



UNIVERSITI PUTRA MALAYSIA

***DEVELOPMENT OF AUTO-CALIBRATED INTERFACING
CIRCUIT FOR THICK FILM MULTI-GAS SENSOR***

REZA KHAKPOUR

FK 2010 30

**DEVELOPMENT OF AUTO-CALIBRATED INTERFACING
CIRCUIT FOR THICK FILM MULTI-GAS SENSOR**

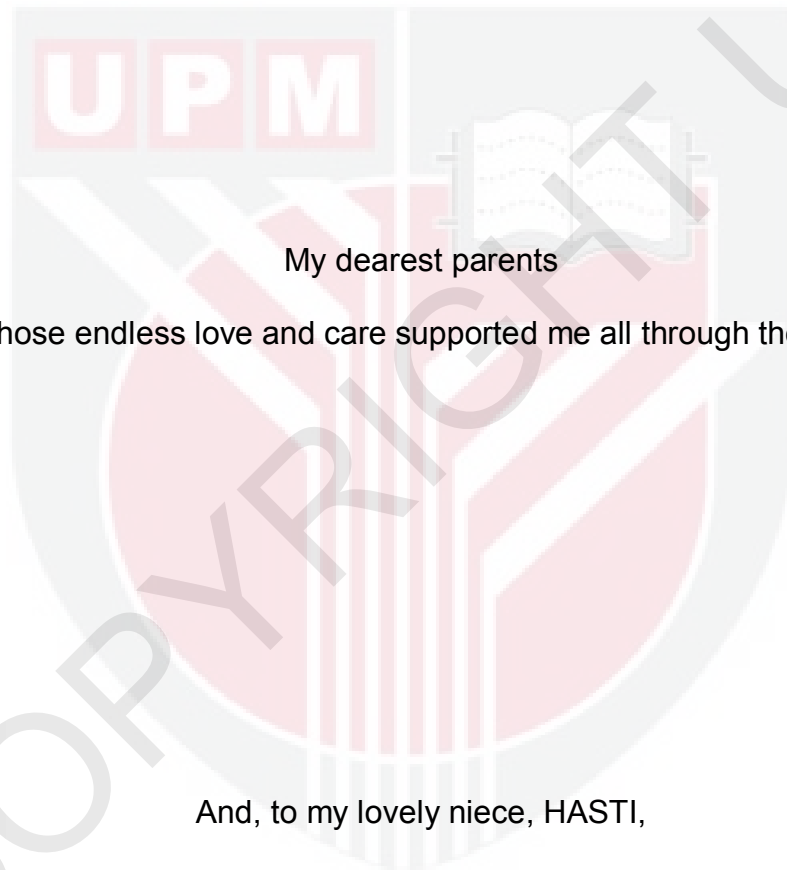
REZA KHAKPOUR



**Thesis Submitted to the School of Graduate Studies, University
Putra Malaysia, in Fulfilment of the Requirements for the Degree of
Master of Science**

March 2010

Dedicated to



My dearest parents

whose endless love and care supported me all through the way

And, to my lovely niece, HASTI,

whose spirit encouraged me to survive

**Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirement for the degree of Master of Science**

**DEVELOPMENT OF AUTO-CALIBRATED INTERFACING CIRCUIT FOR
THICK FILM MULTI GAS SENSOR**

By

REZA KHAKPOUR

March 2010

Chairman: Mohd Nizar B. Hamidon, phd

Faculty: Engineering

The gas sensors have been used for a number of applications particularly for reducing the pollution and human exposure to dangerous gasses. There are different ways of fabricating gas sensor which typically have high accuracy and high ability. One of these methods is by using thick film technology. Due to their high sensitivity and low cost of production, thick film gas sensors have been extensively employed. Screen printing is the general method of manufacturing thick film gas sensors which is a well organized technology and a low-cost way for large-scale production.

The gas sensor with thick film technology consists of a sensitive layer and a heater. Each gas sensor is biased at constant temperature where the best reaction occurs at this temperature, which means they need be controlled. The effect of ambient temperature must be compensated because they will influence the heater performance negatively.

The main objective of this thesis is to drive the heaters of thick film multi gas sensors by controlling the voltage and keeping the temperature of the heaters constant so that each heater will be able to compensate the effect of ambient temperature changes. Furthermore, the system can measure, monitor and display the gases detected by multi sensors in wide range. The interface circuit consists of ADC, DAC, microcontroller, current buffer, and latch buffer. The voltage divider method was used in this thesis by employing external series resistor in order to control the heater, compensate the ambient temperature, and measure the gas.

Finally, a single microcontroller was employed to automatically run the entire process such as driving the heaters, controlling the heaters temperature, compensating the ambient temperature of the heaters, measuring the amount of gasses detected by the sensors and finally selecting the sensors.

