ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Asymmetric Multilevel Inverter for Single Phase Induction Motor

Pinky Arathe
Department of Electrical and Electronics Engineering, Central India Institute of Technology (CIIT), Indore, M.P 453771, India.

Sunil Kumar Bhatt
Department of Electrical and Electronics Engineering, Central India Institute of Technology (CIIT), Indore, M.P 453771, India.

Abstract:
Multilevel inverters convert are mostly used for the high power applications because their ability to operate that the higher output voltages also produces lower levels of harmonic distortion components in the switching output voltage. In the electric power quality harmonic contents is one of the major problems so there are so many methods for indicating the quantity of harmonic distortion contents. The most widely used measure is the total harmonic distortion (THD). If the number of levels increases the harmonic content will simultaneously get reduced. SPWM method is used to reduce harmonic components of output voltages. Multilevel inverter can be realized by cascading of H-Bridges. Cascaded or H-bridge multilevel inverter with separated DC sources is the feasible topology to use as a power conversation for medium and high power applications.THD will reduce with increase the number of levees with the help of PWM techniques.

Key Words: ***Single phase IM, MLI, SPWM, LSPWM, THD, PD, and IGBT.***

Introduction

When Technology is getting advanced day by day. We are also getting advanced. The living standards are now raised. People demand for efficient work in less time and less cost. In fact people are also doing more hard work to sustain in competitive environment. The same is with the motors. They too have to prove themselves as tough and beat the competition. One such much known competitor is asynchronous motor. Multilevel inverter has become popular to fulfill usage of power [1] generally simple inverter gives 2 or 3 level output voltage but multilevel inverter gives more output voltage levels. It produces a stepped output voltage with reduced harmonic distortion when compared to a two level inverter. Multilevel inverters are basically 3 types [2]

- Flying capacitor inverter (FCI)
- Cascaded inverter (CI)
- Diode clamped inverter (DCI)

The DC to AC converters, also called Inverter, convert DC power to AC power at desired output voltage and frequency. The conversion process has to be efficient to achieved high efficiency, static switch are used, which are on and off at regular interval to be obtain the task of conversion. If change in width of pulse in Inverter variation in magnitude of fundamental and harmonics. This voltage fed into the induction motor, we can control speed of machine.

Overview of IM (Induction Motor)

These motors consist of rotor which has copper bars. Copper bars are placed in rotor slots. In order to complete the path of rotor circuit these copper bars are short circuited with the help of end rings from both the sides. The solid end rings usually use copper, brass or aluminium for completing the rotor path.

Overview of Control Techniques of Motor

The achieve variable speed of IM is derived from the formula given as

$$N_r=(1-s) \qquad (1.1)$$

Thus, in IM speed can be controlled by controlling two parameters i.e. synchronous speed and slip s. There are various method of control speed of IM, i.e. Stator Voltage Control, Frequency Control Method, Rotor

Cite this article as: Pinky Arathe & Sunil Kumar Bhatt, "Asymmetric Multilevel Inverter for Single Phase Induction Motor", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 6 Issue 5, 2019, Page 49-53.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Resistance Control, EMF Injection Method, Pole Changing Method and Cascading of Induction Motors shown in fig 1.1

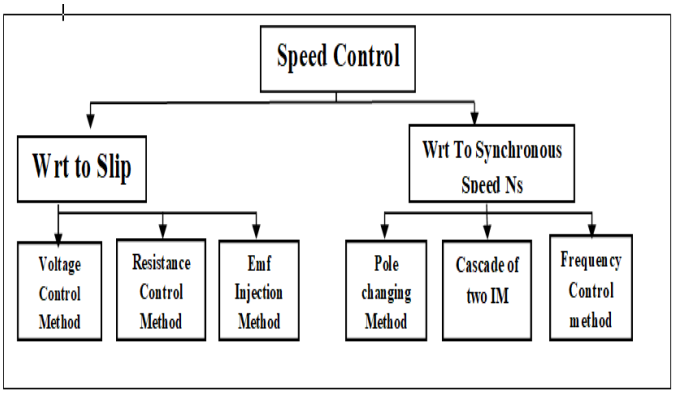

Fig 1.1 Classifications of Speed Control Techniques of Induction Motor

Other than that two more Techniques is also used to control the IM speed, one is the Scalar Control method(also called V/F control technique)and second one is Vector Control Method.

Overview of MLI

All electrical company who works in power and drives system the MLI have play very important role. Specification of MLI is normalized power, reduced the noise and improved the power quality. We can change only structure without destroy circuit gives high power and high voltage.

