MICROMACHINED RESONATOR STRUCTURES AND METHODS FOR OSCILLATOR AND TIMING APPLICATIONS

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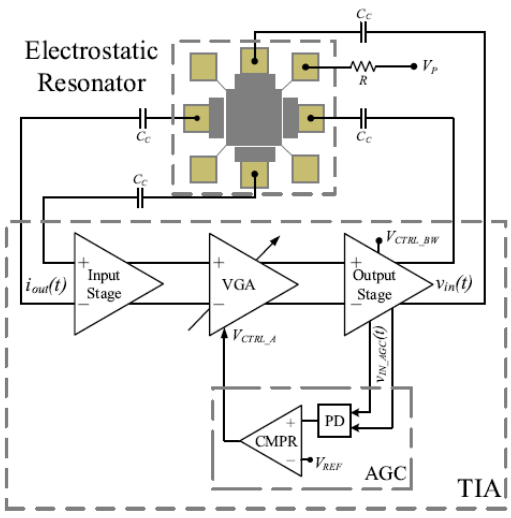
ALIGO INNOVATION

BACKGROUND

Reference oscillators are of great interest because of their ubiquitous use in timing applications generally, and in modern wireless communication devices particularly. They are indispensable to ensure proper synchronization in almost any system. Microelectromechanical system (MEMS) resonators are receiving continuously increasing interest due to their small size as well as their potential for integration with other MEMS devices and electrical circuits on the same chip which makes them excellent candidates for replacing crystal-based resonators in many timing applications. This is especially important for handheld and wearable electronic devices addressing high volume consumer orientated applications where weight, size, and cost are critical parameters.

TECHNOLOGY

The invention is a MEMS resonator and amplifier design that produce high performance MEMS oscillators for timing devices applications. The new MEMS design is based on a LAME mode resonator and is implemented through dual wafer SOI technology. The structures are implemented by patterning two wafers with different etched depths and wafer bonding them to create the released movable structures. One anchoring architecture incorporates with a central anchoring support which is suitable for creating high performance bulk-mode gyroscopes. A transimpedance amplifier circuit (TIA) provides a feedback loop between the sensing and driving electrodes of the oscillator. The TIA is used to achieve low phase noise high performance MEMS-based oscillators.



Other MEMS resonator designs based on single wafer technology have also been created by the research team in order to achieve a desirable combination of high quality factor and low motional resistance without requiring any DC voltage for operation.

COMPETITIVE ADVANTAGES

- Fabricated devices were measured to operate at quality factors as high as ~42000 in atmospheric pressure and ~871000 in 100-mTorr vacuum. The resonators also exhibit a f.Q product of 1.56×10^{13} in vacuum, which is one of the highest reported in the literature. Accordingly, the devices are well-suited to a wide range of MEMS resonator applications such as timing, and can provide relatively high performance even in air, reducing the packaging costs.

- The novel circuit design was integrated with MEMS resonators to realize superior performance oscillators achieving very low power and high-performance phase noise (the measured phase noise in air and under vacuum is about -104 dBc/Hz and -116 dBc/Hz, respectively, at a 1-KHz offset, while the phase noise floor reaches -130 dBc/Hz). The short-term stability of the MEMS-based oscillator is ±0.38 ppm.

APPLICATIONS

- Timing circuits
- Electronics of all types requiring a clock
- Wireless circuits that require a reference clock for carrier generation

TECHNOLOGY DEVELOPMENTAL STAGE

The MEMS oscillators and control circuitry have been fabricated and characterized in a laboratory environment (TRL 4)

BUSINESS OPPORTUNITY

The technology is available for licensing

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