A COMPARATIVE STUDY OF METER ACCURACY BETWEEN SINGLE PHASE ANALOG ENERGY METER AND DIGITAL ENERGY METER UNDER VARIOUS LOAD CONDITION

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MAY 2009

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A report submitted in partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering (Industrial Power)

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MAY 2009

I declare that this report entitle "A Comparative Study Of Meter Accuracy Between Single Phase Analog Energy Meter And Digital Energy Meter Under Various Load 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.

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Date : 08/05/2009

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ABSTRACT

This project is to make a comparative study of meter accuracy between single phase analog power meter and single phase digital power meter under various load condition. This meter will measure and display the electrical consumption at home. TNB has been replacing the analog power meter to the digital power meter. Unfortunately, this situation has caused some unhappiness to the consumers. They claimed that the reading from the digital energy meter is higher than the old analog meter. This situation occurred because of the meter accuracy. The aimed of this project is to prove the consumers claimed relevant or not. Both of these meters will connect to the various loads exactly or similar with the load at home such as fluorescent lamp and television.

ABSTRAK

Projek ini bertujuan untuk membuat kajian mengenai perbezaan ketepatan pada meter kuasa jenis analog satu fasa dan juga meter kuasa jenis digital satu fasa menggunakan beban yang berlainan Meter-meter ini akan menyukat dan memaparkan penggunaan tenaga elektrik di rumah. Pada masa sekarang Tenaga Nasional Berhad (TNB) telah menukar meter kuasa jenis analog kepada jenis digital. Malangnya, tindakan ini telah menimbulkan rasa tidak puas hati di kalangan pengguna. Mereka mendakwa penukaran ini telah menyebabkan pengingkatan pada bacaan meter mereka. Oleh itu, tujuan utama projek ini dijalankan adalah untuk mengkaji dakwaan pengguna mengenai peningkatan bacaan meter itu benar atau pun tidak. Kedua-dua meter kuasa ini akan disambung ke pelbagai beban yang menyerupai beban di rumah kediaman.

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AC	-	Actual Reading
CR	-	Current Reading
IR	-	Initial Reading
TCL	-	Total Connected Load

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CHAPTER 1

INTRODUCTION

1.1 Introduction

There are two type of single phase energy meter which are analog and digital meter. This meter will measure and display the electrical consumption at home. The limit current for these meters not more than 100 Amperes. TNB has been replacing the analog power meter to the digital power meter. Unfortunately, this situation has caused some unhappiness to the consumers. They claimed that the reading from the digital energy meter is higher than the old analog meter. This situation occurred because of the meter accuracy. This project is to study the comparison of meter accuracy between single phase digital and analog meter under various load condition. The aimed of this project is to prove the consumers claimed relevant or not. Both of these meters will connect to the various loads exactly or similar with the load at home such as fluorescent lamp and induction motor usually used in washing machine.

1.2 Objective

The main objectives for this project are:

i. To study about the principles of the power meter.
ii. To analyze the differences in readings of analog and digital meter.
iii. To verify the claimed.

1.3 Problem Statement

Basically this project is running because of the following problems that are state below:

i. To prove the consumers claimed about the increasing of the meter reading when TNB change the old analog meter to the digital meter.

ii. To compare readings between analog power meter and digital power meter.

iii. To identify the caused of complaint from consumer "electric bill increase after meter was change from analog to digital".

1.4 Purpose of This Project

The purposes of this project are:

i. This project is to make the comparative study of the actual reading between analog power meter and digital power meter.

ii. To provide analytical study of actual meter reading for both meter. This will help to prove the consumers muttering.

iii. The aimed of this project is to prove the consumers claimed relevant or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is the study about the project requirement to fulfill the objective. The literature review that has been study is the basic concept of the single phase analog power meter and single phase digital power meter. The study is focus on how the both meters work and the type of load had been used in the research.