Inverter is a static device structure which converts DC Power into AC Power with required frequency level but in this, produces power with some harmonic component. Now MLI is also type of inverter which reduces the harmonic component in output power. MLI Input is DC Power but output AC power. Output having different level which comparatively sine wave. If we increase level of inverter the going to nearby sinusoidal voltage without harmonics.

Inverter made by without transformer to achieve the high voltage level and less harmonics content. Now this day MLI used in many applications in industry for the convert voltage or maintain the power quality such as all types FACTS devices STATCOM, SCV, UPQC, and UPFC etc.

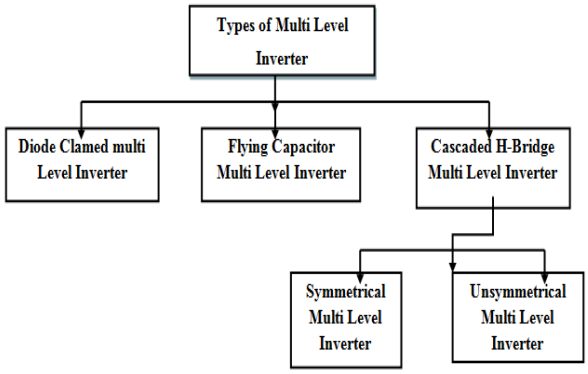

Fig 1.2 Types of Multilevel inverter

Here fig 1.2 shows types of Multi Level Inverter which having Diode clamed, flying Capacitor and Cascaded H-bridge and types of control algorithm for control output voltage.

This paper implementing Cascade H bridge multilevel inverter with SPWM controls technology.

Operation of cascade MLI Topology

The Unsymmetrical cascaded multilevel inverter has 3 DC sources and 12 power switches magnitude of DC sources are 100V, 200V and 100V respectively. The sources are connected to 3 H-Bridge units which known as cascaded in single phase. This individual H-bridge the output voltage is +VDC, 0 or –VDC. Hence this desired output voltage for 9 level Unsymmetrical Cascade Multilevel Inverter are +4VDC, +3VDC, +2VDC, +VDC, 0, -VDC, -2VDC, -3VDC, -4VDC. To get the respective output voltage the power switches are turned ON and turned OFF.

By making of the proper combination of switches we got the desired output voltage. To get maximum output voltage +4V; the switches S1, S10, S9, S6, S5 AND S2 are ON and remaining switches are OFF at this time. For +3V; the switches S1 S10, S12, S6, S5and S2 are ON and remaining are OFF. Similarly all voltage levels can be analyzed by see the table given below Table 1

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Table 1 -Switching pattern for Unsymmetrical cascaded 7 level inverter

o/p	4V	3V	2V	V	0	-V	2V	3V	4V
S1	1	1	0	1	0	0	0	0	0
S2	1	1	1	1	0	0	1	0	0
S3	0	0	0	0	0	1	0	1	1
S4	0	0	1	0	0	1	1	1	1
S5	1	1	1	0	0	0	0	0	0
S6	1	1	1	1	0	0	1	0	0
S7	0	0	0	0	0	0	1	1	1
S8	0	0	0	1	0	1	1	1	1
S9	1	0	0	0	0	0	0	0	0
S10	1	1	1	1	0	1	1	1	0
S11	0	0	0	0	0	0	0	0	1
S12	0	1	1	1	0	1	1	1	1

Simulation program of seven level MLI

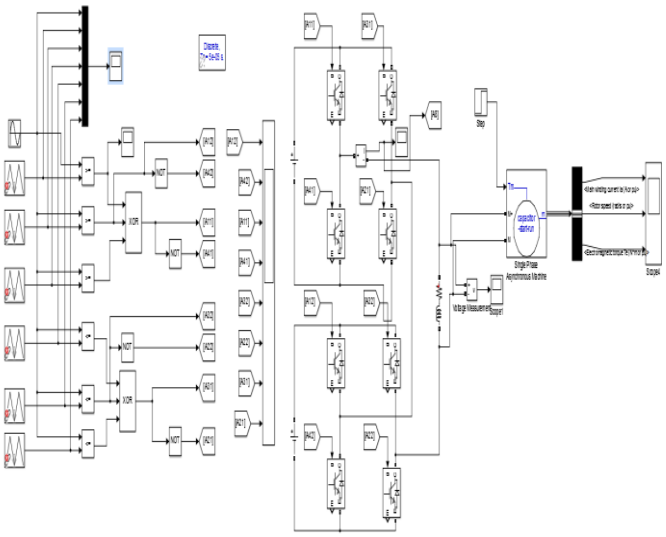

Figure 3.1 Simulation diagram of seven levels MLI with single phase induction motor

