



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND DEVELOPMENT SEMI CIRCLE CURRENT  
MEASUREMENT DEVICE**

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

by

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## **DECLARATION**

“I, hereby declare that this thesis entitled, DESIGN AND DEVELOPMENT SEMI CIRCLE CURRENT MEASUREMENT is a result of my own research idea concept for works that have been cited clearly in the references.”

**Signature** : .....

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## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the Degree of Bachelor of Electrical Engineering Technology (Electrical Technology Department) (Hons.). The member of the supervisory is as follow:

.....  
(EN MOHD FIRDAUS BIN MOHD HALIM)

## **ABSTRACT**

The instrumentation system has given a higher contribution especially in electrical engineering field especially in current measurement system. The invention of the current measurement has been simplified by the introduction of clamp-on meter. The clamp-on meter is user friendly tool to perform current measurement without breaking the circuit. This research focus on the invention of this measuring tools by design the jaw to be easier to take the reading of the current to be taken without need to fully clamp the wire. This makes the current measurement even friendlier than ever.

## **ABSTRAK**

Sistem instrumentasi memberikan sumbangan yang sangat tinggi terutama sekali dalam bidang kejuruteraan elektrik terutama dalam sistem pengukuran arus elektrik. Penciptaan pengukuran arus elektrik telah dipermudahkan oleh pengenalan pengapit -on meter. Meter pengapit -on memudahkan pengguna untuk mengambil ukuran semasa tanpa mengganggu keadaan litar. Kertas kerja menjurus kepada ciptaan alat pengukur dengan reka bentuk rahang menjadi lebih mudah untuk mengambil bacaan arus elektrik yang perlu diambil tanpa memerlukan wayar diapit sepenuhnya.. Jadi, bacaan semasa yang boleh diambil dengan ciptaan ini walaupun pengapit rahang pada wayar dalam bentuk separuh bulatan .

## **DEDICATIONS**

Special dedication to my loving family, all my siblings, and my kind hearted supervisor

En.Firdaus Bin Mohd Ab Halim and also dearest friends.

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## LIST OF SYMBOLS AND ABBREVIATIONS

PIC	=	Programmable Intelligent Computer
ADC	=	Analog to Digital Converter
LCD	=	Liquid Crystal Display
ISIS	=	Intelligent Schematic Input System
MCB	=	Miniature Circuit Breaker

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

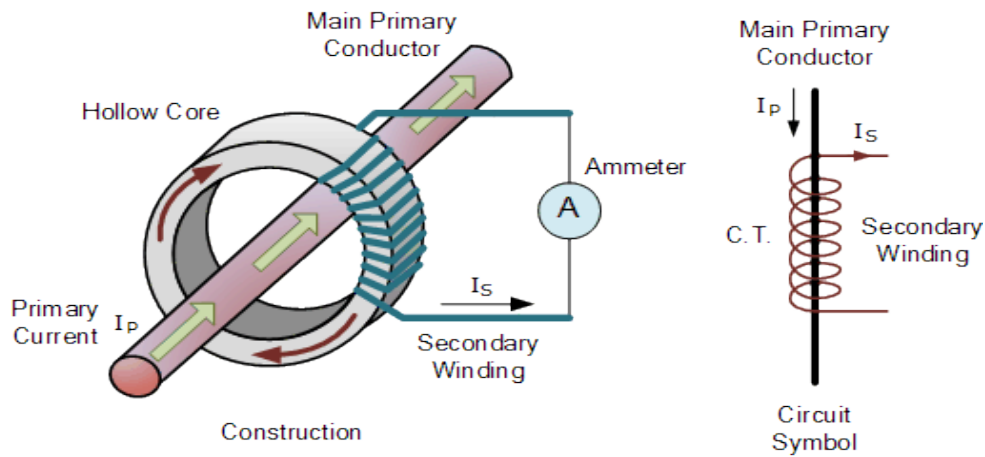
In 21st century, the field of precise engineering has been highlighted as an advanced technology which is currently becomes more popular especially in the broader area. The development of these measurement methods for the numerous purposes has become more popular and advance. A large number of research groups has developed various positioning systems for use such as in industrial and manufacturing system..

### 1.1 Background

What is measurement? Measurement is a set of operations performed on a physical object or system, for the purpose of determining some physical property of the object or system according to an established, documented procedure. A semi circle is a half circle in another word it formed by cutting a whole circle along a diameter line. So, this semi circle current measurement means a device use to measure amount of current across a wire in a semi circle shape.

The current transformers are currently used as a key component of current measurement in the electrical system ( Thu Ya Kyaw, Akihiro TORII, Kae DOKI, and Akiteru UEDA ,2012 ). Basically, using current transformer is an alternative way to perform curent measurement and it is very suitable to determine alternative current (AC). So, in this paper a current transformer will be use as a key componet of a current measurement and will be develop more to gain a better precise as its use to measure a current in semi circle shape.





