READOUT INTERFACING CIRCUIT FOR NATURAL FREQUENCY DETECTION OF MEMS RESONATOR

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In the name of ALLAH,

Most Compassionate, the Merciful,

Praise to ALLAH, Lord of the Universe.

ABSTRACT

This paper presents the readout interfacing circuit (ROIC) for natural frequency detection of MEMS resonator. It is reported that the MEMS Resonator vibrate at specific natural frequency under different condition. Therefore, the main aim of this research is to design the interfacing circuit to capture the current in order to analyze resonator frequency behavior. The work is focused on the development of ROIC prototype design with the MEMS resonator emulator included. The architecture of ROIC is mainly based on two blocks: transimpedance and instrumentation amplifier where this design is simulated using Multisim and implemented on PCB level. Simulation result of MEMS Resonator emulator model shows, it produces a current of 2.89nA at 22kHz natural frequency which is close to published works. Simulation result of ROIC with MEMS emulator model produces 10.7mVrms at 21kHz with 10 gain. The ROIC hardware implementation with practical values of RLC produces 0.624Vrms as compared in simulation process produces 1.46Vrms at the same 1.5kHz natural frequency even though the theoretically produces 1.6KHz natural frequency. As conclusion, it is shown that the ROIC is able to capture the natural frequency with 95.5% accuracy compared to the theoretical value.

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CHAPTER 1

INTRODUCTION

1.1   INTRODUCTION

In this chapter, mainly a project background or overview about the project will be described. Basically it also tells about appropriate techniques have been used in the project and the expected overall performance using the techniques will be explained. Also, in this chapter will state the problem statement and finally come up with a several objectives. Moreover, it will also touch on the scope of the project work and the organization of the project report.

1.2   PROJECT BACKGROUND

Nowadays, the Micro-Electro-Mechanical System technology has changed the world especially manufacturing technology in small scale. MEMS actually are combination between mechanical structure, sensors and actuators with micrometer scale sizing[3]. They have commonly used in sensing application such as inertial sensor, mass sensor, charge sensor, microfluidics, oscillator and filter [1]. Micromechanical system (MEMS) silicon resonant or MEMS Resonator is one type of the MEMS technology where it is commonly used in oscillator, mechanical filter and mass MEMS sensor because it has high performance device with small size and high potential for integration with CMOS electronic circuit as well as low cost batch fabrication [1][4][6][8]. Before the MEMS resonator is introduced in the electronic application field, the Quartz crystal oscillator have been used as a resonator especially in timing device and communication application