Variable Frequency Drive for Three Phase Induction Motor

By

Hamza Arshad 01-133162-065 Ali Raza Kiani 01-133162-091

Mohsan Ali 01-133162-095

Supervised by

Engr. Faheem Haroon



{Session 2016-20}

A Report is submitted to the Department of Electrical Engineering, Bahria University, Islamabad.

In partial fulfillment of requirement for the degree of BS(EE) .

Certificate

We accept the work contained in this re	eport as a confirmation to the required standard for
the partial fulfillment of the degree of I	BS(EE).
Head of Department	Supervisor
Internal Examiner	External Examiner

Dedication

Dedication is the expression of friendly connection or thank by the author towards another person. This includes a variety of people, including a parent, a spouse or partner, a friend, a supervisor, or a colleague, sibling or other family member.

Acknowledgements

We start by thanking Allah for giving us such passion to complete our work at this stage of life. We thank everyone especially who are guiding us throughout our degree and who helped us in order to achieve this kind of work. We provide our deepest thanks to project In charge **Engr. Madiha Khalid** and to our project supervisor **Engr. Faheem Haroon** for their monitoring and their complete guidance to fulfil our goals and aims in this work.

Abstract

Motor vehicle installations for many years have been considered as backbone for industrial applications. If the induction motor is directly connected to for example main supply it will operate at its limit speed at which it can. On the other side, a lot of applications requires performance at variable parameters. Our main and foremost aim is to increase enegy saving by introducing this project. To achieve this ability a variable speed control drive is used along with the load to get variable parameters for example in cars. Indeed it results in the best performance and most efficient delivery of the imported car.[1]

Controlling the variable speed frequency provides an easy and efficient way to control the open-loop speed of the motor phase induction. This we applied is known as V/F control. In this paper system the functionality of the V/f drive is summarized. Our strength depends on the square wave produced by the controller and after passing through the circuit to drive the switch using the motor.

This paper incorporates Voltage, current and speed test results at different frequencies which show that the driving speed varies depending on the frequency and at the same time the power transmission is controlled to keep the V / f ratio constant.

Table of contents

1	Intro	duction	
	1.1	Background	10
	1.2	Motivation of the Project	10
	1.3	Problems faced	11
	1.4	Possible Solutions to Problems	11
	1.5	Objectives of Project	12
2	Litera	nture Review	
	2.1	Defining VFD	14
	2.2	About 3-phase Induction Motor	15
	2.3	Working of VFD and Motor	17
	2.4	Basics of VFD	18
	2.5	Operator Interface Part	20
	2.6	Derive Operation	21
	2.7	Working Principle of VFD	22
	2.8	Application	24
	2.9	Advantages	25
3	Requi	rement specifications	
	3.1	Design Strategy	28
4	Syster	n Design	
	4.1	Algorithm	37
	4.2	Explanation of Different Parts	40
	4.3	Mosphet IR2110 Driver	41
	4.4	Hardware Setup	48
5	Syster	n Implementation	
	5.1	System Integration and Interface	50
	5.2	PIC16F877A Explanation	51
	5.3	Main PCB Diagram 3D layout	51
6	Testing and Evaluation of VFD		
	6.1	Testing and Evaluation	53
	6.2	Circuit Diagram of Controller in Proteus	53
	6.3	Waveform of output and Controller	55
7	Concl	usion	
	7.1	Conclusion	59
	7.2	Benefits in daily life	59
8	Refer	ences	60

List of Figures

Figure. 2.1	Ideal waveform of PWM compared with sinusoid	14
Figure. 2.2	Parts of 3-Phase Induction Motor	15
Figure. 2.3	Squirrel cage induction motor Rotor	16
Figure. 2.4	Phases of 3-phase induction motor	16
Figure. 2.5	Basic Components of VFD	19
Figure. 2.6	Simple Diagram of VFD	20
Figure. 2.7	Drive operation Quadrants	21
Figure. 2.8	Real waveform of sinusoidal as compared to PWM waveform	24
Figure. 3.1	220v to 110v transformer	28
Figure. 3.2	Windings of stator of an Induction Motor	30
Figure. 3.3	Three phase induction motor terminal box Connector	30
Figure. 3.4	Star along with Delta Connections	31
Figure. 3.5	Squirrel Cage Rotors and Wound Rotors	32
Figure. 3.6	Squirrel Cage Rotor	33
Figure. 3.7	All Parts of induction motor	33
Figure. 4.1	Fixed fan application in variable frequency drive	39
Figure. 4.2	The induction motor making	40
Figure. 4.3	V/Hz graphs	41
Figure. 4.4	Basics of VFD	42
Figure. 4.5	Output Results	42
Figure. 4.6	Induction motor speed-torque Characteristics	43
Figure. 4.7	Induction motor torque speed by V/F control Method	43
Figure. 4.8	Block Diagram	44
Figure. 4.9	Symbols of Motor	46
Figure. 4.10	Simple Rectifier with Filter	48
Figure. 5.1	Proteus Interface	50
Figure. 5.2	3D layout of Simulation	51
Figure. 6.1	Whole Controller Simulation	53
Figure. 6.2	Simulation Output Waveform	54
Figure. 6.3	Hardware Setup	
Figure. 6.4	Output at 1.25Hz freq	55
Figure. 6.5	Output at 3Hz freq	55
Figure. 6.6	Output at 5Hz freq	56
Figure. 6.7	Output at 1Hz freq	56
Figure. 6.8	Output at 5Hz freq	57
Figure. 6.9	Output at 12Hz freq	57

List of Tables

Table 2.1 V/F ratio for different values of F and V

23