AUTOMATIC RESET RESIDUAL CURRENT CIRCUIT BREAKER WITH IDENTIFICATION OF FAULT CONDITION

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Bachelor of Electrical Engineering

12 May 2010

" I hereby declare that I have read through this report entitle "Auto Reset RCCB with Identification of Fault Condition" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)"

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Supervisor's Name : Mr. Muhammad Sharil Bin Yahaya

Date : 11/05/2010

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This Report is Submitted in Partial Fulfillment of Requirements for the Degree of Bachelor in Electrical Engineering (Industrial Power)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

12 Mei 2010

I declare that this report entitle "Automatic Reset RCCB with Identification of Fault Condition" 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 : LIM SWEE ANN

Date : 11/05/2010

DEDICATION

Special dedicated to my beloved parent and family

For my supervisor, Mr. Muhammad Sharil Bin Yahaya and Mr. Hidayat Bin Zainuddin

Universiti Teknikal Malaysia Melaka

And lastly to my beloved friends and who encouraged, guided and inspired me throughout my journey in education

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ABSTRACT

Residual current circuit breaker (RCCB) is a circuit breaker that detects the unbalance current of phase and neutral conductor. Unbalance current can be caused by current leakages through the body of a person or phase short to the ground wire (circuit protective conductor, extraneous conductive part or exposed conductive part) and produce earth fault. At residential, RCCB will trip instantaneous when earth fault or current leakage occurs at the appliances. Normally, this type of RCCB would not automatically reset by itself after the fault has been cleared whereby it require manual reset by a person. Thus, this project is done to propose a system that able to automatically reset the RCCB in the distribution board at residential. The automatic reset system is designed using the similar concept of auto-recloser at the transmission line. This automatic reset system will identified the fault by using the similar concept of continuity test concept to ensure the system is safe to be reset automatically. The continuity test can provide sufficient information about fault condition due to short circuit or earth fault by measuring the resistance of cable insulation. Therefore, at the end of this project it is expected that the proposed automatic reset RCCB is able to give significant result in identifying the faulty condition and automatically reset the RCCB safely.

ABSTRAK

RCCB adalah sebuah pemutus litar yang boleh mengesan arus tak seimbang antara wayar hidup dan wayar neutral. Arus tak seimbang disebabkan oleh kebocoran arus kepada badan manusia atau fasa ke bumi litar pintas dan penghasilan kegagalan bumi. Di perumahan, RCCB akan memutuskan litar dengan segera apabila mengesan arus tak seimbang atau kebocoran arus di peralatan elektrik rumah. Jenis RCCB ini biasanya tidak akan diset semula sendiri apabila kegagalan telah hilang, di samping itu dikehendaki seseorang untuk diset semula. Dengan ini, satu projek telah dicadangkan untuk merekabentuk sebuah RCCB akan diset semula sendiri di perumahan. Sistem RCCB diset semula sendiri adalah direkabentuk melalui konsep ujian keterusan (continuity test) dengan diset semula sendiri dalam keadaan yang selamat. Ujian keterusan boleh memberi maklumat tentang litar pintas atau kegagalan bumi dengan mengukur rintangan penebat wayar. Akhirnya, RCCB diset semula sendiri yang dicadangkan akan memberi ramalan yang boleh mengesan keadaan kegagalan dan RCCB akan diset semula sendiri dalam keadaan yang selamat.

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RCCB	-	Residual Current Circuit Breaker
CPC	-	Circuit Protective Conductor
TNB	-	Tenaga Nasianal Behad
IEEE	-	Institute of Electrical and Electronic Engineers
CT	-	Current Transformer
RCD	-	Residual Current Device
EFIC	-	Earth Fault Identification Circuit
ARRC	-	Automatic Reset RCCB Circuit
DC	-	Direct Current
AC	-	Alternating Current
DMM	-	Digital Multimeter
DPDT	-	Double Pole Double Throw (relay)
MCB	-	Miniature Circuit Breaker
IEE	-	The Institution of Electrical Engineers
BS	-	British Standard

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

RCCB will trip instantaneous when earth fault current and leakage current more than 100mA. This type of RCCB would not automatically reset by itself after faults are cleared in the system. There conditions occur when the lightning created temporary fault current cause the RCCB trip. In this situation, RCCB must manually reset by a person to supply the electricity to the load. Some of the home users due to lack of knowledge about the protection device like RCCB and MCB, they are afraid to reset back the RCCB. Sometimes, even worst when home user is not in home like they go to holiday, electrical and electronic appliance out of supply, those appliances like fridge, alarm system, and electrical gate is temporary turn off. Under this condition, this will cause a problem like foods are spoiled in the fridge and bring a lot of inconvenient to home user. Thus, this project is developed a system that able to reset RCCB automatically once earth faults are cleared. The auto-recloser concept is applied to this project.