Following figure 4.1- shows the load current, phase voltage, torque, motor speed, rotor current & Total harmonic distortion of a seven-level inverter. Table five are represents various parameters used during the simulation of seven level inverter. Current waveforms are closed to sinusoidal. Fig 4.7 represents the THD graph analysis of propose seven level inverters. In this above case, the Total Harmonic Distortion value is 18.05%

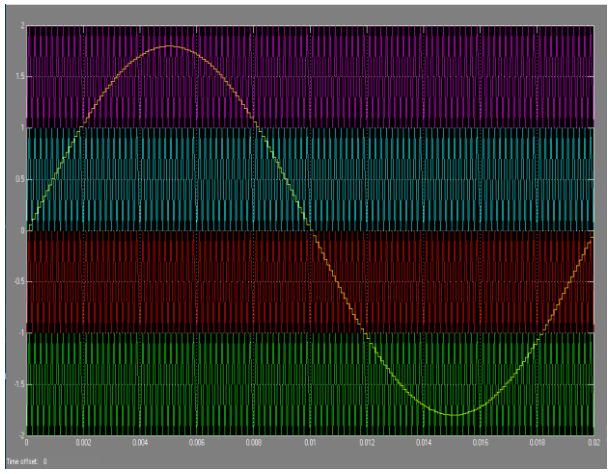

Fig 4.2 Reference waveform and carrier waveform of in-phase disposition

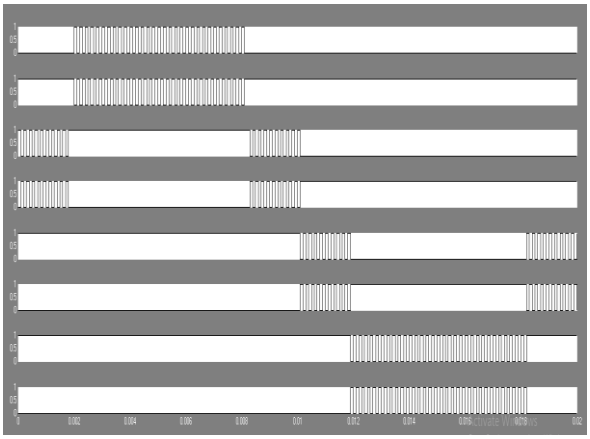

Fig 4.2(a) Firing pluses of in phase disposition

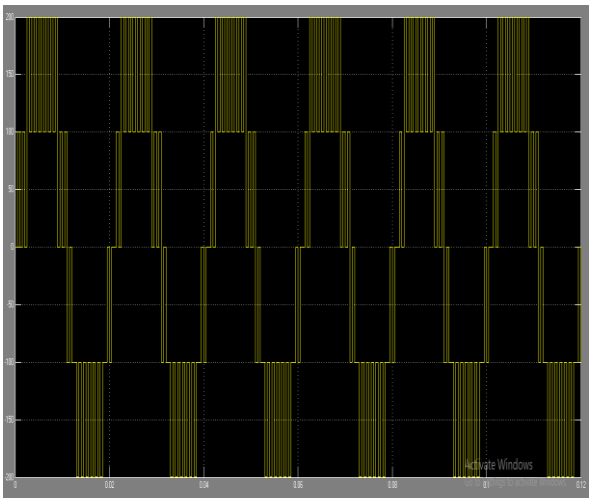

fig 4.2(b)Output wave form of seven level inverter in phase disposition

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

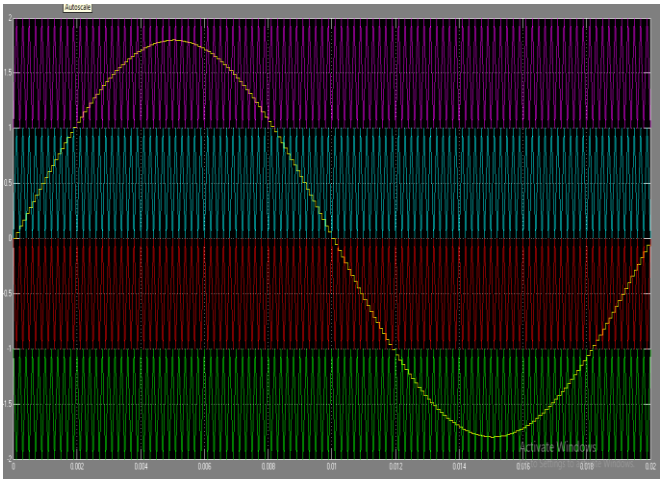

Fig 4.3 Reference waveform and carrier waveform of in-phase opposition disposition Modulation