2.2 Specification of the Meters

Both of the meters (single phase analog power meter and single phase digital power meter) are borrowed from TNB Berhad. These meters are already calibrated according to TNB calibration. Below are the types of meters that will be used in this project:

2.3 Single Phase Analog Power Meter

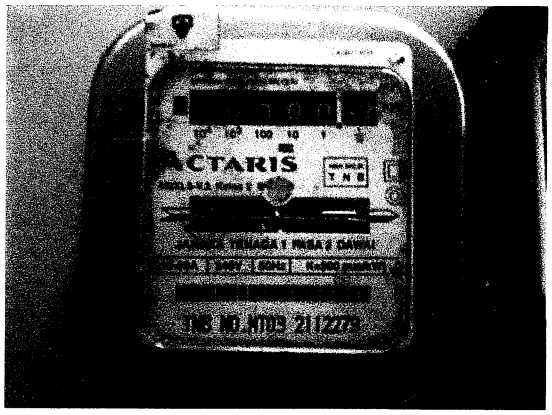

Figure 2.1: Single Phase Analog Power Meter

Meter specification:

- Model : ACTARIS
- Frequency : 50Hz
- Connection : 1 phase, 2 wire
- Voltage : 240V
- Limit Current : 10Amp – 50Amp
- Reading of Consumption : 500 rotation/kWh

Figure 2.1 show the single phase analog power meter. Single phase analog power meter are used for measuring electric energy in single-phase system of low voltage with frequency of 50 Hz. In special cases, the single phase electricity meters can be made for measuring electric energy using instrument current transformers or instrument current and voltage transformers (indirect connection). Its measuring assemblies meet requirement of measurement in the accuracy class 2 according to international standard.

Figures 2.2 show the internal connection and connection to the load of the single phase analog power meter. All the terminals must be known before any connection can be making. All the connection should be correct to protect any short circuit and also to protect the meter from damage and burn.