**Figure 1-1: Basic construction of current transformer [7]**

## 1.2 Problem Statement

Measurement device is very important now days, but still a current measurement device still to be need a development in help to give a better accuracy and ease when the reading to be taken. The problem of standard current measurement device is the wire is needed to dismantle due to need to be fully clamp. The problem also is hard to take a reading at challenging places such as in control circuit cabinet. The purpose of this semi-circle current measurement is to help fixed this problem.

## 1.3 Objective Study

The objectives of this project are:

1. Design and develop a current measurement device.
2. Design and develop new feature of jaw in order to pick up a current signal without enclosed the jaw.
3. Design the jaw in order to facilitates work in tight spaces and permits current measurements on live conductors without circuit interruption

## 1.4 Scopes of Study

This project will concentrate at develop of current measurement device that can be measure amount of current in wire without fully clamp the wire. In advance the design of the device must easy to handle in order the measurement of current can be done although in tight space.

The limitations regarding this project are:

1. Position of the conductor being measured within the ring of the clamp-meter jaws this will affect the reading because of leakage flux.
2. The presence of any a.c. magnetic field, such from large transformer of electric motors. The alignment of the jaws with the magnetic fields will affect the error.
3. When the large current being measured, it is possible core saturation can occur. This will affect the accuracy of the reading.

# **CHAPTER 2**

## **LITERATURE REVIEW**

### **2.0 Introduction**

This chapter contains research and information on the project to several important concepts in information systems failure, technology and materials to be used in this study. In this chapter also includes the description of hardware and also software in detail for being use in this research.

### **2.1 Introduction Literature Review**

This section provides a previous study of related work regarding the application of clamp meter or others measuring current device in various field. Several previous researches have been studied to develop and to gain more knowledge about current measurement tools. It is necessary to understand how the software and hardware were used in the current measuring devices system development. This is important because to confirm that current study that being conducted contributes at some level of application. Later it will become more practical and efficient.

#### **2.1.1 Open Loop Current Sensor**

A current sensor is a device that detects electric current in a wire either AC or DC. It generates a signal proportional to amount of current in the wire. In this open loop current sensor, the working principle is focus on magnetic flux and hall element. The magnetic flux generated by the conductor act as primary current is concentrated in magnetic circuit. Next the current being measured by hall device. The output from hall device is proportional to the amount of current being measured and will represent the exact value of measure current. So this paper presents a current in a wire being measured by using a hall effect.

### **2.1.2 Close Loop Current Sensor**

A closed loop current sensor is also a device that detects electric current in a wire either AC or DC. Its work by detect a magnetic flux generate by a wire (primary current). The primary current is then compensated by a current generated by the secondary winding. The compensated current is generated by signal conditioning electronic circuit by using the output of Hall Element. The compensate current represented the exact value of the primary current by divided with the number of turn in secondary winding.

### **2.1.3 Current Measurement with the Application of a Non-contact Thermometer**

Thu Ya Kyaw, Akihiro TORII, Kae DOKI, Akiteru UEDA (2012). In the precise engineering field a non-contact ac and dc current measurement method in the range of milliamp is recently very required. The method propose in this paper is the current measurement by measuring its temperature when the current pass trough it with a model resistor. The method use in this paper is temperature measurement by a non-contact thermometer. This project also clarifies the relationship between power consumption, temperature and amount of current. The amount of current is proportional with the power consumption and the magnitude of current being estimates by measuring the temperature of the target object.

### **2.1.4 Sensitive Linear Electric Current Measurement Using Two Metal-Coated Single-Mode Optical Fibers'**

Ching-Tarnng Shyu and Likarn Wang (1994). This paper proposed a new technique name as fiber-optic sensing technique for electrical current measurement. The experiment use is based on the sensitive thermal detection. March-Zehnder type of two metal coated single mode fibers was used in an interferometer. A constant bias current with enough accuracy was proposed as a method which to amplify the phase due to the current being measured. This paper study proves that a wide dynamic range and good linearity can be obtained using this method as well as sensitivity of measurement is well enhanced. This

study show the measurement sensitivity can be enhanced by more than 20 times compared to traditional method in which a bias current of 50 mA is used to measure 4 mA dc current.

### **2.1.5 Current Measurement device Design Based on MSP430 Single-Chip Microcontroller**

Liwei Geng (2010). This paper presents the study of a high-current measurement device without contacting directly to the wire. The measurement of current is easily can be done by contacting to the wire directly. However contacting directly to the high current is very dangerous. This paper proposed a method a measurement of current without contact to the wire and also describes a pincer current transformer and the principle of electromagnetic induction to be approach. The CPU used as instruments tool is made by the United State Company Texas Instrument, msp4301437. The instrument use were an ultra-low power microcontroller and suitable for hand-held device and battery power.

