



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MICROCONTROLLER- BASED VOLTAGE AND CURRENT STABILITY CONTROLLER FOR DOMESTIC APPLICATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

By

NURUL FATIN BINTI ROSDANI

B071410114

920813-15-5010

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

.....
(Associate Professor Mohd Ariff bin Mat Hanafiah)

ABSTRAK

Projek ini menghuraikan ketidakstabilan arus dan voltan yang melampau iaitu salah satu ketidaknormalan voltan yang memberi keruncingan kepada kualiti kuasa. Masalah ini boleh berlaku di mana-mana sistem kuasa sama ada dalam penjanaan, penghantaran atau pengagihan. Projek ini akan memfokuskan kepada kawasan domestik, permasalahan ini boleh merosakkan alat kelengkapan rumah. Bila berlakunya kejatuhan dan kenaikan voltan, suis utama dalam papan agihan akan terputus bekalan kesan daripada arus tinggi yang terhasil. Pengguna perlu menghidupkan semula bekalan kuasa di suis utama secara manual tanpa perlindungan keselamatan akan menyebabkan bahaya kepada pengguna. Jika kegagalan tenaga berlaku sementara pengguna tiada di rumah atau mereka tidak sedar tentang masalah ini, ia akan mengganggu operasi peralatan elektrik sekaligus merencatkan aktiviti-aktiviti yang melibatkan bekalan voltan. Ia membahayakan kepada pengguna kerana mereka tidak tahu keadaan bekalan kuasa pada masa tersebut. Projek ini dilaksanakan bertujuan untuk menambah keselamatan kepada pengguna dalam menghidupkan dan mematikan bekalan kuasa secara automatik melalui kawalan yang diperbuat oleh mikropengawal. Projek ini melalui penggunaan simulasi litar Proteus dan MicroC. Kemudian, perkakasan dibina untuk tujuan pelaksanaan litar. Pengetahuan litar elektronik, litar elektrik dan pengaturcaraan diperlukan dalam menjayakan projek ini. Selain itu, pengetahuan dan keselamatan perlu diambil kira dan diaplikasikan sepanjang proses projek ini dijalankan.

ABSTRACT

This project describes instability of the current and voltage abnormalities that give critical power quality. It can happen in any power system level whether in generation, transmission or distribution. Focusing to domestic area, irregularity can damage the house equipment appliance. Anytime under and over voltage happen, major switch in distribution board will turn off due to high current generated by main power supply. It will disturb equipment operation in house and activities involve supply voltage. Consumer need turn on the main MCB manually without safety protection will cause hazard to the user. If the power failure happens while the consumers are not at home or they do not aware of this problem, it will disrupt the operation of electrical home appliances. It is dangerous to users since they do not know the condition of the main power supply. This project made purposely to add safety to the users since it turns on and off main power supply automatically through control made by microcontroller. This project is through circuit simulation use Proteus and MicroC software. Next, the hardware is constructed for the execution of the circuit. Electronic circuit knowledge, electric circuit and programming used in this project. Apart from that, knowledge troubleshooting and safety must be considered when knowledge mean needed through the project process.

DEDICATION

To my beloved parents

Rosdani bin Mohamad

Kartini binti Awi

Farizal bin Zainal

Rosenita binti Mohd Hussin

Siblings

Norsyafiqah binti Rosdani

Saiddatul Syazwina binti Farizal

Syazriel Sufian bin Farizal

Luqman Hakim bin Rosdani

Athirah binti Rosdani

Supervisor

Associate Professor Mohd Ariff bin Mat Hanafiah

Thank you very much for the support, love, encouragement, help and blessing.