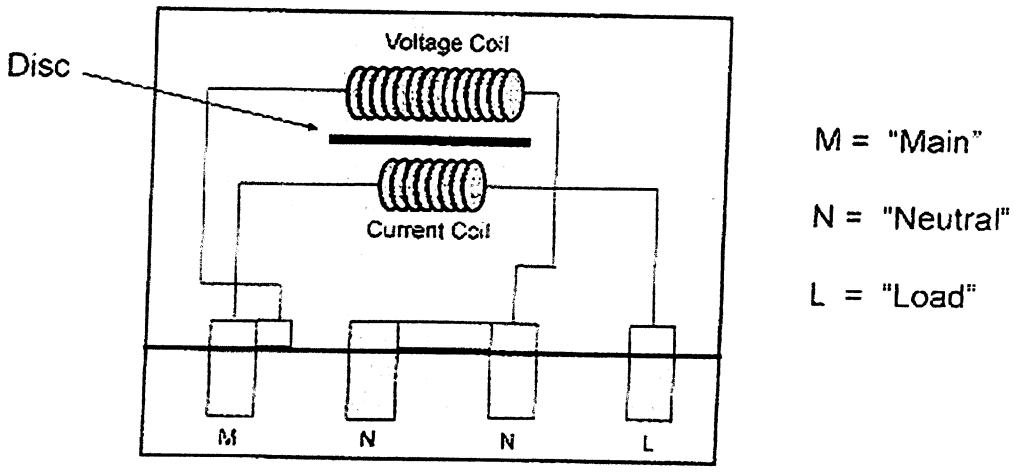

Figure 2.2: Internal Connection

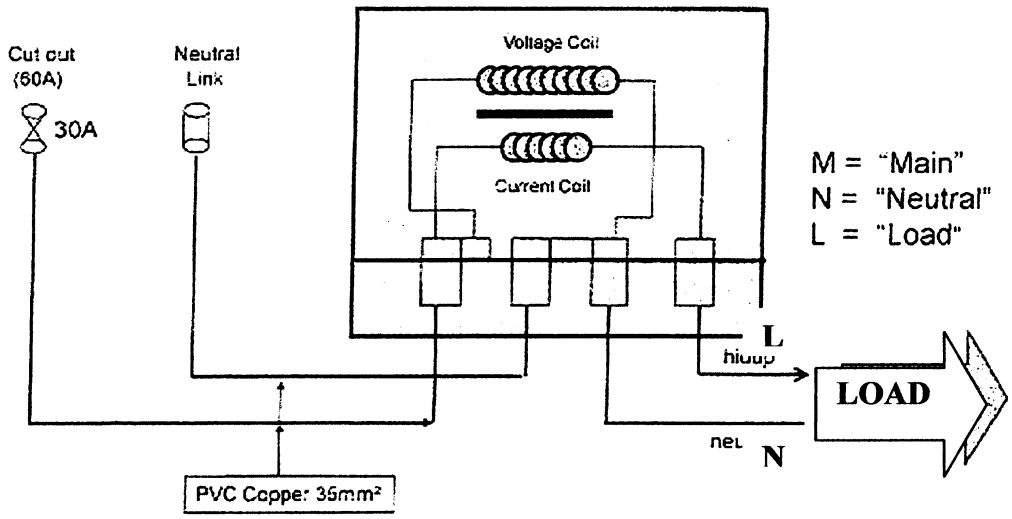

Figure 2.3: Internal Connection and Connection to the Load

Figure 2.3 show the internal connection for single phase analog meter and connection to the load.

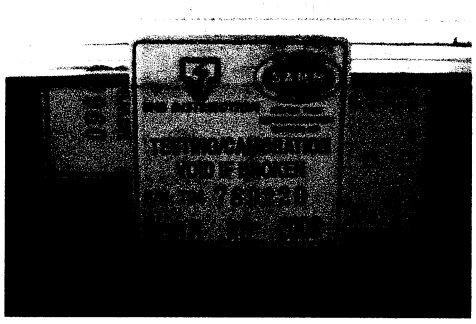

Figure 2.4: TNB Testing/Calibration

Figure 2.4 show the tag for testing and calibration from Tenaga Nasional Berhad (TNB).

2.3.1 Main Component in Single Phase Analog Energy Meter

There are several main components in the single phase analog energy meter and single phase digital energy meter. Below are the components in both meters and their function:

2.3.1.1 Current Coil

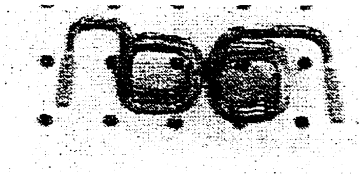

Figure 2.5: Current Coil

Figure 2.5 show the current coil in the analog power meter. It is used to carry the current to be measured. Their circumference is little and rough. [1]

2.3.1.2 Voltage Coil

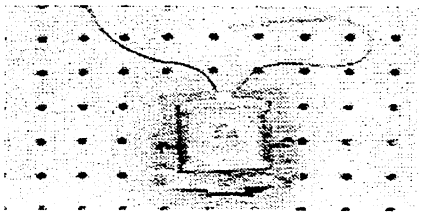

Figure 2.6: Voltage Coil

Figure 2.6 show the voltage coil. It is used to carry the voltage to be measured. Their circumference is many and very thin. [1]

2.3.1.3 Disc

The rotating of the disk is directly proportional into energy used. [1]

2.3.1.4 Hole

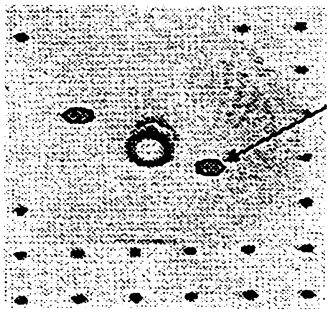

Figure 2.7: Hole

Figure 2.7 show the hole. It function is to avoid saucer move when no burden. [1]

2.3.1.5 Dial Register

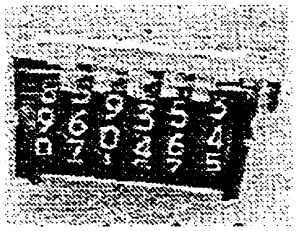

Figure 2.8: Dial Register

Figure 2.8 show the dial register. The register unit of energy is in kWh. It has 6 figures. [1]