### **2.1.6 Bonding Wire Current Measurement with Tiny Film Current Sensors**

Hidetoshi Hirai, Yuya Kasho, Masanori Tsukuda and Ichiro Omura (2012). The aim of this project is to develop new technique to measure currents in each bonding wire on diode chip or an IGBT simultaneously. The author approach new technique based on film current sensor. The film current sensor consist of tiny scale coil printed on a polyimide film with high speed analog amplifier with a digitizer which include with numericl calculation function. This bonding wire technique for a current measurement has 8 channel film current sensors. It also include with the digitizer and the high speed analog amplifier for a digital data processing. As a conclusion, Bonding wire technique will be simple powerful tools in an instrument system as a tool to measure current and to analyze the current and can be label as successful method to measure a current.

## 2.2 The current transformer

### 2.2.1 Introduction to the current transformer

The current transformer (C.T) is a device design to create an alternating current in its secondary winding which the amount of current is proportional to the current being measured (primary winding). It's also known as Instrument transformer.

The current transformer (C.T) works by reduces high voltage current to a much lower value. It's also providing appropriate way to safely monitoring the amount of electric current flowing in an AC transmission line without breaking the circuit by using standard ammeter. The working principle of this current transformer is obviously no different with the ordinary transformer.

In the primary winding of this current transformer, it consists of only a few turns or only a single turn. The primary winding can be as a single flat turn, a coil of heavy duty wire wrap around the core, or only a conductor or only a bus bar placed through a central hole as shown in the figure 2.0.



**Figure 2-1 : Standard Current Transformer [7]**

### 2.2.2 Basic types of current transformers

There are three basic types of current transformer:

**Table 2-1: Type of Current Transformer**

<b>Type Of Current Transformer</b>	<b>Description</b>
<b>Wound current transformer</b>	The primary winding is physically connected in series with the conductor that carries the measured current flowing in the circuit. The value or the magnitude of the secondary current is dependent on the turns ratio of the transformer.
<b>Toroidal current transformer</b>	This type of current transformer does not contain a primary current. Instead, the line that carries the current flowing in the network is threaded through a hole in the toroidal transformer. The current transformer has a split core which allows it to open, install, and close without disconnecting to the circuit where they attached.
<b>Bar-type current transformer</b>	The primary winding of this type of transformer uses actual cable or bus-bar of the main circuit, which is equivalent to a single turn. This primary winding are fully insulated from the high operating voltage of the system and usually bolted to the current carrying device.

### 2.2.3 Working principle of current transformer

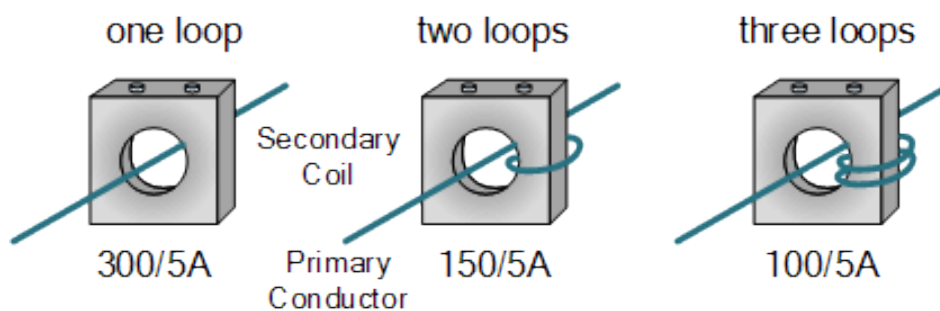
Usually current transformers are used together with ammeter in which the design of the current transformer to provide a maximum secondary current (output reading) corresponding to a full-scale deflection of ammeter.

Usually most current transformers the primary and secondary currents are expressed as a ratio of 100/5, which means when the current at primary winding is 100 Amps the secondary winding will goes to 5 Amps. The amount of primary current will became smaller as the number of secondary winding increase.

$$T.R = n = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

In other word  $N_s$  (secondary winding) increases,  $I_p$  (primary current) goes down by a proportional amount.

Note that the ratio between primary and secondary turn are usually large. For example, assume the current rating of the primary winding is 100A and for the secondary winding has standard rating at 5A. So that the ratio between this two winding is 20:1, in which the primary current is 20 times greater than the secondary current.



**Figure 2-2: Current transformer primary turns ratio [7]**

To summaries, the current transformer is a type of instrument transformer used to convert a primary current into a secondary current through a magnetic medium in which it will be a main part in this semi circular current measurement.