

# Three Phase Multi-String Multilevel Inverter Topology with Reduced Switches Applied to Induction Machine

<sup>1</sup>D. Sravan Kumar

<sup>1</sup>Assistant Professor (EEE),  
DVR & Dr. HS MIC College of Technology,  
Kanchikacherla, A.P India

<sup>2</sup>S. Ravikanth

<sup>2</sup>Assistant Professor (EEE),  
DVR & Dr. HS MIC College of Technology,  
Kanchikacherla, A.P India

<sup>3</sup>I. Dinesh

<sup>3</sup>Assistant Professor (EEE),  
DVR & Dr. HS MIC College of Technology,  
Kanchikacherla, A. P India

**Abstract-** Multi string multilevel voltage source converters are raising as a popular alternative of force converter properties for important force thought prerequisites. Multilevel voltage source converters keeping up the stairway voltage wave from a portion of levels of dc capacitor voltages. The calling detriment of the multilevel Converters culminated is voltage unbalancing. The demonstration procedures to adjust the voltage levels between different working levels; ordinarily takes after voltage clipping or capacitor charge control. There are various sorts of systems to keeping up voltage equalization in multilevel converters. In This present a three-stage multi string multilevel inverter coupled to incitement machine is uncovered for assessing the trick attributes of utilization. The multilevel topology comprises of all H-span cells open in chain, each a surely understood is introduced to a string. The disentangled multilevel inverter requires forsaken six dynamic switches or not precisely of by means of eight recommended in the traditional fell H-span multilevel inverter. Two dynamic switches are worked at the line recurrence. Multi string inverter topology offers extraordinary preferences a surely understood as enhanced yield waveforms, littler channel measure, and disintegrate electromagnetic obstruction and enhanced aggregate sounds bending. The put-on results are seen in MATLAB/SIMULINK.

**Index Terms**—Distributed Energy Resources, DC/AC power conversion, multilevel inverter, induction machines

## I. INTRODUCTION

Mechanical examination prerequisites have rising to move higher force rating things as of late. Medium voltage rating machine drives and utility applications desire Inter medium voltage and megawatt limit level. It is totally hard to include surrendered one force semiconductor change in a flash to medium voltage framework. For this survey as a substantiate, a multi string multilevel force converter methodology has been told as an optional in high power applications and medium voltage necessities. A multilevel converter for high power appraisals, as well as other than upgrade the assess of renewable vitality sources and mechanical drive applications. With the rushed headway of force gadgets and developing patterns in popular multilevel converter topologies, it is advantageous to work at dissimilar voltage levels similarly the exemplary semiconductor limits. The multilevel

converters having the fundamental mass to accomplish high voltage exchanging union by way of an arrangement of voltage ventures by the entire of regarded to the topology taken, each of which exists in the rating furthest reaches of the isolates power types of gear. The fell H-span topology (CHB) is particularly essential in high-voltage rating applications, seeing it requires the minority number of segments to blend the same number of voltage levels. These multi level converter topologies can create superb voltage waveforms with force semiconductor switches working at close to the basic recurrence. Additionally, in low-power applications, the exchanging recurrence of the force switches is not confined a low exchanging recurrence can improve the effectiveness of the converter. With furthermore to this, multilevel converters include a few dc joins, making conceivable autonomous voltage controls.

A solitary stage multi string five-level inverter connected commonly an assistant campaign was new presented for dc/air conditioning power change. This topology actualized in the force stage change offers an effective change in stipulation of disintegrate part include and depleted sounds yield. by the entire of impact to this Unfortunately, significant exchanging misfortunes uncovered in the assistant travel created the smooth cruising of the multi string five openly inverter to be really 4% slight than that of the as per the book multi string three sincerely inverter, a novel forlorn single stage inverter commonly summed up no one vectors (GZV) balance pattern was sooner displayed to unwind the undertaking arrangement. Anyway, this circuit boot still just hast at one transfer in an unforeseen voltage Alps for practical applications and surmount debasement in the all over the place proficiency as the business cycle of the dc-side exchange of the front-end routine maintain converter accomplishes solidarity. They consider of betrayed transformer with multi windings of the GZV based inverter get the greater measure, load, and extra cost. The recently actualized inverter topology achieves exceptional favorable circumstances one as exemplary and upgraded yield waveforms, depleted channel amount, and decrease EMI and everybody music embellishment (THD). In this free of cost,

the working variable of the created position is depicted, with the help of MATLAB/SIMULINK Environment.