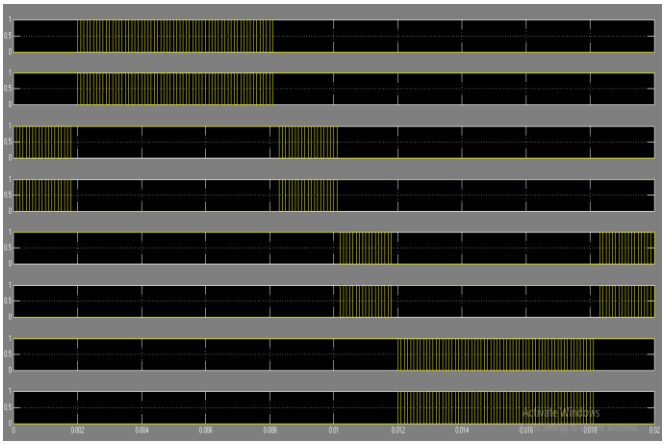

Fig 4.3(a) Firing pluses of In phase opposition disposition

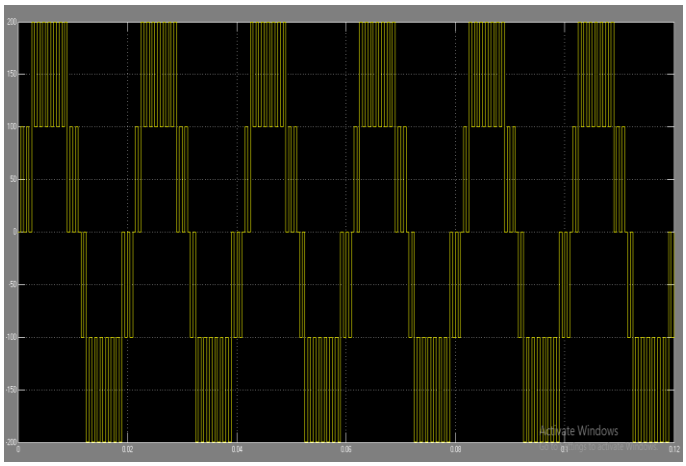

fig 4.3(b) Output wave form of seven level inverter in phase opposition disposition

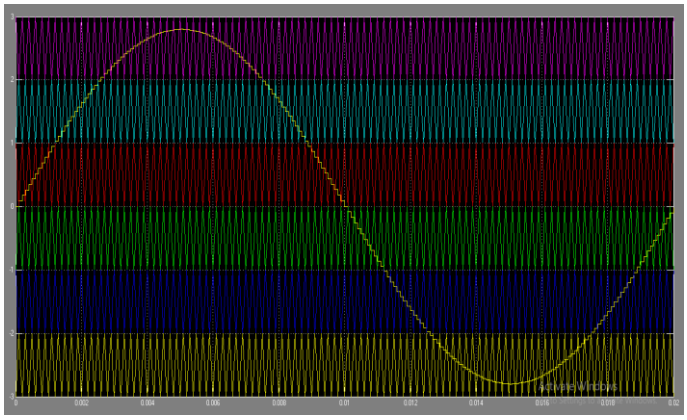

Fig 4.4 Firing pluses of In alternative phase opposition disposition

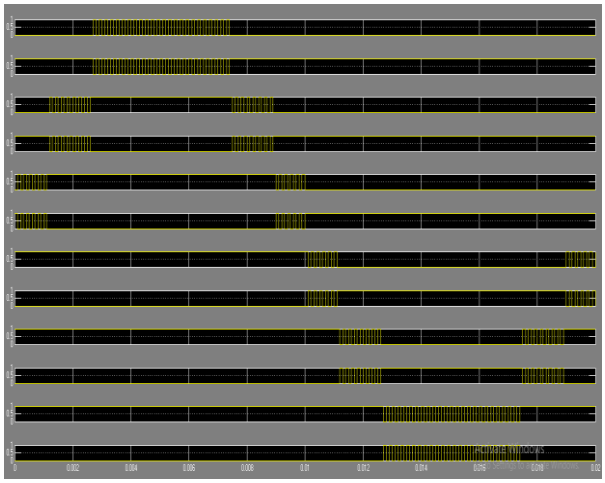

fig 4.4(a) Output wave form of seven level inverter in alternative phase opposition disposition