2.3.1.6 Magnetic Brake

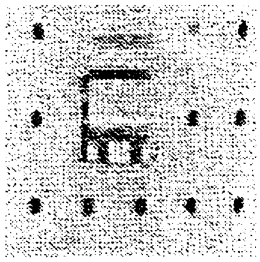

Figure 2.9: Magnetic Brake

Figure 2.9 show the magnetic brake. It works as a control of the round movement and the disk speed follow constant speed. There are two permanent magnet located at the top and below of the disk. Without brake magnet, disk would rotate with very fast. [1]

2.4 Single Phase Digital Power Meter

Figure 2.10: Single Phase Digital Power Meter

Meter specification:

- Model : KMSB
- Frequency : 50 Hz
- Connection :1ph, 2 wire
- Voltage : 240 V
- Limit Current : 10 – 100 Amp
- Reading of Consumption : 800 pulse/kWh
- Class : Class 2

Figure 2.10 show the single phase digital power meter. The single-phase digital meters with LCD display are designed for active energy measurement for direct connection in single-phase in 2-wire network low voltage with frequency 50 Hz. The measuring assembly of digital electricity meters meets the requirements on measurement in accuracy class 2.0 in accordance with international standard. This meter is equipped with the circuit of transmitting pulses which is proportional to the consumption of energy. That extends their usage more by collection and processing of data of measured electrical energy, too. It enables collection of data and parameterization of electricity meter through the optical interface, tariff functions are controlled externally or internally, power measurement and measurement of electricity energy is in the mode are consumption- supply.

Figure 2.11 show the internal meter connection of single phase digital power meter. The connection is different between this type of meter and analog power meter. The connection must be correct according to meter design.

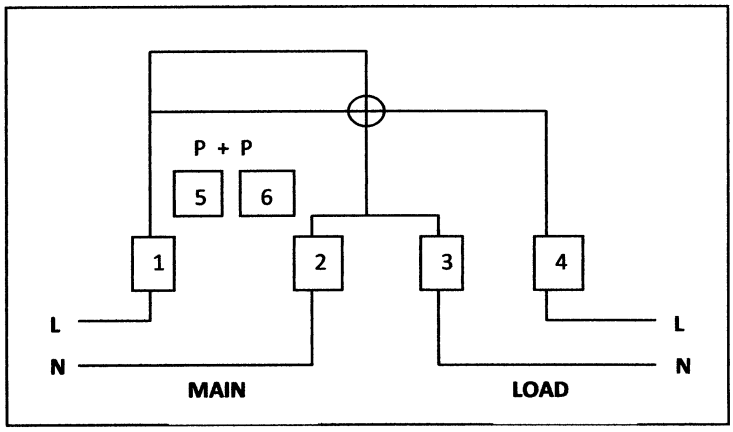

Figure 2.11: Internal Meter Connection

Table 2.1 show the analog meter technical data consists of accuracy class, reference voltage, current rating, and mains frequency, maximum power of voltage and current circuit, average temperature coefficient, number of rates, weight and coverage.

Table 2.1: Analog Meter Technical Data

Accuracy class	2.0
Reference voltage - direct connection	120V, 230V, (220V), 240 -120V
- Indirect connection	100V, 230V
Current rating - direct connection - I_b	5A, 10A, 15A, 20A, 25A, 30A
- I_{max}	20A, 30A, 40A, 60A, 80A, 90A, 100A
- Indirect connection - I_n	5 (6) A, 1(1.2) A
Mains Frequency	50 Hz, 60 Hz
Maximum power of voltage circuit	1.1 W/5.2 VA
Maximum power of current circuit	0.36 W/0.4 VA
Average temperature coefficient	cos θ = 1<+0.06 %/°C, cos θ = 0.5 <-0.08 %/°C
Number of rates	1 or 2
Weight	Maximum 1.5 kg
Coverage	IP 51