

STUDY OF CURRENT HARMONIC REDUCTION IN OFFICE BUILDING

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Bachelor of Electrical Engineering (Industrial Power)

June 2013

“ I hereby declare that I have read through this report entitle “Study Of Current Harmonic Reduction In Office Building ” and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)”

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STUDY OF HARMONIC CURRENT REDUCTION IN A OFFICE BUILDING

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**A report in partial fulfilment of the requirement for the degree of Electrical
Engineering (Industrial Power)**

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

JUN 2013

I declare that this report entitle “Study of Harmonic Current Reduction in a Office Building” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name :

Date :

Especially To My Lovely Ummi

ACKNOWLEDGEMENT

Alhamdulillah first gratitude to Allah S.W.T for His mercy and grace, finally I be able to complete my report for the Final Year Project. I able to finish and complete a report entitle” Study of Harmonic Current Reduction in Office Building”.

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ABSTRACT

The main point of this project is to study current harmonic distortion in low voltage of office building. As we know that, harmonic distortion is the changes in the waveform of the supply voltage from the ideal sinusoidal waveform. In the other side, harmonic distortion also known as any repetitive waveform of voltage and current describe by quality total harmonic distortion which is also known as THD. In fact current generated by modern office equipment. An analysis of harmonic distortion in building for electrical installation with computer devices will be studies. A set of method or technique to attenuate the harmonic distortion will be cover during this project. Besides that, there are two types of filter that commonly used to attenuate this problem which is passive filter and active filter. In this project also, simulation of the MATLAB will be shown. Simulation of MATLAB will be used to stimulate the data that collected from the harmonic effect.

ABSTRAK

Keutamaan projek akhir tahun ini adalah untuk mengkaji kadar gangguan harmonic semasa dalam sesebuah bangunan yang dihuni. Sepertimana yang kita tahu, gangguan harmonic ini berlaku adalah disebabkan perubahan dalam bentuk gelombang voltan dari bekalan gelombang sinusoidal yang ideal. Dalam pada itu, gangguan harmonic ini juga dikenali sebagai gangguan berulang voltan dan arus yang mana ia digambarkan sebagai hasil tambah semua gangguan harmonic didalam sesuatu system yang dikenali sebagai THD. Alatan pejabat moden seperti computer, mesin Photostat dan juga jumlah lampu didalam sesuatu bangunan mampengaruhi hasil analisis gangguan harmonic ini. Terdapat beberapa kaedah yang boleh digunakan untuk mengurangkan kadar gangguan harmonic didalam sesuatu bangunan yang dihuni. Antaranya ialah menggunakan penapis seperti passive filter dan juga active filter. Dalam kertas kerja ini, kita akan melihat kelebihan yang ada pada active filter kerana ia amat sesuai untuk digunakan didalam system untuk mengurangkan kadar harmonic dalam bangunan yang dikehendaki. Untuk menunjukkan hasil yang memuaskan, software seperti MATLAB/Simulink telah digunakan untuk memperolehi data-data yang dikehendaki. Tambahan pula, ia akan dibuktikan melalui hasil kaedah yang diperolehi daripada makmal yang telah dijalankan ujian harmonik ini.

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CHAPTER 1

INTRODUCTION

1.1 Background

In electrical power system, harmonic current pollution is a one of the most major power quality problem that need to be solve to get the good or excellent power supply. This make power quality is really important in the distribution system. In the other side, there also several phenomena that can cause an interruption or disturbance due to the power supply which is overvoltage , voltage sags, voltage surges and harmonic.

In this report, current harmonic reduction due to the office building will be discovered. As already know, that the term of harmonic commonly referred to the power quality in ideal world. That meanhow pure the voltage is and how pure the current waveform is in the sinusoidal form from the source can be seen. For information also, the ideally electrical supply should have a perfect sinusoidal waveform without any kind of distortion.

Harmonic distortion can be shown when current or voltage waveforms are distorted from its ideal sinusoidal form. By the way, the harmonic distortion can give result of many reasons. Nowadays, an engineer that related with this field need to derive or find a new method to reduce the harmonic distortion. So with the increase of the complex designs in the industry harmonic distortion has increased very well.

