

Study Of Five Level Diode Clamed Inverter Fed 3 Phase Induction Motor Drive System For Various Parameters

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Abstract-The main aim of this study is to find out the harmonics effect of the source on the performance of the induction motor with different accepts for various application.

If the current or voltage waveforms of power source are distorted from its ideal form it will be termed as harmonic distortion. This harmonic distortion could result because of many reasons.

Keywords—Switching;current harmonics;distortion.

I-INTRODUCTION

The electrical drives is a combination of an electric motor and its electric supply system. Thus analysis cannot always be limited to the electric drives but have to be extended over the whole electric drive from the shaft-end to the electric input power supply.

The main aim of this study is to explain the effect of harmonics distortion of the input power fed through the multilevel inverter related to the deviation in motor torque torsional vibrations, etc.

A. Problem Statement

The output voltage in a conventional two level inverters are square wave in nature and it contains number of odd harmonics, which causes various losses in the induction motor and affects the performance. Thus by increasing the number of levels , Total Harmonic

Distortion and losses in the Induction Motor can be reduced”.

B. Causes of harmonics

Various industrial loads including static converters (such as electric furnace, induction heating devices and switching power supply) inject current harmonics in power systems. Generally power electronic devices such as switching sources and converters are most important sources of harmonic generation. Converters usually generate harmonics from nth level in AC side, given by

$$n = k n_p \pm 1$$

Where:

k - is a constant and

n_p is the number of converter pulses.

II. EFFECT OF INVERTER HARMONIC

1. **Third Harmonics**: Third harmonic flux waves produced by each of the three phases neutralize each other as it differs in time phase by 120°. Thus air gap flux does not contain third harmonics and its multiplies. The fundamental mmf wave produces flux which rotates at synchronous speed which given as $n_s = 120 f_1/P$ rpm where f_1 is supply frequency and P is number of poles.

2. **Fifth Harmonics**: Fifth harmonic mmf wave produces flux which rotates at $120 f_1/5P = n_s/5$ rpm and in direction opposite to the fundamental mmf wave.

3. **Seventh Harmonics** : Similarly , seven harmonic mmf produces flux which rotates at $ns/7$ rpm and in the direction of fundamental m.m.f. wave.

Thus it can be seen that harmonic m.m.f. wave produces flux which rotates at $1/K$ times the fundamental speed and in the direction of fundamental wave if $K = 6m + 1$ and in the reversed direction if $K = 6m - 1$ where m is any integer. The most important and predominant harmonics whose effects must be minimized are 5th and 7th harmonics.

A. INDUCTION MOTOR PARAMETER:

Sr No.	Parameter	Values in unit.
1	Stator Voltage	415 Volt.
2	Stator steady state Current	7.9 Amp
3	Rated Speed	1460 rpm
4	Load Torque	25.08 N-m

Table :1

B. INDUCTION MOTOR PARAMETER CALCULATED FOR SIMULATION .

Sr No.	Parameter	Values in unit.
1	Rotor Current	3.95 – 4.0 A
2	Stator Resistance	1.9- 2.4 Ohms
3	Rotor Resistance	1.8- 1.94 Ohms
4	Stator core loss current	6.356 A
5	Magnetizing Current	4.74 A
6	Excitation Current	2.72 A
7	Stator core loss Resistance	37.72 Ohms
8	Stator Magnetizing Inductor	0.1542 H
9	Magnetizing Reactance	48.44 Ohms
10	Slip	5.30 %
11	Rotor Frequency	2.65 Hz

Table :2

III- SIMULATION RESULT OF TWO LEVEL INVERTER

A) Two Level Inverter

With above parameter and rating of Induction motor, a MATLAB simulation is done for two level inverter with input DC voltage of 770 V, Modulation Index of 0.9 and switching frequency of 5khz. Following results are obtain for line current and voltage.

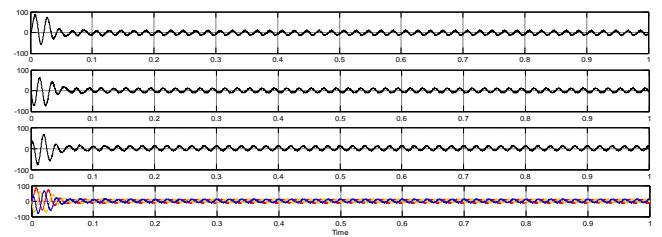


Fig : 1 Line current (Two Level)

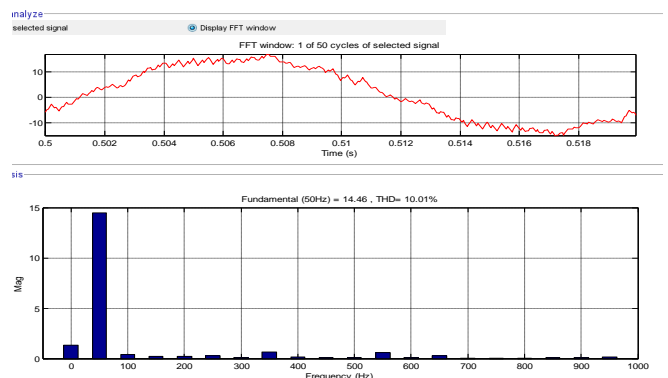


Fig 2 – THD analysis (line current - Two Level)

