HIGH ELECTROMECHANICAL COUPLING DISK RESONATORS

Tech ID: 29472 / UC Case 2018-185-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,368,424	07/22/2025	2018-185

BRIEF DESCRIPTION

Capacitive-gap transduced micromechanical resonators routinely post Q several times higher than piezoelectric counterparts, making them the preferred platform for HF and low-VHF (e.g. 60-MHz) timing oscillators, as well as very narrowband (e.g. channel-select) low-loss filters. However, the small electromechanical coupling (as gauged by the resonator's motion-to-static capacitance ratio, Cx/Co) of these resonators at higher frequency prevents sub-μW GSM reference oscillators and complicates the realization of wider bandwidth filters.

To address this situation, researchers at UC Berkeley developed a capacitive-gap transduced radial mode disk resonator with reduced mass and stiffness. This novel Berkeley disk resonator has a measured electromechanical coupling strength (Cx/Co) of 0.56% at 123 MHz without electrode-to-resonator gap scaling. This is an electromechanical coupling strength improvement of more than 5x compared with a conventional radial contour-mode disk at the same frequency. This increase should help improve the passbands of channel-select filters targeted for low power wireless transceivers and lower the power of MEMS-based oscillators.

SUGGESTED USES

1. RF channel-select filters that can enable practical software-defined cognitive radio.

2. Ultra-low noise oscillators for timing, radar, navigation, and communications, where the higher electromechanical coupling, the lower the oscillator power consumption and the wider its application range.

3. Gyroscopes, accelerometers, and inertial measurement units, that employ resonating elements, such as MEMS-based gyroscopes used in automobiles, cell phones, and gaming wands (e.g. the Wii).

4. Sensors that employ resonating elements, including the previously mentioned inertial measurement units, but also sensors for gas, temperature, pressure, motion, stress, and most attributes that need to be sensed (note, that resonant sensors are widely recognized as the most sensitive sensors).

5. High Q, High Cx/Co tank circuits used not only in communications but also a variety of other integrated circuits (as high Q and high Cx/Co benefit most integrated circuit applications).

6. Energy scavenging devices, where Cx/Co often governs the overall efficiency and capability of the energy scavenger.

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Zero-Quiescent Power Transceiver
- Micromechanical Frequency Divider
- RF-Powered Micromechanical Clock Generator
- Active Resonator System with Tunable Quality Factor, Frequency, And Impedance

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