1.2 Problem Statement

Current harmonic distortion can be identifying due to the non-linear relationship between the voltage harmonic and percentage load of the common harmonic producing device like electrical equipment in the office building [1] . As already know that harmonic distortion is a pollution form of the electric network which is being problematic when the sum of harmonic current is biggest compare to the boundary-values. In office building, the electrical circuits that were designed for a relative plug load may be overload by electronic equipment.

This because there are growing and implementation in electronic equipment that widely used nowadays. Electronic equipment like fax machine, printers, computers and air conditioner actually can provide a significant increase in office productivity. Besides that, this equipment will turn on a high percentage of overall demand factors. In the same time, it's also allowed maximum load as a per cent of connected load. Building wiring also can associate the most losses of the harmonic.

A wiring model was developed for a typical commercial building functionality to evaluate the energy loss impact of harmonic and reactive current. The main focus and objective that an engineer needs to be pay attention about this power quality which is they need to know the power system that would be generating the electrical energy to the end user. One of the main reasons is the user need to be informing about the power quality issue like sagging and harmonic distortion. These make the importance given to the power quality that needs to be learning.

1.3 Objectives

The main objective that had been identified in this report is to find the solution of the statement problem that effect the harmonic current reduction in office building at UTeM. Objective that identified are as follows:

1. To study and identify what problem that created harmonic current reduction in office building at UTeM.
2. To make analysis of the impact and causes for the problem occurred.
3. To solve the problem that created by harmonic current reduction in office building.

1.4 Scope

The scope of this project is to study about harmonic source in office building. In this project, the total harmonic distortion (THD) had been discuss. This report have been create to limit harmonic current in power system using total harmonic distortion of the current and voltage as the main criteria. This project also wants to mitigate the harmonic distortion due to voltage and current waveform. In the same time, to find the best solution which is to attenuate the current and voltage waveform by using the method that selected. In this project, MATLAB Software will be used to do the simulation and the data will be collected from the simulation. The data will be collect and record before do the further analysis. The experimental also had been used to collect the data that need to compare with the simulation data. In this report the equipment laboratory of PascaSiswazah in Faculty of Electrical Engineering had been used to collect the data.

CHAPTER 2

LITERATURE REVIEW

2.1 What Is Harmonic

Harmonic are the one of the major concern in a power system. In the power system, harmonic can cause the distortion due to the current and voltage waveform. So for us, to analysis the harmonic is from the non-linear loads. Unfortunately, for over many year of research, these methods have the complex result to analysis. So much important for the engineer to given the much batter for the method of analysis and find the way how to control the harmonic [1].

In the other side, harmonic can present in power system with the non-integer multiplies of the fundamental frequency and have a periodic waveform. For our information, the harmonic that generated in the power system comes from two distinct types of loads. For the first category of loads, it can be describe that load as linear loads. At this part, what can be seen that the linear time-invariant loads are characterized such that applications of sinusoidal voltage result in sinusoidal flow of current [1].

For power system, it can be see that any item of equipment which is draws current from the supply which is proportional to the applied voltage and it called linear load. There is an example of this linear load which is incandescent lamps. The current and voltage waveform associated with linear load are shown in Figure 1.0 [2].

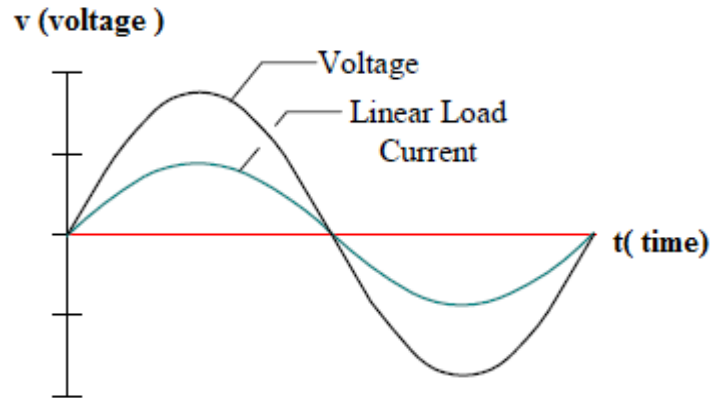


Figure 1.0: Voltage and Current Waveform for linear load [2]

For the second category, non-linear load can be considered. For a non-linear devices, the application of sinusoidal voltage that not result in a sinusoidal flow which is applied to sinusoidal voltage [1] .

