. The balanced load potentials can be achieved if the proposed inverter operates on the switching states depicted in Table I. This inverter has 24 different modes within a cycle of the output waveform. According to Table I, it can be noticed that the bidirectional switches operate in 18 modes. For each mode, there is no more than one bidirectional switch in on the state.

## III.SIMULATION RESULTS AND DISCUSSIONS

Figure 1 shows the proposed nine levels inverter-fed induction motor circuit diagrams. Fig 4 shows the Enhanced Boost Converter for non conventional applications. The Enhanced Boost Converter is used to convert low potential dc into high potential dc output. This output potential is given to the inverter. The inverter circuit is used to convert dc supply into nine-level AC output. The LC filter is used to convert staircase output into a sinusoidal output potential and also reduce the harmonic. The motor speed is plotted.

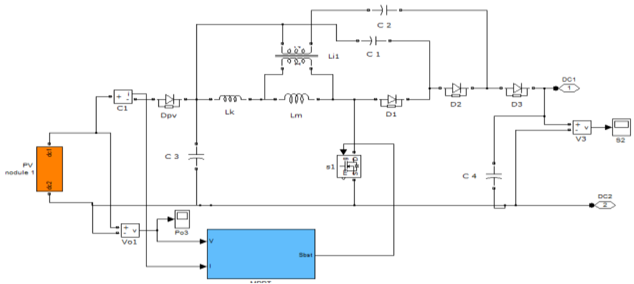


**Fig 4 Enhanced Boost Converters**



Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

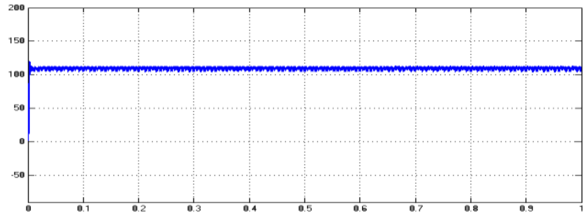


**Figure 5 PV output potentials from solar cell**

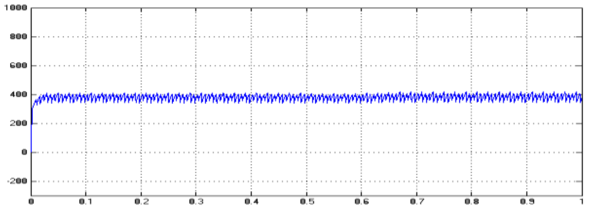


**Figure 6 Enhanced Boost Converter $V_o$**

Fig 5 shows the PV output potentials from the solar cell. Fig 6 shows the high gain dc-dc converter output potential. Fig 7 shows the inverter output potential across phase to phase before the LC filter. Fig 8 shows the inverter output potential across phase to phase after the LC filter. Fig 9 shows the rotor current output. Fig 10 shows the rotor speed in RPM. It is settled at 1440 rpm. Fig 11 shows the torque output. It is settled at 5 N-m.