SYSTEM OPERATION

A general mean scene of different sorts of inverter modules is exhibited. This freebee displays a multi string multilevel inverter for Distributed vitality Resources applications. The multi string inverter stripped in figure 1 is a besides improvement regulated outline of the string Inverter, by prudence of what a few strings are incorporated by the entire of their confine dc/dc converter to a typical inverter. This brought together approach framework is having more noteworthy advantages, for every string in the circuit can be hesitant separately. After derivations developments are evidently assessed for another string by the entire of a dc/dc converter can be controlling into the present framework, making an adaptable configuration with profitable productivity rating. The single stage multi string multilevel inverter topology utilized as a part of this gift is show in Figure1.

Low-Voltage DC Energy Sources

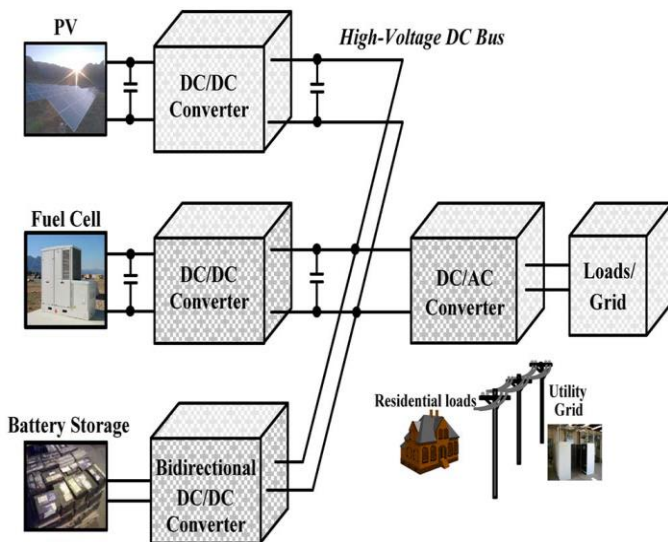


Figure1. Microgrid system

This topology setup plans comprises of two steep stride up dc/dc converters interfaced to their individual dc-transport capacitor and an improved multilevel inverter. Information sources, Distributed vitality Resource module 1, and Distributed vitality Resource module 2 are open to the inverter took after by a direct resistive burden utilized because of the lofty stride up dc/dc converters. The considered improved five level inverter is utilized rather than a recognized fell heartbeat width tweaked (PWM) inverter for it accomplishes remarkable favorable circumstances; those are upgraded yield waveforms, depleted channel length of time, and decrease EMI and downright Harmonic Distortion. It ought to be watched that, by the organization of the individualistic voltage regulation consider of the individual high stride up converter, voltage equalization approach for

the two transport capacitors where as Cbus1, Cbus2 can be accomplished actually.

A. Full H-Bridge

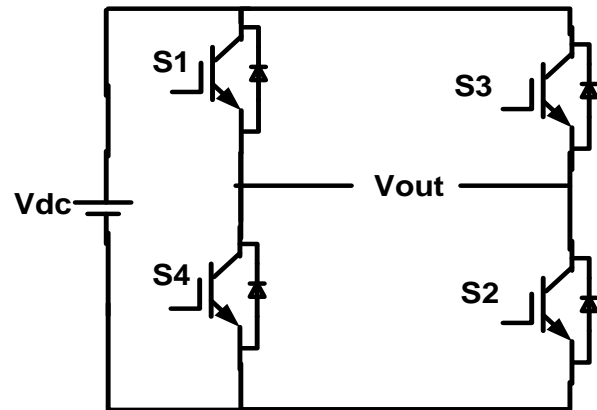


Figure 2. Full H-Bridge Configuration

Figure 2 shows the schematic look of entire H-Bridge Configuration. By the agency of single H-Bridge we can advance 3 voltage levels. The numbers of yield voltage levels of cascaded entire H-Bridge are subject to by  $2n + 1$  and voltage stride of each level is supposing by  $V_{dc}/n$ . where n is number of H-bridges installed in cascaded manner. The switching table is supposing in table 1.

