

**DESIGN OF FILTER FOR REDUCING HARMONIC
DISTORTION IN
INDUSTRIAL DISTRIBUTION SYSTEMS**

Project Report is presented in partial fulfillment for the award of the
Bachelor of Electrical Engineering (Honors) of
UNIVERSITI TEKNOLOGI MARA



LILY HARYANI BTE KAMARUDIN
Faculty of Electrical Engineering
Universiti Teknologi Mara
40450 Shah Alam, Malaysia
NOV 2007

ACKNOWLEDEMENT

The author wishes to extend his sincere gratitude to her supervisor, Dr. Noraliza Bt. Hamzah for her valuable guidance and encouragement during the period of the research project. Special thanks to Universiti Teknologi Mara (Uitm) for giving the opportunity to undergo this research entitle of “Design of Filter for Reducing Harmonic Distortion in Industrial Distribution Systems “.

The author also would like to forward her appreciate to her parents and friends for their kindness and attention. Last but not least, to those who helped the author whether directly or indirectly while during the thesis.

Thank you very much and may god bless you always.

ABSTRACT

Power quality is the degree to which both the utilization and delivery of electrical power affects the performance of electrical equipment. Harmonics power quality issues have been taken into consideration. Harmonic is a term that describes sinusoidal waveforms that operate at a frequency that is a multiple of the fundamental 50 or 60 Hz frequency. Frequency in Malaysia is 50 Hz. Harmonic in power systems shortens the equipment's life expectancy and effect in the electrical distribution system. The most significant effects of high frequency harmonic currents such as inductive heating of transformers, generators, motors, relays, coils and etc.

This paper presents the mitigation techniques in power distributions system by using passive filter and active filter. The basic principle operations for both type of filter have also been observed. Both type of filter was designed to mitigate the harmonic generated by adjustable speed drives (ASD). Studies are made to investigate which filters are more effective in reducing harmonic distortions using PSCAD software.

PSCAD is a general-purpose time domain simulation program for multiphase power systems and control networks. PSCAD enables the user to schematically construct the circuit, run a simulation, analyze the results, control meter and plotting the graph.

The simulation results show that these two types of filter can reduce the harmonic distortion. Simulation results show that the active filter is more effective in reducing harmonics as compared to passive filter. The study also proves that both filters give better performance in reducing harmonics when they are placed close to the harmonic producing loads. The evaluations of harmonic distortion for end users are according to IEEE Standard 51.

TABLE OF CONTENTS

CHAPTER	DESCRIPTION	PAGE
1	INTRODUCTION	
	1.0 Introduction	1
	1.1 Project Objective	3
	1.2 Scope of Work	3
	1.3 Thesis Organization	3
	1.4 IEEE Guideline	4
2	LITERATURE SURVEY	
	2.0 Introduction	5
	2.1 Power Quality Problem	5
	2.2 Example Of Power Quality Problems	
	2.2.1 Voltage Sag	7
	2.2.2 Power Failure Or Blackout	8
	2.2.3 Frequency Variation	9
	2.2.4 Harmonics	9
	2.2.5 Spike	10
	2.3 PSCAD	11
	2.3.1 Typical PSCAD	12
	2.3.2 Application Of PSCAD	13
	2.4 IEEE Guideline for Harmonic	14
3	THEORY ON HARMONIC	
	3.0 Introduction	16
	3.1 Harmonic Studies	16
	3.2 Harmonic Voltage Distortion	17
	3.3 Harmonic Distortion	18
	3.4 Source of Harmonics	19

3.5	Effect of Harmonics	20
3.6	Harmonic Mitigation Techniques	
	3.6.1 Harmonic Filter	22
	3.6.1.1 Passive Filter	22
	3.6.1.2 Active Filter	24
	3.6.2 Capacitors	25
	3.6.3 Converter	25
	3.6.4 Telephone Line Interference	26
4	METHODOLOGY	
4.0	Introduction	27
4.1	Project Implementation	27
	4.1.1 PSCAD Software and Simulation	28
	4.1.2 IEEE 13-Bus Industrial Distribution System	28
	4.1.3 Design Shunt Passive Filter	
	4.1.3.1 Theory of Shunt Passive Filter	30
	4.1.3.2 Basic Operation of Shunt Passive Filter	30
	4.1.3.3 Design Passive Filter	30
	4.1.3.4 Configuration of Passive Filter	31
	4.1.4 Design Active Filter	
	4.1.4.1 Theory of Active Filter	32
	4.1.4.2 Basic Operation of Shunt Active Filter	33
	4.1.4.3 GTO Switching Characteristic	34
	4.1.4.4 Design Shunt Active Filter	35
	4.1.4.5 Configuration of Shunt Active Filter	35