1.2 Projective Objective

Based on problem statement has been discussed, the objectives of this project are:

i. to design a system that can indentify fault condition due to earth fault.
ii. to design a system that able to reset the RCCB automatically and safety after the fault in the system is cleared.
iii. to conduct performance analysis on the fault identification system.
iv. to conduct performance analysis of the proposed automatic reset RCCB.

1.3 Project Scopes

This project is conducted to design an automatic reset RCCB with ability to identify that the earth fault has been cleared through the earth fault identification system at residential. The project scopes are:

i. applying the continuity concept as fault identification in the single phase domestic system.
ii. sensitivity of the RCCB is 100mA and rated current is 40A.
iii. motor to switch on the RCCB automatically is used 240Vac induction motor.

1.4 Report Overview

Chapter 1 introduces and briefly summarizes the project and its objectives. In Chapter 2, the Literature Review includes the relevant background theory pertaining to power system analysis and domestic wiring system. Chapter 3, the Methodology section contains a description of the analysis that was conducted throughout the project duration. Chapter 4, Project Development electrical section contains components are studied their data specification or datasheets. Chapter 5, Result contains all measurement data and picture of the project prototype. Chapter 6, Discussion and Analysis discusses the result obtain in the Chapter 5. Finally, Chapter 7 Conclusion and Recommendation provide a nutshell description what was done and the result and conclusion. Statements of future work recommendation were also made here.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is executed to understand the concept and the designation of Automatic Reset RCCB. Several concepts of cases will be explained in this chapter because the understanding of all concepts is necessarily important to conduct this research.

2.2 Earthing Systems

In three-phase system there are three single voltages measured between each phase and a common point called the neutral point or neutral ground. The neutral point is the common point of three star-connected windings is shown on Figure 2.1. So that, TNB has three-phase four wires connected to supply electricity to consumer. The neutral point may be directly connected to earth or connected through a resistor or a reactor. The neutral point can be unearthed, directly earthed and impedance-earthed. When an insulation fault occurred or a phase is accidentally earthed, the values taken by the fault currents, the touch voltage and overvoltage are closely linked to the type of neutral earthing connection. A directly earthed neutral strongly limits overvoltage but it causes very high fault currents, whereas an unearthed neutral limits fault currents to very low values but encourages the occurrence of high overvoltage.

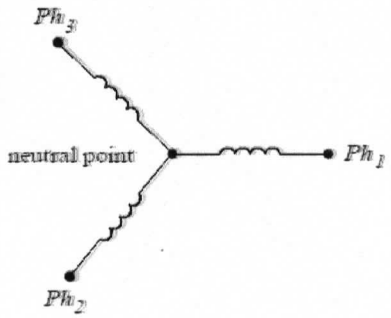

Figure 2.1: Neutral point of a three-phase star system

2.2.1 TT System Directly Earthed Neutral

Earthing systems are governed by standard IEC 60364-3. There are three types of systems which are IT, TT and TN. TT system is used by TNB in Malaysia. [15]

First letter T	= the neutral is directly earthed.
Second letter T	= the exposed conductive parts of the loads are interconnected either altogether or by a group of loads. Each interconnected group is earthed. One exposed conductive part can be individually earthed if it is far away from the others.

TT system has the star or neutral point of the supply transformer directly connected to earth by means of an earth electrode, and the earthing of the consumer's installation is also directly connected to earth via an earth electrode as illustrated in Figure 2.2 [15].

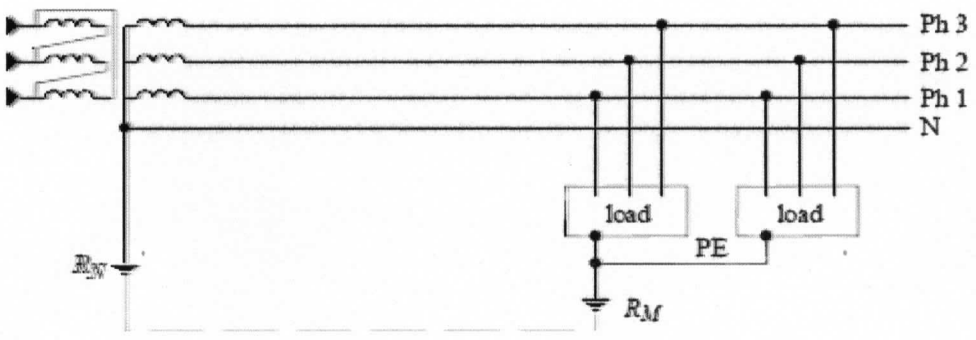

Figure 2.2: Directly earthed neutral (TT system) in low voltage

A TT system requires an earth electrode at the consumer's premises. Such an electrode must be protected from corrosion and mechanical damage and the ideal arrangement is as shown in Figure 2.3 [15].