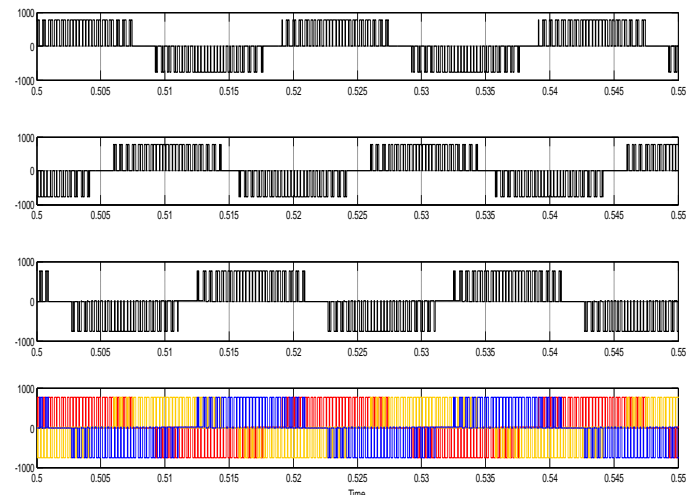


Fig : 3 Line voltage (Two Level)

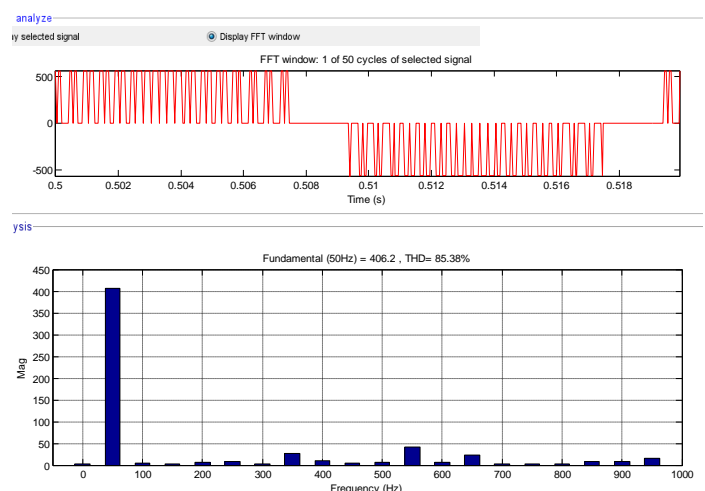


Fig 4 – THD analysis (line voltage - Two Level)

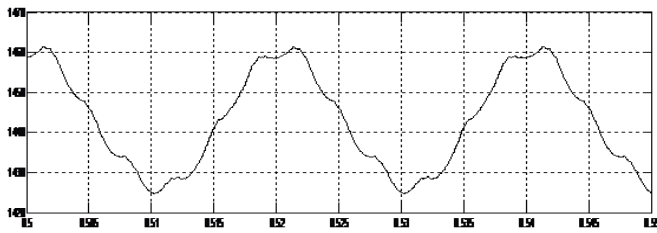


Fig 5 – Speed Deviation (Two Level)

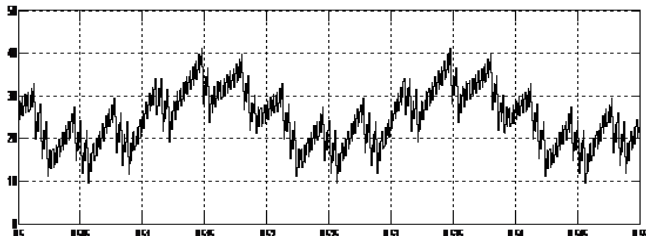


Fig 6 – Torque Deviation (Two Level)

B) Three o Level Inverter:

With the same parameter of motor and DC voltage source, a simulation is performed for Three level VSI Inverter and following results are obtain for THD analysis of line current and voltage.

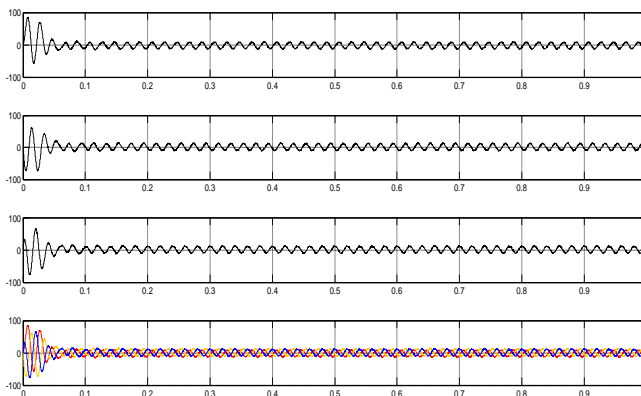


Fig : 7 Line current (Three Level)