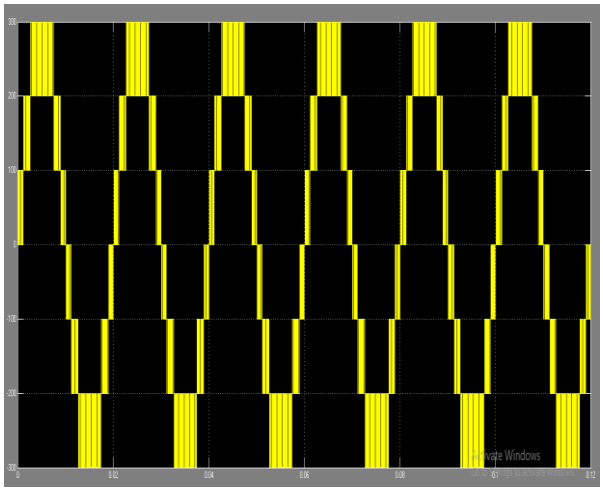

fig 4.4(b) Output wave form of seven level inverter in alternative phase opposition disposition

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Summary

In the above following thesis work we have presented type of multilevel inverters, their fundamental topologies. Modulation scheme lie under PWM also explained which is draw of attention towards the benefits of phase disposition (PD) modulation method by comparing all of them together. This mode of operation and switching pattern tactic of the new topology is presented. The simulation matlab 2011 results and experimental results show the PD modulation method is a method that can be effectively used to reduce higher level order harmonics of the multilevel inverter & results in a remarkable decrease in output voltage Total harmonic distortion.

Table-2 Comparison of different Phase Modulation of Total Harmonic Distortion

No. of Level	PD	POD	APOD
3	52.06%	54.17%	54.17%
5	26.69%	26.69%	37.13%
7	18.05%	22.48%	25.20%

Multilevel inverters provides an effective enhancement in overall switch frequency with respect to the vanishing of the lowest order switch frequency terms. In this chapter we discussed about to different type of pulse width modulation techniques. PWM methods are useful in controlling the output voltage & reducing the harmonics. There are various modulation techniques for multi level inverters, but carrier based modulation technique is quiet simple and efficient over all others.

Conclusion

Five and seven level inverters are simulated in MATLAB 2011 and the total harmonic distortions of their output voltages are also compared. We are found that the harmonics of a seven level inverter o/p voltage is the least compared to five level inverter. There is a single phase induction motor is connected to the load of the inverter and as the speed of which is the controlled by varying of the duty cycle of the pulse width modulation pulses given to the IGBT of the inverter. The presence of significant terms of the harmonics made the motor to suffer from several torque pulsations, especially at the time of low speed, which manifest themselves in teeth locking of the shaft and undesired Electromagnetic interference and motor heating. So that the multilevel inverters are the optimistic alternative and cost effective solution for high power applications and high voltage including motor drive and power quality problems.

References

[1] Bharath. K and R. J. Satputaley Dept. Of EEE, Single phase asymmetrical cascaded multilevel inverter design for induction motor , ASAR International Conference, Chapter- 2013, ISBN: 978-81-927147-0-7.

[2] Muhammad H. Rashid, “Power Electronics Circuits, Devices and Applications, 3rd ed. Pearson publication, 2009.

[3] A survey and study of different types of pwm techniques used in induction motor drive, Sandeep Kumar Singh , Harish Kumar , Kamal Singh , Amit Patel, Volume-4, Issue-1, 018-122.

[4]. J. Rodriguez, J.-S. Lai, and F. Z. Peng, "Multilevel inverters: a survey of topologies, controls, and applications," IEEE Trans. Ind. Electron., vol. 49, pp. 724-738, 2002.

[5]. J. S. Lai and F. Z. Peng, “Multilevel converters – A new breed of power converters,” IEEE Trans. Ind. Applicat., vol. 32, pp. 1098–1107, May/June 1996.

Author Details

Pinky Arathe
Student of M.Tech (Power System)
Department of EE,
Central India Institute of Technology,
Indore- 452001, M.P. India.
Email: pinkyarathe01@gmail.com