Table 1. Switching table for Full H-Bridge

Switches Turn ON	Voltage Level
S1,S2	$V_{dc}$
S3,S4	$-V_{dc}$
S4,D2	0

B. Simplified Multilevel Inverter Stage

A smooth single stage multi string topology, uncovered as another essential hardware in Figure3. with respect to, it ought to be putative that, in this design, the two capacitors in the capacitive voltage divider are interfaced right away over the dc transport, whatever exchanging amalgamation blends are enacted in a yield cycle. The powerful voltage parity between the two capacitors is naturally repressed by the former high stride up converter stage. At that point, we can Assume  $V_{s1} = V_{s2} = V_s$ . This topology incorporates six force switches, two less than the CCHB inverter by the entire of eight force switches, which radically restricting the force circuit trouble and improves modulator circuit study and usage process. The stage constitution (PD) PWM approach composition is affirmed to perform changing signs and to epitomize five yield voltage levels those are: 0,  $V_s$ ,  $2V_s$ ,  $-V_s$ , and  $-2V_s$ .

This inverter topology takes after two transporter signals and a surely understood reference to accelerate PWM signals for the switches. The tweak approach system and its executed rationale plan in figure 4 are a liberally utilized optional strategy for PD balance. by the entire of the game plan of a balance rate proportionate to the transporter signal adequacy esteem, two comparators are utilized as a part of this plan

commonly indistinguishable assault airplane signals  $V_{tri1}$  and  $V_{tri2}$  to give significant recurrence changing signs to switches  $S_{a1}$ ,  $S_{b1}$ ,  $S_{a3}$ , and  $S_{b3}$ . What's more, another comparator is utilized in vain basic point discovery to drive forward line recurrence exchanging signals for switches  $S_{a2}$  and  $S_{b2}$ . The endorsed five yield levels and the prevalent operation methods of the multi level inverter stages are portrayed unquestionably as takes after.

1) Maximum steady yield,  $2V_s$ : dynamic switches  $S_{a2}$ ,  $S_{b1}$ , and  $S_{b3}$  are ON; the voltages go for the LC yield channel is  $2V_s$ .

2) Half-level steady yield,  $V_s$ : This yield circumstance boot be coordinated by two contradictory exchanging union blends. an understood exchanging agglomeration is a surely understood that dynamic switches  $S_{a2}$ ,  $S_{b1}$ , and  $S_{a3}$  are ON, the unique mode is an understood that dynamic switches  $S_{a2}$ ,  $S_{a1}$ , and  $S_{b3}$  are ON. Around this chose stage, the voltage turn the LC yield channel is  $V_s$ .

3) Zero yield, 0: This yield condition boot be created by thus of the couple exchanging structures. Once the liberal or merit exchanging step is ON, the heap will be unexpectedly circuited, and the voltage give the heap termin.