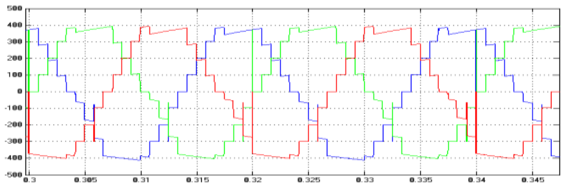


**Figure 7 $V_{RY}$ and $V_{YB}$ without the filter**

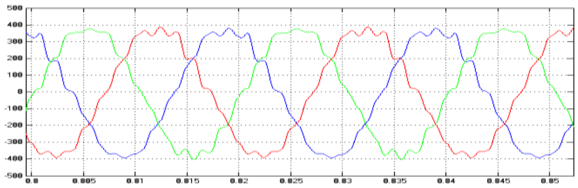


**Figure 8 $V_{RY}$ and $V_{YB}$ with filter**

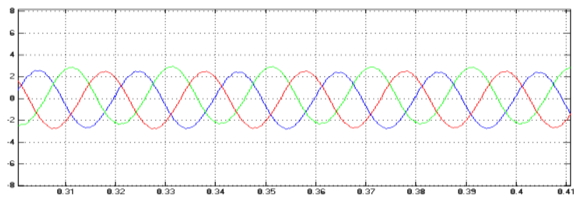


**Figure 9 Current output**

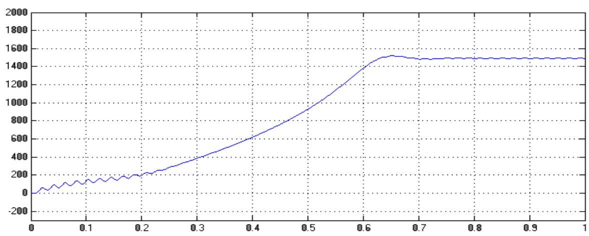


**Figure 10 Rotor speed in rpm**

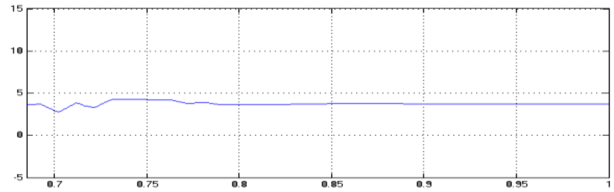


**Figure 11 Torque in Nm**

## IV COMPARATIVE ANALYSIS

The circuit performance is compared to simulation results. The inverter output potential is as shown in fig 12 using without the filter and with the filter. The potential has staircase output and spike. This distortion and step wave is converted into sinusoidal form with the help of the LC filter. The current THD is as shown in fig 13 without and with the filter. The current has THD of 5.62% without filter and THD of 3.32% with the filter. The proposed circuit has less harmonic compare than without the filter. It is shown in table 2 and fig 13.

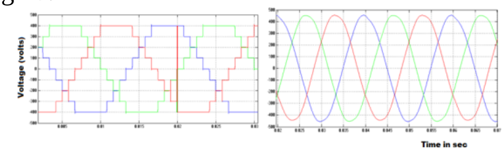



**Figure 12 $V_0$ (a) (b)**

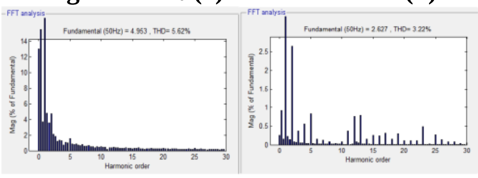



**Figure- 13 FFT analyses**

**Table 2: Performance parameters**

| Parameters | New 3ph 9-level without the filter | New 3ph 9-level with filter |
|---|---|---|
| Input potential (4Vdc) | 400V | 400V |
| No. of switches | 16 | 16 |
| No. of Diodes | 6 | 6 |
| %THD | 5.62 | 3.22 |

## V CONCLUSION

Enhanced Boost Converter based asymmetrical cascade 3-phases 9 levels inverter-fed induction motor was proposed in this article. The circuit operation and simulation results were presented and discussed. The Enhanced Boost Converter is used to fed 4Vdc power supply to the inverter. It is used to give constant and optimum output potential from the PV source with the help of MPPT technique. The circuit performance is compared with simulation results.

*Retrieval Number: K14690981119/19©BEIESP*
*DOI: 10.35940/ijitee.K1469.0981119*
*Journal Website: www.ijitee.org*



*Published By:*
*Blue Eyes Intelligence Engineering*
*and Sciences Publication (BEIESP)*

The proposed front end dc-dc converter has more potential gain and the second stage has less current harmonic.
Thus the proposed converter is more suitable for non conventional applications.

## REFERENCES


1. S. Lee, P. Kim, and S. Choi, “High step-up soft-switched converters using potential multiplier cells,” *IEEE Trans. Power Electron.*, vol. 28, no. 7, pp. 3379–3387, Jul. 2013.
2. Y. P. Hsieh, J. F. Chen, T. J. Liang, and L. S. Yang, "Novel Enhanced Boost Converter for distributed generation system," *IEEE Trans. Ind. Electron.*, vol. 60, no. 4, pp. 1473–1482, Apr. 2013.
3. Wuhua Li. "Performance analysis of an interleavedhigh step-up converter with voltage multiplier cell",2010 Twenty-Fifth Annual IEEE Applied Power ElectronicsConference and Exposition (APEC), 02/2010 (Cross ref)
4. X. Wu. "Analysis and Optimal Design Considerationsfor an Improved Full Bridge ZVS DC–DC ConverterWith High Efficiency", IEEE Transactions on Power Electronics,9/2006 (Cross ref).
5. "Static Compensators (STATCOMs) in PowerSystems", Springer Science and Business MediaLLC, 2015 (Cross ref).
6. Yari, Keyvan, Alfred Baghramian, Sara Hasanpour,and Mojtaba Forouzesh. "Single-switch high step-upconverter based on coupled inductor and switched capacitortechniques with quasi-resonant operation", IET Power Electronics, 2016. (Cross ref).


## AUTHORS PROFILE

**Mr.M.Selvaperumal** completed his Bachelors of Engineering Degree in Electrical and Electronics Engineering from Madras University in the year 2002 and Masters of Engineering in Power Electronics and Industrial Drive systems from Sathiyabama University, Chennai in the year 2005.Currently he is a research scholar in Electrical Engineering of Sathiyabama University.

**Dr.D.Kirubakaran** secured his Doctor of Philosophy from Anna University, Chennai in the year of 2012. His research areas includes power electronics converter, 3 phase inverters, and power electronics drives systems. He has also presided as the chairperson in various national and international conferences held in India and abroad. Dr.D.Kirubakaran has published in more than 75 research articles in the leading international journals. Also he is a member of various professional societies like IEEE, IETE, ISTE, IEI etc.

*Retrieval Number: K14690981119/19©BEIESP*
*DOI: 10.35940/ijitee.K1469.0981119*
*Journal Website: www.ijitee.org*



*Published By:*
*Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)*