Abstrak tesis yang dikemukakan kepada Senat University Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PEMBANGUNAN LITAR PENGANTARAMUKAAN AUTO-KALIBRASI BAGI
PENDERIA BERBILANG GAS SELAPUT TEBAL**

Oleh

REZA KHAKPOUR

Mac 2010

Pengerusi: Mohd Nizar B. Hamidon, phd

Fakulti: Kejuruteraan

Penderia gas telah digunakan di dalam sesetengah aplikasi untuk mengurangkan pencemaran dan juga pendedahan manusia terhadap gas berbahaya. Terdapat pelbagai cara untuk memfabrikasi penderia gas yang biasanya mempunyai ketepatan dan kebolehan yang tinggi. Salah satu daripada cara tersebut adalah dengan menggunakan teknologi selaput tebal. Dengan daya kesan yang tinggi dan kos pengeluaran yang rendah, penderia gas selaput tebal sering digunakan. Pencetak skrin adalah cara umum bagi penghasilan penderia gas selaput tebal yang mana telah mempunyai teknologi yang baik dan cara murah untuk pengeluaran yang tinggi.

Penderia gas dengan teknologi selaput tebal mempunyai lapisan pengesan dan pemanas. Setiap penderia gas digunakan pada suhu tetap dimana tindakbalas optimum berlaku pada suhu ini, yang mana ia perlu dikawal. Maka kesan daripada perubahan suhu hendaklah di ambil kira kerana ia akan mempengaruhi keupayaan pemanas secara negatif.

Tujuan utama thesis ni adalah untuk memanaskan pemanas penderia gas selaput tebal dengan mengawal voltan dan memastikan suhu pemanas adalah tetap. Seterusnya, sistem ini boleh diuji dan gas yang dikenalpasti oleh penderia dapat ditunjukkan. Litar sistem ini termasuklah ADC, DAC, mikropengawal dan penyalur arus. Pembahagi voltan digunakan di dalam tesis ini untuk membahagikan rintangan pada pemanas, pengawal suhu dan pengukuran gas.

Akhir sekali, mikropengawal digunakan untuk mengawal seluruh proses pemanas, suhu pemanas, pengukuran jumlah gas yang dikenalpasti oleh penderia dan pemilihan penderia.

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Finally, I would like to express honest thanks to my family for continuous inspiration and support they gave me and I will ask God to keep them safe. Also, I hereby thank all my dear friends for their support and care, in particular Zohreh.

I certify that an Examination Committee has met on _____ to conduct the final examination of Reza Khakpour on his Master of Science thesis entitled "Development of Auto-Calibrated Interfacing Circuit For Thick Film Multi gas sensor" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Samsul Bahari Mohd Noor, PhD

Lecturer
Faculty of Graduate Studies
Universiti Putra Malaysia
(Chairman)

Mohd Zainal Abidin Abd Kadir, PhD

Lecturer
Faculty of Graduate Studies
Universiti Putra Malaysia
(Internal Examiner)

Mohd Fadlee A. Rasid, PhD

Lecturer
Faculty of Graduate Studies
Universiti Putra Malaysia
(Internal Examiner)

Ibrahim Ahmad, PhD

Professor
Faculty of Graduate Studies
Universiti Putra Malaysia
(External Examiner)

Bujang Kim Huat, PhD

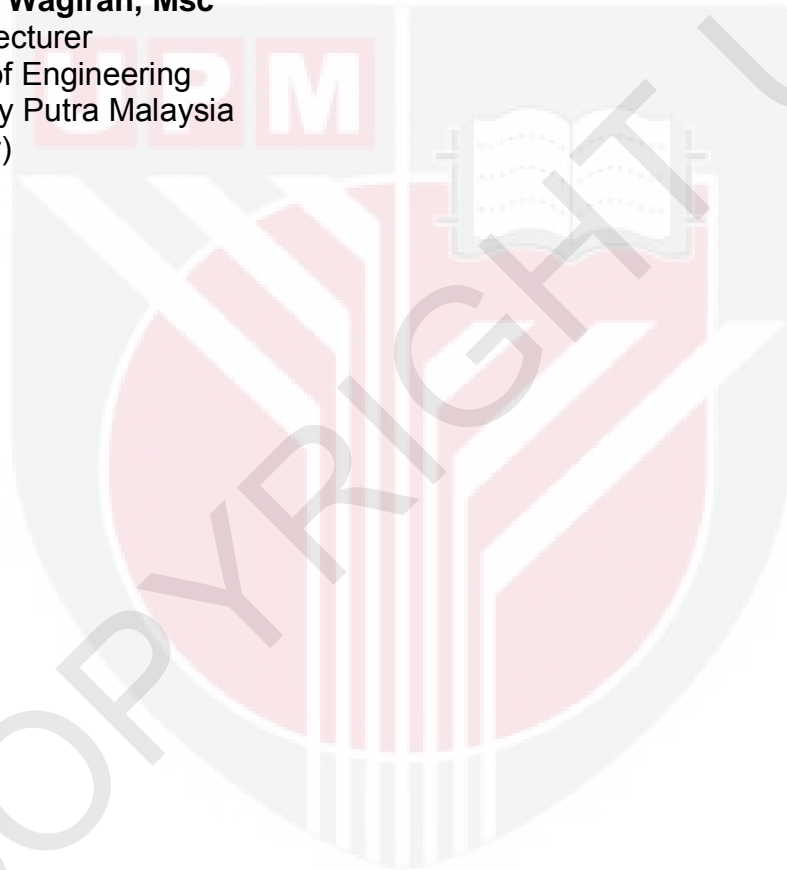
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Mohd Nizar Hamidon, PhD
Senior Lecturer
Faculty of Engineering
University Putra Malaysia
(Chairman)

