AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Design, Analysis and High Precision Measurements of Radio Link for the Smart Energy Meters

A Thesis submitted in partial fulfilment of the requirements of

Master of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

by

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Cairo – (2016)

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Date: 31 December 2016

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain Shams University. The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

The thesis comprises of six chapters. Chapter 1, is an introduction presenting the importance of the undertaken subject, description of the problem and highlighting the contents of the thesis.

Chapter 2 shows smart meters systems the target of executing them and it gives brief analysis of smart meter design. And it gives a background of traditional energy meters (electromechanical and electronic meters). And introduce short introduction to smart grid. This chapter includes a brief discussion of communication technologies for smart meters systems.

Chapter 3 introduces the effects of electromagnetic interference/compatibility (EMI/EMC) that is apparent everywhere due to the broad utilization of electronic and electrical systems in items for example, TVs, PCs, and automobile. Also, discuss the human exposure levels and relation to EM compatible. This chapter includes a brief discussion of estimation techniques utilizing open sites, transverse electromagnetic (TEM) cells, resonating chambers, and anechoic chambers are talked about here, in light of their specialized defences and bases, their qualities and impediments.

Chapter 4 describes the radiated immunity and emission measurements procedures. And investigate the different methods used to maintain uniform field area inside transverse electromagnetic (GTEM).

Chapter 5 introduces an investigation of the performance of smart meter under radiated electromagnetic disturbances. Their performance characteristics regarding the ones measured without electromagnetic field will be thought about.

Chapter 6 is a conclusion and future work of this research. This research work is mainly concerned with electromagnetic compatibility EMC evaluation of smart meters and analyses the working environment of these meters. It also throws light on the probable EMI sources, suppression and immunity improvement techniques for compliance of these smart meters to the national and international norms. The motivation behind this work is to raise open attention to security worries because of establishment of smart meter system. The analysis of this system suggests that the designer should review its designation rules or basics on the smart meter system design.

Key words: Smart meter, Electromagnetic interference, Electromagnetic compatibility, Radiated immunity and emission tests, Field uniformity, GTEM.

ABSTRACT

Due to increasing of electronics and digital circuits in all sides of daily life, the electromagnetic pollution is increasing daily. The performance of electronic and electrical equipment is much influenced by this electromagnetic pollution. Now day most of energy meters are still electromechanical. But due to the advantages of smart meters, the conventional meters are being replaced by them. As part of a smart grid, smart meters will be everywhere, and not always in the most ideal operating conditions (inside transformer rooms or near to mobile phone base stations). So, these EM noises might affect the performance of smart meters.

Whether you believe in manmade climate change or not, one fact is certain; we are depleting our energy supplies faster than we can replace them. The majority of fossils fuel supplies are likely to run out this century and until we achieve an equivalent energy production from renewable sources, we need to monitor and control our daily energy consumption. One way we can do this is by using Smart Electronic Meters; conventional energy meters with movable disc were used to register the energy earlier. But due to certain advantages of electronic meters, these meters are being replaced by smart meters.

Smart meters are very much vulnerable to EM noises & this might affect the performance & reliability of meters. EMI/EMC evaluation has thus become necessary to ensure that these meters work satisfactorily in the present day environment.

This research work is mainly concerned with electromagnetic compatibility (EMC) and analyzes the possible impact of the use of smart metering systems, using high precision measurement techniques. This work introduces electromagnetic compatibility (EMC) as an integral process needed for the design of smart energy meters that are used in the operation of the Smart Grid, and it deals with the immunity of smart energy meters to a variety of EM sources that can affect communications and operation. The other aspect of EMC that must be taken into account is controlling emissions from these devices and equipment that might adversely affect nearby electronics by radiated emission.

When the communication modules are installed in the smart meter device these modules should be included in the EMC testing and evaluation. However, at present,

the kilowatt-hour meter standard does not consider testing of meters incorporating with such communication modules.

The purpose of this work is to raise public awareness of safety concerns due to installation of Smart Meter System.

This study may be the stepping-stone into bringing EMC measurements-test method to Egypt.

Acknowledgment

I wish to express my deep gratitude and respect to my supervisors committee: Prof. Dr. Hadia Mohamed Said Elhinnawi and Prof. Dr. Sohair Fakhry Mahmoud for their continuous guidance and support. Their helpful and valuable discussions were the core reason for accomplishing this work.

I would like to sincerely thank Prof. Dr. Ibrahim El- shaer, the general manager of Polytechnique Metrology Centre (PMC) who was a great support during the period of experimental work. Also, I would like to thank Eng. Alaa Hussien (Technical Manager of PMC lab), and technician team of PMC lab for generously helping me in experimental part of this thesis.

Finally, my thanks and gratitude is dedicated to every member of my family for their patience and understanding all along the way.

December 2016

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