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LIST ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

MCB	-	Miniature Circuit Breaker
ASD	-	Adjustable Speed Drive
PLC	-	Programmable Logic Controller
R.M.S	-	Root Mean Square
L	-	Inductance
kHz	-	Kilohertz
HZ	-	Hertz
I	-	Current
R	-	Resistor
V	-	Voltage
A	-	Ampere
Ω	-	Ohm
mA	-	Mili Ampere
AC	-	Alternating Current
IDMT	-	Definitely Minimum Time
CT	-	Current Transformer
F	-	Fault
DC	-	Direct Current
k Ω	-	Kilo Ohm
D	-	Diode
LCD	-	Liquid Crystal Display
ADC	-	Analogue to digital converter
CPU	-	Central Processing Unit
NO	-	Normally Open
NC	-	Normally Closed

CHAPTER 1

INTRODUCTION

1.0 Background of Project

The main intention of this project is to design a microcontroller based voltage and current stability controller for domestic application. This project is to develop a device that can be installed in the domestic distribution board in order to detect the instability of the current and voltage, hence securing the outage caused by the tripping of the main MCB. This project intended to design a microcontroller based system that will intelligently monitor the stability and the safety, hence protect the equipment in the main MCB and facilitates in case any problem occur which contributed to the instability of the current and voltage.

1.1 Problem Statement

In domestic area, whenever under and over voltage happen, power supply failure will occur where the main MCB will turn off and cause damage to the domestic appliances since there is no protection circuit or device towards under and over voltage problem. Turning ON the main MCB manually without safety protection will cause hazard to the user. It is time conserving and electrical appliances will be interrupted. If the power failure happens while the consumers are not at home or they do not aware of this problem, it will disrupt the operation of electrical home appliances such as refrigerator and safety devices like security camera. Thus, this project is proposed to provide additional protection safety to detect the instability of the current and voltage.

1.2 Objective Project

The specific objectives for this project are to:

1. To design a controller for domestic application by using microcontroller PIC16F877A.
2. To develop a device that can be installed the domestic distribution board.
3. To analyse the instability of the current and voltage.

1.3 Scope of Project

The investigation carried out in this project is limited to protection that will focuses in domestic distribution board at home. The project is divided into two parts, the first one is simulation using software and the second is hardware development.

The division of scope:

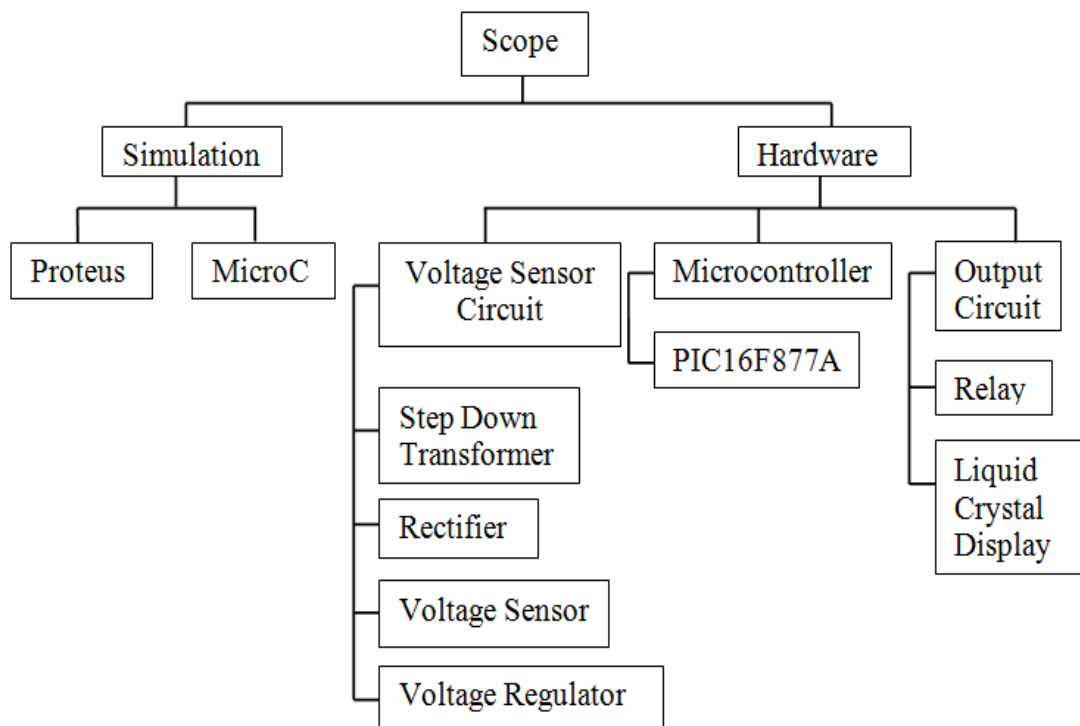


Figure 1.3: Division of Work Scope Project

1.4 Organization of Report

This report consists of five chapters begin with report introduction and end with conclusion. The remainder chapters are literature review, methodology and results as well as discussion. Literature review covers overview and method to provide protection in instability of the current and voltage. Meanwhile, methodology shows sequence of works in order to develop this project. Results of implementation of this project will be written in chapter four along with its discussion. Chapter five will delivers conclusion and recommendation for future planning. However, results with discussion and conclusion will be continued in Bachelor Degree Project II.

1.5 Summary

This chapter covers the background of the project and the problem statement which encouraged this project to be conducted. The goals of this project report also deliberated in this chapter. Furthermore, the scope of this project report also discussed to make sure this project report was conducted systematically and guided according to its objectives.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss the significant part of the voltage and current stability controller for domestic application; how this abnormality happened continue with voltage and current protection. Information gains from this research will be used all over project assessment.

2.1 Theory and Literature Review: The Voltage and Current Stability Controller for Domestic Application.

2.1.1 Definition of Over Current and Over Voltage

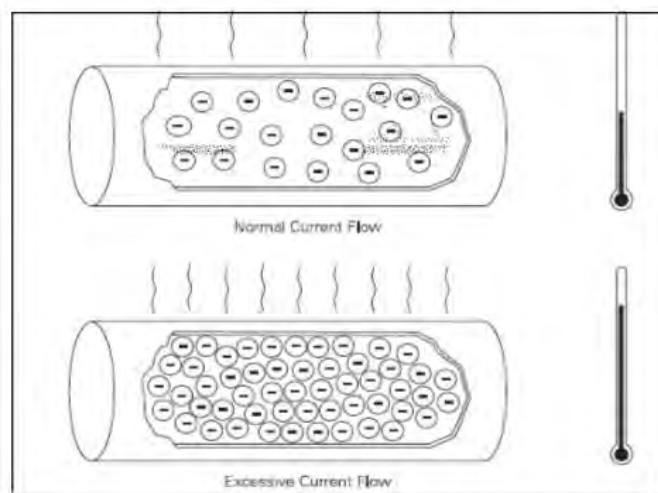


Figure 2.1.1: Over Current Flow

According to National Electrical Code on over current protection for equipment and conductors by Mike Holt (2012) determines the over current as any current more than rated current of equipment or ampacity a conductor. It may result from overload, short circuit, or ground fault. Electric current flow in a conductor always generates heat. That larger electric current flows, that warmer the conductor. Damaging excess heats to electronic component. For that purpose, conductor have a consider carrying capacity during continuous or ampacity. Over current protection equipment applied to protect conductor from excess electric current flow.

The over current or excess current is a larger than intended electric current flows through a conductor, lead to heat excess generation, and fire risk or damage to equipment. A few possible causes to over current is short circuit, ground fault, mechanical failure of components, reduction in flux, failure one of supply phase, insulation excess burden failure, and incorrect design.