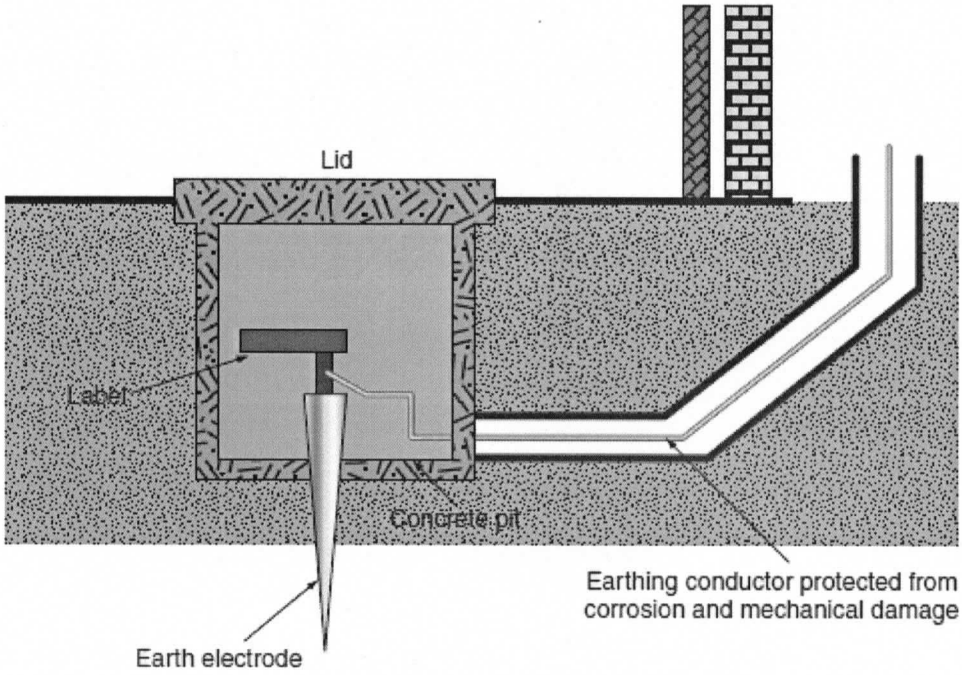

Figure 2.3: Earth electrode installation

2.2.1.1 Advantages of TT System

i. The simplest system to design, implement, monitor and use.
ii. Does not require permanent monitoring during use (only a periodic inspection test of the RCCBs may be necessary).
iii. The presence of RCCBs will prevents the risk of fire when their sensitivity is below or equal to 100mA (for residential) or 500mA (for industrial).
iv. Easy location of faults.
v. Upon occurrence of an insulation fault, the short-circuit current is small.

2.2.1.2 Disadvantages of TT System

i. Switching upon occurrence of the first insulation fault.
ii. Use of an RCCB on each outgoing feeder to obtain total selectivity.
iii. Special measures must be taken for the loads or parts of the installation causing high leakage currents during normal operation in order to avoid spurious tripping [11].

2.2.2 Grounding Wire at Residential

Most of the appliances with metal casing in houses are wired with three wires in one cable. There are live wire (brown insulation), neutral wire (blue insulation) and ground wire (green insulation). The ground wire is not meant to carry any current under normal operation.

All the current will going into an appliances through live wire, then come out through the neutral wire. If the earth fault or leakage current occurs in the appliance, some of the current will flow to the ground wire and the balance will flow back to the neutral wire. The "ground wire" is attached to the metal case of appliance, such as refrigerator, electrical rice cooker and etc. If the live wire inside the appliance comes in contact with the metal case or some leakage current flow to the metal case, is called earth fault or ground fault. The current is carried to the ground wire and the RCCB trips. If there were no ground wire attached to the metal case of appliance, somehow in indirect contact with metal case of appliance and your body wound completes the circuit back to ground, thus the electric shock will happen [13].

2.2.3 Earth Fault and Leakage Current

Earth fault is accidental contact between a live (phase conductor) or neutral and ground conductor, typically resulting from failure of electrical insulation. In effect, the failure shorts the line side of the supply to earth. The utility mains supply to most equipment normally provides both a protective earth (PE) conductor and a bonded neutral