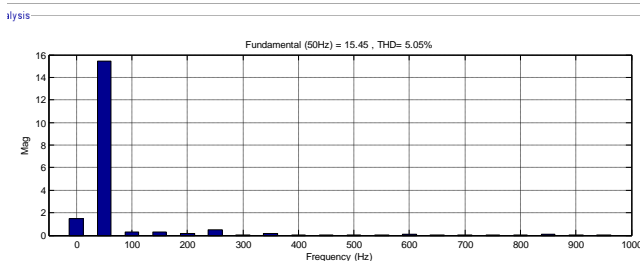
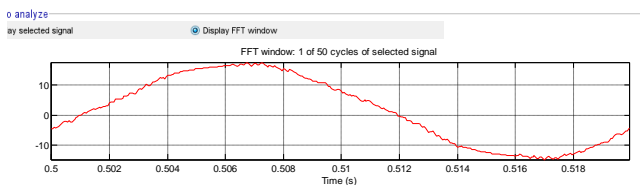


Fig 8 – THD analysis (line current - Three Level)

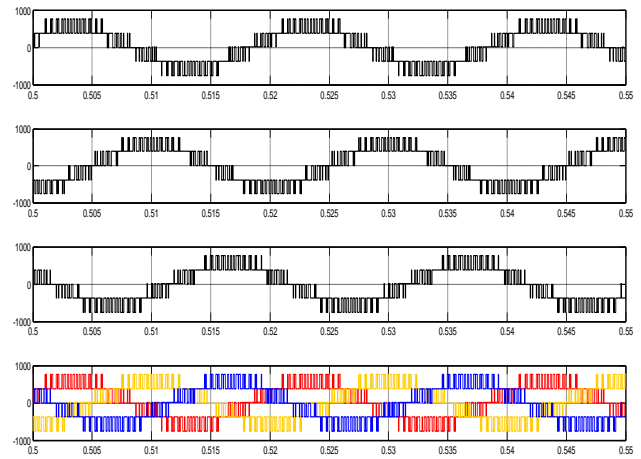


Fig : 9 Line voltage (Three Level)

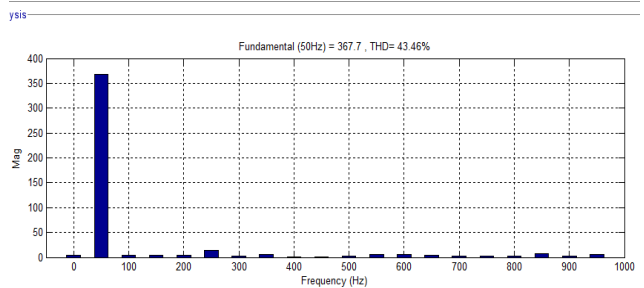
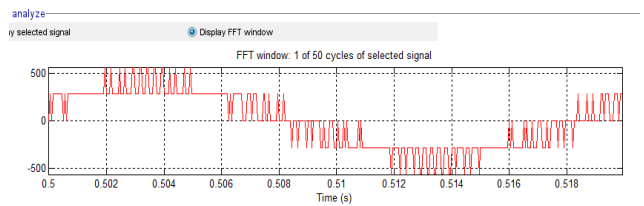


Fig 10 – THD analysis (line voltage - Three Level)

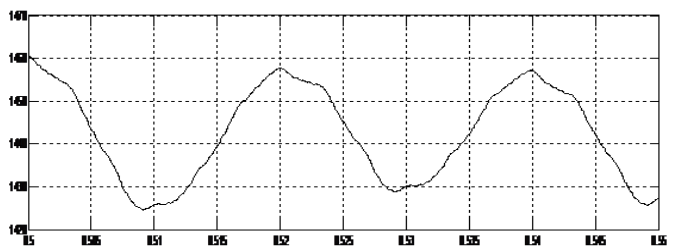


Fig 11 – Speed Deviation (Three Level)

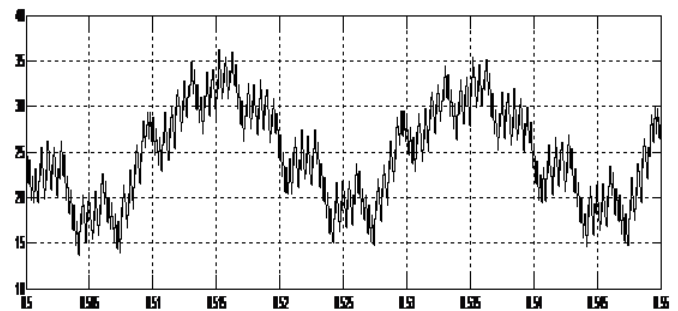


Fig 11 – Torque Deviation (Three Level)

Table : 3 - THD Comparison of Two Level & Multilevel Inverter (Three Level)

Parameter	Two Level	Three Level	% Change
Current THD	10.01 %	5.05 %	50.44 %
Voltage THD	85.38 %	43.48 %	50.92 %
Speed Deviation	1425- 1460 rpm	1435- 1460 rpm	
Torque Deviation	10-40 Nm	15-35 Nm	

Conclusion: From the above comparison table , it is seen that the input power quality of the inverter can be improved by increasing the levels of inverter , also the deviation in the mechanical parameter can also improve.

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