The term nonlinear is used to describe the load which is their draw current from the supply is not similar in shape of the applied voltage. The examples of this case include discharging lighting, computer and variables speed drives. This nonlinear current can distorts the voltage supply waveform [2].

Meanwhile for the voltage drop across the source impedance, it was subtract from the induced voltage resulting in the distortion of the supply voltage form. From this study, what can beseeing that majority of nonlinear loads is equipment that utilizes the power semiconductor device for power conversion [2]. This also include the computer Switched Mode Power System (SMPS) that convert the AC to DC [2]. Figure 1.1 below show the typical current waveform of a computer switched mode power supplied unit [2].

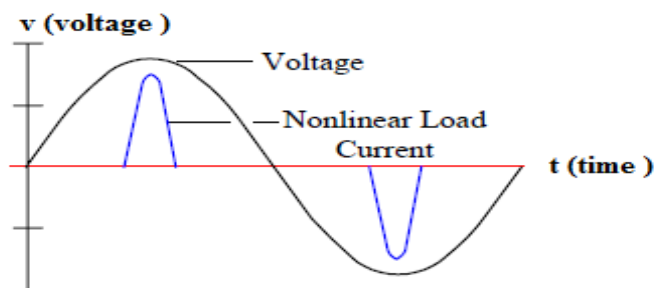


Figure 1.1: Typical Computer Nonlinear Load. [2]

2.2 Total Harmonic Distortion (THD)

One equation had to be used to calculate the nonlinearity of the load or distortion in a waveform are given by the equation in (1) and it's called as total harmonic distortion (THD). THD is the ratio of the RMS value of the total harmonic current and RMS value of the fundamental portion, I_1 of the waveform. Usually this value was express in percentage [17].

$$THD = \frac{\left(\sum_{h=2}^N (I_h)^2 \right)^{1/2}}{I_1} \quad (1)$$

Where I_1 and I_h can be present as the magnitude of the fundamental and h is the harmonic component respectively of the current or the voltage waveform.

2.3 Reduces of Harmonic.

There are two type of filter that currently used in order to reduce the harmonic distortion which is active filter and passive filter. For active harmonic filter, this is an electronic device that can be used to eliminate the unwanted or undesirable harmonic on the network system by inserting negative harmonic into the network. The active filters are normally available for low voltage networks. In active filter configuration, it's have an active component like IGBT-Transistor and this can eliminate many different harmonic frequencies [1].

Meanwhile for the signal types, it does also can be in single phase AC or three phase AC. In the other side, for harmonic filter, it consists of passive component such as resistor, inductors and capacitors. The passive filter are commonly used and this filter also available for different voltage level and this is different if compare with the active filter that currently used for low voltage[1].

For our information, total harmonic distortion should be less than 5% through a plan of distribution system as the standard and if the THD measurement above than 5%, so that distribution need to be investigated. Therefore, there are important to use this filter for reduce the harmonic by using the solution that available soit can prefer to measure the effective harmonic filter. This is for ensure the effective of minimization of Total Harmonic Distortion (THD) [15].

2.4 Effect of Harmonic

There was several effect of three phase harmonic on circuit. Harmonic distortion can lead a problem for the plant distribution system, utility distribution system and other equipment services by the distribution system [11]. What can be seen here that harmonic can affect the voltage distortion due to their excessive temperature rise in motor, electrical noise and also sensitive electronic multifunction [12].

In the other side, this harmonic distortion can effect the efficiency of the equipment which is it can lead it to immediate multifunction for equipment or equipment trip. This effect can lead to equipment overheating and make a reduction in service life by a factor of up and can effect economic loss [13].

In office building, this harmonic distortion can give a problem due to the power system inefficiency. Some of the negative ways that can effect the equipment are listed below:

- a) Equipment like computer and telephone may have been experience due to the interference or failure for the user [11].
- b) Utility meter that used at the office building can record incorrectly measurement and as a result make a higher billing to the consumer [11].
- c) The using of fuses and circuit breaker in the office building equipment in the office building can cause the harmonic distortion to the equipment due to their false or malfunction operation or trip. In the other side, if can damage and blow the compound without reasonable reason. [11].