The over voltage is when the voltage in a circuit or partly of it is raised above upper design limit. Electrical appliances and electronic are designed to operate on at one certain maximum supply voltage and damage that quite a lot can be attributed on voltage. In rated voltage electric light bulb that is given with single wire in it will bring a stream only big enough for wire to get very hot, but soluble hot not sufficient. The current magnitude in a circuit is depending on voltage supplied. If too high the voltage, so wire may melt and light bulb will be burned out. Similar other electrical appliances can stop working, or can in fact bursting into flames if an over voltage supplied to the circuit. A usual natural resource over voltage events that are transient is lightning. When parts of a run burden do suddenly put out, supply system voltage suddenly raised. When large capacitor bank moved with the times, capacitive switching surge created over voltage

2.1.2 Causes of Under and Over Voltage

2.1.2.1 Cause of Under Voltage

Under voltage defined as a fall suddenly in root mean square (r.m.s) voltage and is usually characterized by remained (detained) voltage. Under voltage is short period reduction in r.m.s voltage, mainly attributable short circuit, starting of large motor beginning and equipment failure. Furthermore, under voltage may be classified by their period as shown in

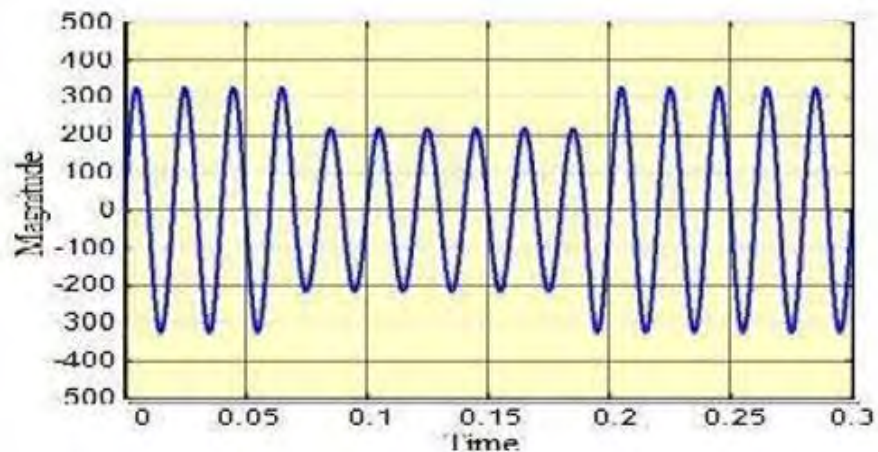


Figure 2.1.2.1(a): Under Voltage Waveform

Under voltage is power disturbance that is most common that quite bad effect especially in industrial and big business customer like sensitivity instruments damage and loss daily production and finance. Example of equipment that is sensitive is Programmable Logic Controller (PLC), Adjustable Speed Drive (ASD) and Chiller's control. Under voltage in the equipment terminal could be due to short circuit offence of hundreds kilometres away in the transmission system.

Under voltage irregularity also may result from nature and system failure whether by damaging equipment or operating condition. One of the factors which caused under voltage is unsuitable cable usage or equipment. Based on Ponnle (2015) usage under assessed cable is from substation into industry or house cause large voltage drop in every termination to building. Hence, it provide loss or power or voltage finally consumer distribution unit. Apart from that, most of substation installed under assessed transformer due to low energy request in a few previous year. When high demand, this under voltage problems occur because of incomprehensive planning on energy consumption in the future leads.

The Kapoor et al. (2014) states that another factor that leading to under voltage problem heavily payload operations from distribution voltage that is low. The Paul et al. (2015) states that when induction motor in three load balanced phase, start them increase will attract beginning that is less identical high much current in all phases that leading to under voltage problem.