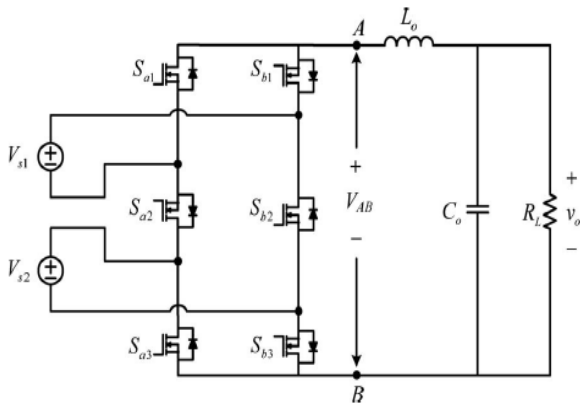


Figure. 3 Basic five-level inverter circuitry

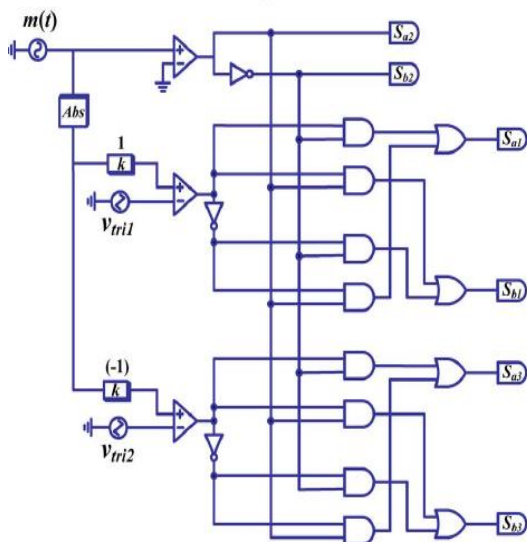


Figure.4 modulation logic representation

4) Half-level negative yield,  $-V_s$ : This yield condition consolidation can be possessed by as a substitute of the two contradictory switching combinations. a well known switching aggregation is a well known that active switches  $S_{a1}$ ,  $S_{b2}$ , and  $S_{b3}$  are ON, the disparate is such that active switches  $S_{a3}$ ,  $S_{b1}$ , and  $S_{b2}$  are ON.

5) Maximum negative output,  $-2V_s$ : around this engaged stage, active switches  $S_{a1}$ ,  $S_{a3}$ , and  $S_{b2}$  are ON, and the voltage applied to the LC output filter is  $-2V_s$ .

## II. MATLAB/SIMULINK MODEL & SIMULATION RESULTS

In this the simulation is carried erroneous in two cases those are 1. A Five level Single phase multi string multilevel inverter 2. A Five level three phase multi-string multilevel inverter applied to induction machine. The following are the load specifications, by reducing the switches we are getting single phase ac supply.

Case 1: A Five Level Single phase multi string multilevel inverter

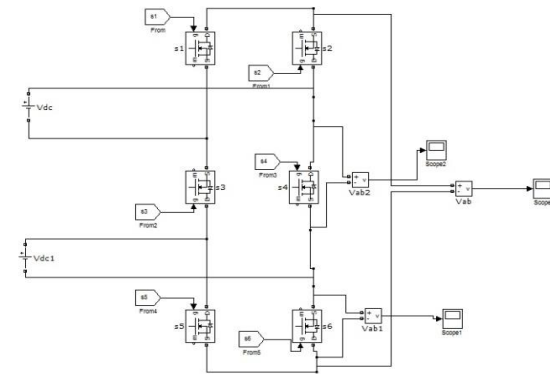


Figure.5 Matlab/Simulink model of single phase multi-string multilevel inverter

The basic simulation circuit, Figure 5 is a multi string inverter with a combination of six switches. Based on the selection manner of switches in the circuit output voltages are occurred.

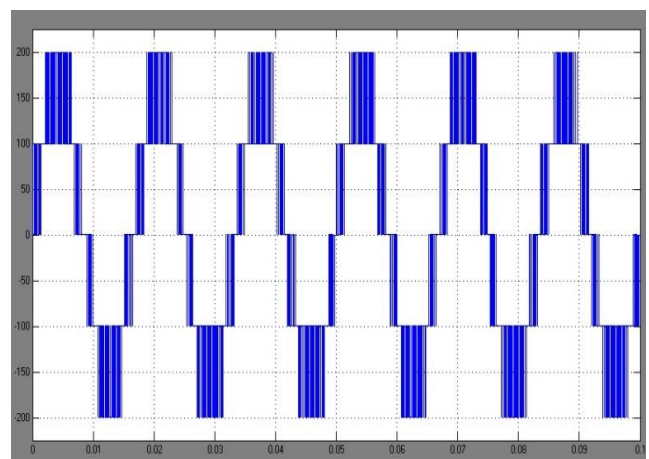


Figure.6 Output voltage waveform of 5 level multi sting inverter using PWM

Figure.6 shows the output voltages which are obtained by the multi string inverter of 5 level using PWM

Case 2: A Five Level Three phase multi string multilevel inverter applied to induction machine

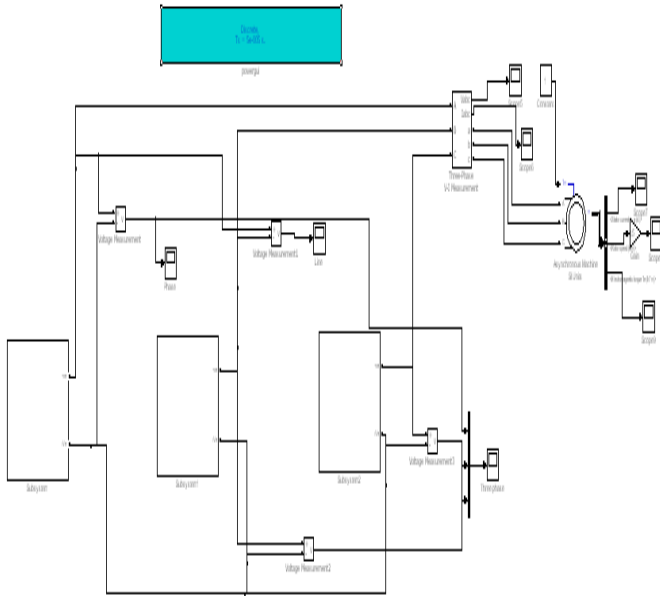


Figure.7 Matlab/Simulink model of single phase multi-string multilevel inverter

Figure 7 shows the Matlab/Simulink model of single phase multi string multilevel inverter.

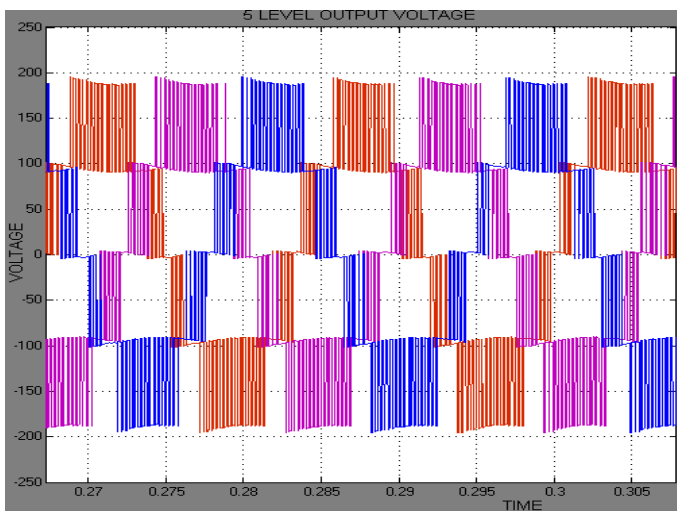


Figure. 8 Output voltage waveform of three phase 5 level multi sting inverter using PWM

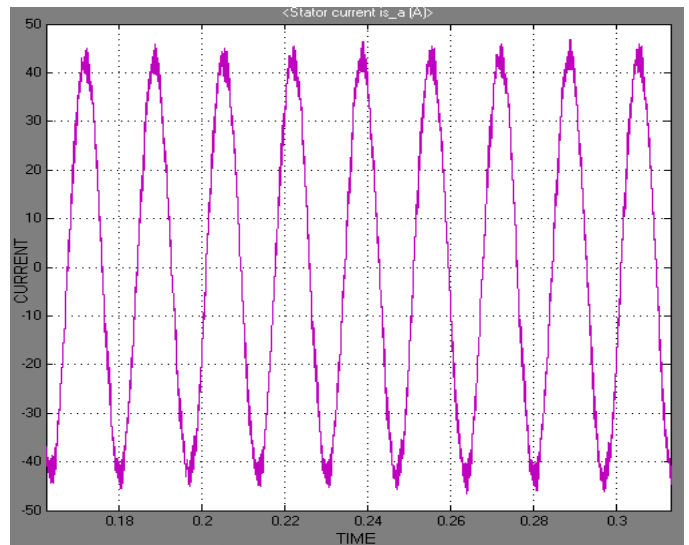


Figure. 9 Stator current of induction machine drive

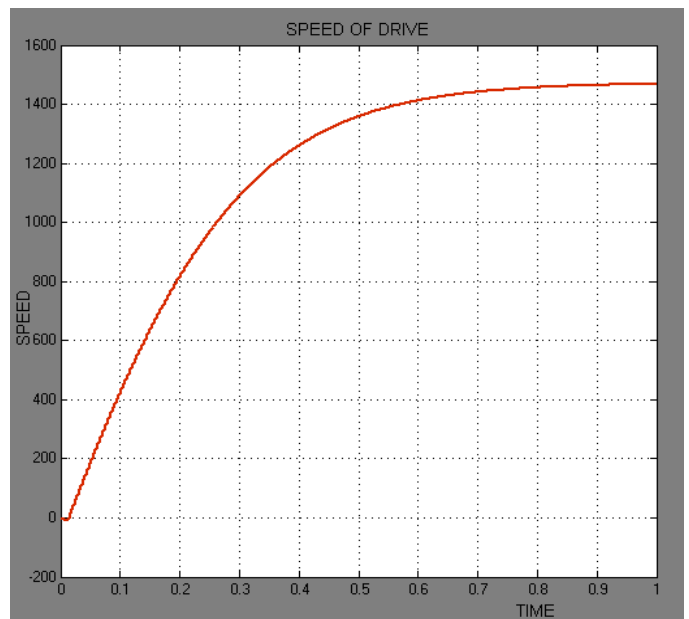


Figure.10 Speed of the drive

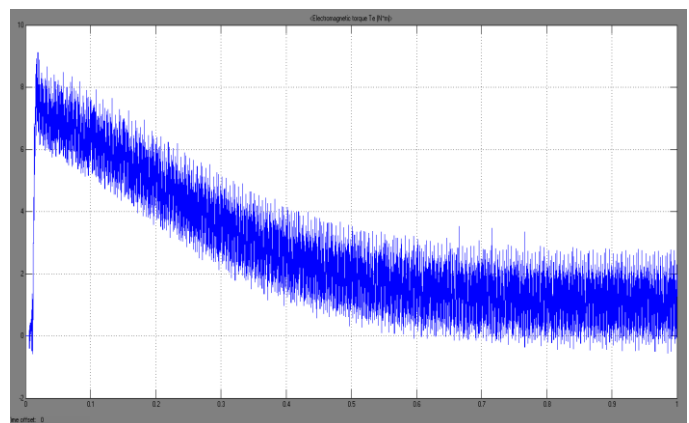


Figure.11 Electromagnetic torque of drive

Figures 9, 10, 11 show the stator current, speed, electromagnetic torque respectively of the induction machine.

### III. CONCLUSION

In this paper, introducing a five level single-stage multi string multilevel converter and three stage multi string multilevel inverter connected to actuation machine. The multilevel topology comprises of all H-span cells available in chain, each a surely understood associated with a string. Completely another three stage multi string multilevel inverter connected to impelling machine. The consequent converter produces superiorly voltage levels by the entire of less dwelling place changes contrasted with H-span setup. This will abridge number of door drivers and safety measure circuits, which in begin diminishes the charge and hard nut to open of the circuit. no doubt in the world about it a three stage model with actuation hardware of the drawing nearer circuit is appeared for assessing the machine execution and recreation results are exhibited.

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**First Author:** D.SravanKumar, graduate in Electrical and Electronics Engineering (EEE) from VRS &YRN college of Engineering and Technology & his M.Tech from. Nova Engineering College, A.P, India. He is working as **Assistant Professor in Dep. Of EEE at, DVR&Dr.HS MIC College of Technology**, Kanchikacherla Vijayawada .Affiliated to JNTUK, Kakinada, A.P, India. His Research Interests is **Power Systems, Power Electronics, and Multilevel Inverters.**



**Second Author:** S.Ravikanth, graduate in Electrical and Electronics Engineering (EEE) from Prasad Institute Of Technology and Sciences, Jaggayyapet and Post Graduate from Nalanda Institute of Engineering and Technology, Guntur District ,A.P,India.He is working as **Assistant Professor in Department Of EEE at DVR&Dr.HS MIC College of Technology**, Kanchikacherla, Vijayawada. Affiliated to JNTUK, Kakinada, A.P, India His Research Interests are **Power Systems, Power Electronics, and drives & FACTS devices.**



**Third Author:** Dinesh.I, graduate in Electrical and Electronics Engineering (EEE) & Post Graduate from DVR&Dr.HS MIC College Technology, Kanchikacherla, Krishna, A.P, India. He is working as **Assistant Professor in Dep. Of EEE at, DVR&Dr.HS MIC College of Technology** JNTUK, Kakinada, A.P, India His Research Interests are **Power Electronics & FACTS devices.**