Rahman Wagiran, Msc
Senior Lecturer
Faculty of Engineering
University Putra Malaysia
(Member)

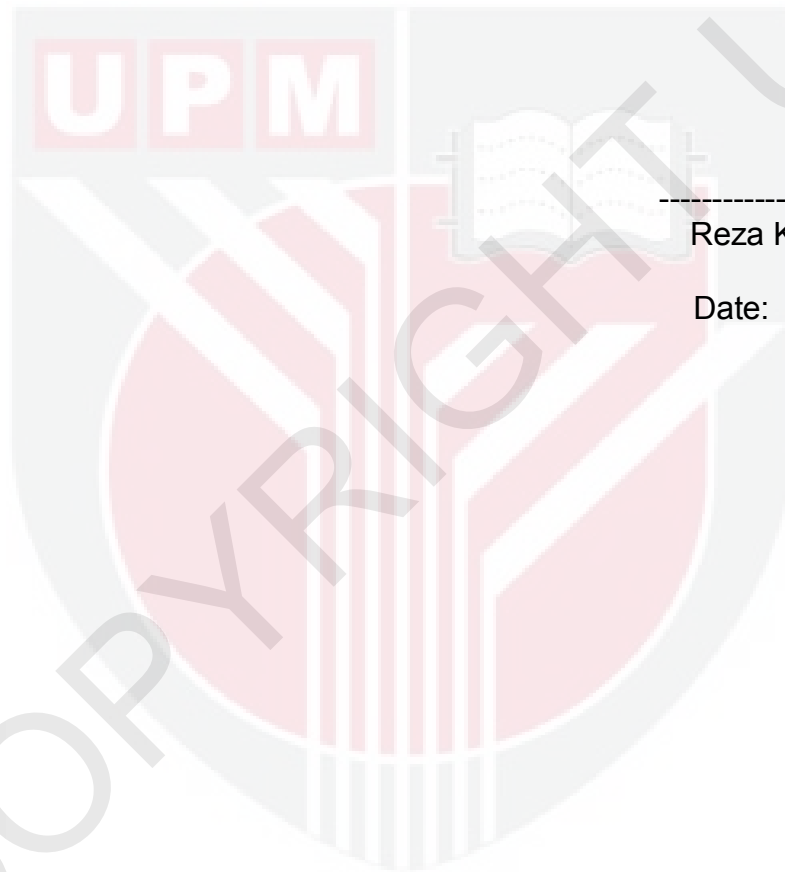


HASANAH MOHD. GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 10 June 2010

DECLARATION

I declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or at any other institution.



Reza Khakpour

Date:

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAKT	v
ACKNOWLEDGEMENTS	vii
APROVAL	viii
DECLARATION	x
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF NOTATIONS	xvii
CHAPTER	
1 INTRODUCTION	1
1.1 Back Ground	1
1.2 Gas Sensor Based on Thick Film	3
1.3 Interface Circuit	6
1.4 Problem Statement	7
1.5 Aims and Objectives	8
1.6 Scope of Work	9
1.7 Organization of the Thesis	10
2 LITERATURE REVIEW	12
2.1 Introduction	12
2.2 Thick Film	12
2.3 Thick Film Heater and Temperature	17
2.4 Gas Sensor Based on Thick Film Technology	22
2.5 Interface Circuit for Controlling Heater and Sensor Read Out	31
3 RESEARCH METHODOLOGY AND DESIGN	51
3.1 Introduction	51
3.2 Driving Heater and Controlling the Temperature of a Heater	52
3.3 Heater Control Block Component	53
3.3.1 Microcontroller	53
3.3.2 ADC	54
3.3.3 DAC	54
3.3.4 Current Buffer	55
3.4 Compensating Ambient Temperature	56
3.5 Extension Compatibility for multi Sensor	61
3.6 Experimental Setup	67
3.6 Sensor Read Out	68
3.7 Summary	72

4	RESULT AND DISCUSSION	74
4.1	Introduction	74
4.2	Simulation and Experimental for Driving and Controlling a Heater	75
4.2.1	Experimental Result of the Effect of Ambient Temperature	79
4.2.2	Experimental result of Compensate Ambient Temperature	82
4.3	Result and Simulation of Extension System for Multi Sensor	83
4.4	Experimental Result of Applying the Gas to The sensor	86
4.5	Summary	96
5	CONCLUSION AND FUTURE WORKS	97
5.1	Conclusion	97
5.2	Future Works	98
	REFERENCES	99
	APPENDICES	103
	BIODATA OF STUDENT	114
	LIST OF PUBLICATIONS	115