READOUT INTERFACING CIRCUIT FOR ISFET IONIC CONCENTRATION MEASUREMENTS

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This thesis is submitted as a partial requirement for the degree
of **Bachelor of Electrical Engineering (Hons) Electronics**

FACULTY OF ELECTRICAL ENGINEERING

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JULY 2013

ACKNOWLEDGEMENT

Alhamdulillah and all praises go to Allah for His blessing, for giving me this opportunity of completing my thesis and for every gift he allows me to enjoy. After this, I would like to thank some people who have been a part of my success and without them this thesis would not be completed.

First is my supervisor Dr. Wan Fazlidah Hanim binti Abdulluah. I owe her great thanks for all her help, gaudiness and advice to complete this thesis. She was not only teaching me but educating and enriching me with noble morals, smart strategies and good knowledge. She was like a caring mother standing by my side through my whole journey of completing my thesis and the final project behind it. Millions of thank to her.

Second are my beloved parents. They have supported me throughout my study financially and incorporeally. They were always by my side with prayers, love and encouragements. I am very grateful to them and to all of my family and friends as well.

Last I would like to express my great thanks to UiTM for helping me to accomplish my degree and my work. They have given me the access to use the labs and the equipments to do my research of this thesis.

ABSTRACT:

ISFET, ion sensitive field effect transistor, is an electrochemical sensor that detects ionic concentrations in the material. Those detected ions will results in a change of the threshold voltage (Vth) of ISFET. The ISFET that was chose for this research was a PH ISFET sensor. The changes in Vth of ISFET will be interpreted by a read-out interfacing circuit (ROIC) that is called CVCC, constant-voltage constant-current. The circuit will show the changes of Vth as variations in the output voltage (Vout). In order to measure the Vout from ROIC, it is connected to a microcontroller based-system that measures the output voltage though a voltmeter Temperature and time is calculated using different sensors. The softwares used were LTspice for simulation, Proteus and Arduino microcontroller. The ROIC was tested under different parameters value of the circuit. Some parameters had an effect of increasing or decreasing on the output voltage from ROIC. The ISFET sensor itself had been investigated under different conditions. It was observed that ISFET is affected by temperature and its fabrication characterization

TABLE OF CONTENTS

Chapter 1

Introduction

1.1   Background

Every specialization has its own benefits to the society. The more time passes, the more developments are seen and the more technologies are invented. The reason are to make the world a better place and less difficult to live on, and to improve the production of this world. The developments involve all aspects of life that is made by different researches in different fields such as agriculture, biomedical, industrial and others. A recent research was based in improving an electrochemical sensor that is named ISFET. It is an electrochemical sensor that produces an electrical response according to ionic concentration in an electrolyte solution by detecting the ions activity in it. ISFET basic structure comes from CMOS technology. ISFET has an advantage which it can be modified to detect different ions. In this research the ISFET chosen was the ISFET to detect PH level. The detections are made though the structure of ISFET as will be explained later. The selectivity of ISFET to response to different ions is made through a membrane that is sensitive to ions [1]. Because of the detected ions that originally are charges, the threshold voltage (Vth) of the ISFET will be changed and thus it will affect the flow of the current from Drain of the ISFET to the Source. Therefore, the ionic concentration cannot be measured directly due to other parameter changes beside Vth. In addition to that, the Vth changes are too small and needs an accurate reading. By connecting ISFET to readout interfacing circuit (ROIC), the changes in the Vth only will be observed by the output voltage from the ROIC. The circuits provide biasing for ISFET sensor as well. The ROIC chosen is constant voltage constant current (CVCC). The CVCC circuit operates in observing the changes occurred on ISFET according to ionic activity and avoiding affecting other parameters in the circuit. However, Vout from CVCC circuit is in an analog output and it needs a voltmeter device to measure it or an oscillator to show its waveform. To get over that, the Vout from CVCC circuit is connected to a microcontroller specifically Arduino Mega 2560 to measure Vout. However, Vout will pass through a voltmeter circuit first and the result will be shown on LCD. The