MEMS RESONATOR Q-FACTOR MICROCONTROLLER BASED MEASUREMENT SYSTEM

This thesis is presented in partial fulfillment for the award of the

Bachelor of Engineering (Hons.) Electronics

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JULY 2013

ACKNOWLEDGEMENT

In the name of Allah S.W.T, the Most Beneficent and Merciful

First and foremost, I praise to the almighty Allah s.w.t for blessing me with a great experience, good health and great safety during my project. Millions of thanks and appreciation to Universiti Teknologi MARA (UiTM) Malaysia, for giving me an opportunity and providing the necessary facilities in completing this project.

This Project work would not have been produced without my supervisor Dr. Wan Fazlida Hanim Abdullah. I am very grateful and thankful for his enthusiastic support and guidance, for all project ideas, and for support in order for me to complete this research thesis.

I would also like to express my sincere appreciation and gratitude to my project colleague, Hasliadi Guliga and Maya Abu Bakar for their guidance, help and supported throughout my final year project time. Not to forget all colleagues friends in EE210 program who cheered up my time and shared their projects ideas.

I would also like to mention Norasmah Jaafar, technician for network 1 lab in FKE because or her help and kindness. The space, table, equipment that we use/borrow and the equipment setup, all has helped me finish my project and my research thesis. Thank you.

Finally, i am deeply gratefully to my parent whose love and moral support has given me great inner strength, encouragement and motivation to succeed. Last but not least, I would like to say thank you for the endless supported that you had given me throughout my studies and research time. Thank you.

ABSTRACT

This paper presents the hardware and algorithm of Q-factor for MEMS Resonator using microcontroller-based measurement system. Conventionally, the characterization of Micro-Electro-Mechanical System (MEMS) resonator required bigger equipment such as oscilloscopes and function generators for analysis. The purpose of this project is to design a simplified system to characterize MEMS Resonator with improve portability. The design and development of signal generator and display system will be based on microcontrollers. Instead of manual data collection and characterization of the signal, the system shall be able to calculate the resonance frequency and calculate the quality factor of the MEMS Resonator. The design of signal generator will be based on sin(x) algorithm to produce digital library to the output. The microcontroller is able to log data time/cycle when signal sampling crosses zero line. The frequency and amplitude can be measured based on the time record and the biggest value of sampling data. Validating against measured value using conventional laboratory equipment, the natural frequency and quality factor obtained has 0.67% and 20% error.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Micro-Electro-Mechanical System (MEMS) are integrated devices consist of mechanical and electrical components with micrometer scale sizing. In general, MEMS consists of four main components such as mechanical microstructures, micro sensors, micro actuator, and microelectronics. All these components are integrated into the same silicon chip called as integrated circuits. Microsensor and microactuator are categorized as transducers [3]. The function of transducer is to detect the changing on environment by measuring parameter such as the change of thermal, mechanical, chemical, magnetic or other phenomena and convert to the electrical signal [13]. For example, the displacement or force sensor of electromechanical system converts a mechanical signal to electrical signal. MEMS can be classified based on their application such as Bio-MEMS, Resonator-MEMS, Energy and Power MEMS. MEMS technology is widely used in various application especially in military, aerospace, automotive, medical and consumer electronics industries. In automotive field, there are lots of sensors that using the MEMS technology such as Crash Sensing for Airbag Control, fuel injector pressure sensor, exhaust gas sensor, tire pressure sensor and brake pressure sensor and control [11-12].