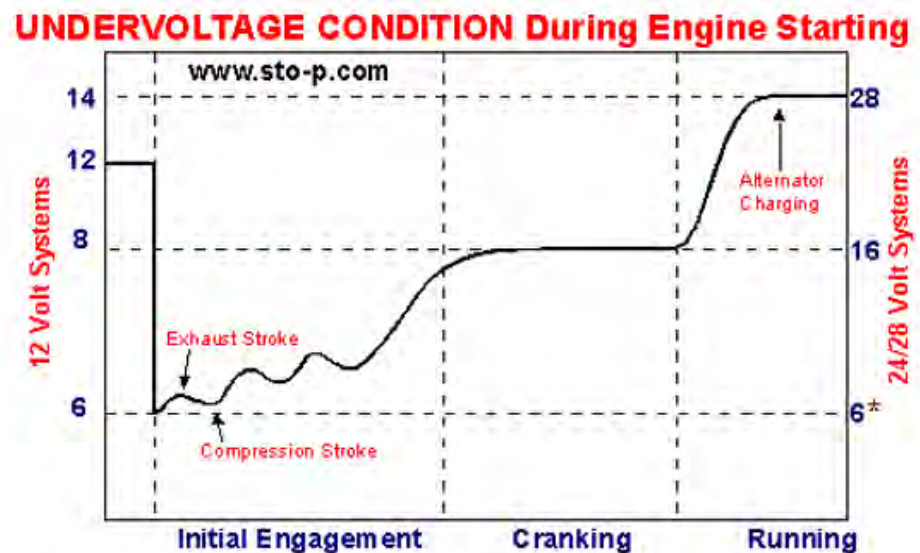


Figure 2.1.2.1(b): Graph of Under Voltage Condition during Engine Starting

The equipment failure also became one of the factors which made presence of under voltage. Failure equipment can cause whether from breakdown the insulation, heating or short circuit. Furthermore, fault happened will make circuit breaker open suddenly and then decided feeding line temporarily. It will form under voltage in other feeder line from same substation (Paul et al. 2015).

Extraordinary nature powers and atmospheric condition (Ponnle 2015) is also one of the factors which caused under voltage problems. Based on Paul et al. (2015), a total that is important under voltage happen when power line face lightning strike. Pollution that came from salt in power line in coast produce lightning on when storm enter since salt is a good conductor.

2.1.2.2 Cause of Over Voltage

Over voltages is less common from under voltage but they also get up due to system faults. Over voltage can happened because of single line to ground fault, that take turns will raise other voltage of phases. It can also cause due to heavy industrialisation loads determining or switching on the capacitor banks. This in generally caused ungrounded or float ground delta systems, where change in ground reference will give voltage increase to unground system.

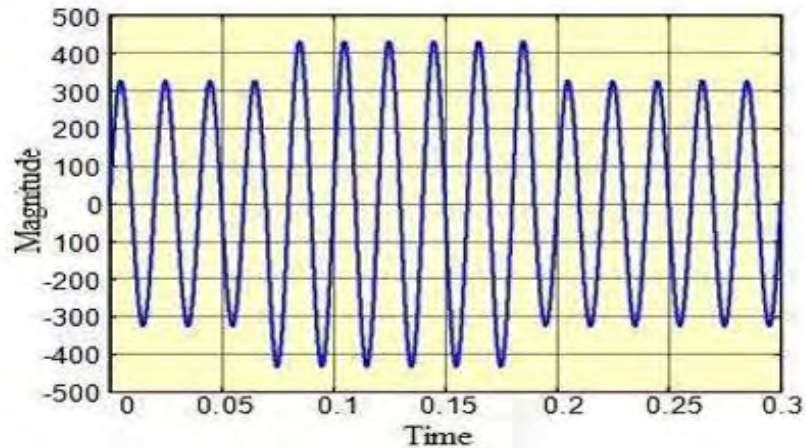


Figure 2.1.2.2(a): Over Voltage Waveform

This is cause of over voltage are mostly due to energization capacitor bank. It also could be generated by sudden load deduction. Due to load determining have decline suddenly current, which will cause voltage of which L is line induction. The effect of over voltage is more severe and destructive. It can cause the electrical appliances fail, expected overheated due to high voltage. Also electronic and tool that is other sensitive is inclined towards malfunction.

Over voltage in power system is due to purposes that various. Over voltage emerges at a power system can be usually classified to two main categories (Ram & Vishwakarma 2011) which are external over voltage and internal over voltage.

i) External Over Voltage

The atmospheric disturbance especially light is this main cause over voltage. This over voltage is take form a unidirectional impulse that highest amplitude possibility has no direct relationship with operating of systems voltage (Ram & Vishwakarma, 2011, pg592).

There are a few factors which created the external voltage: