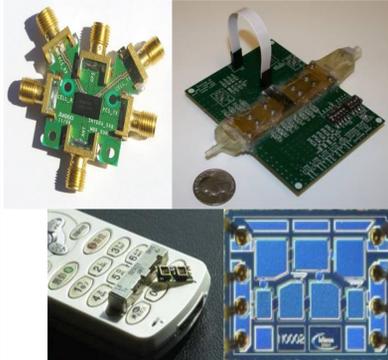


Introduction

Filters are an important technology enabler for numerous RF systems such as multifunction radar/communication system, portable handheld systems and radios.

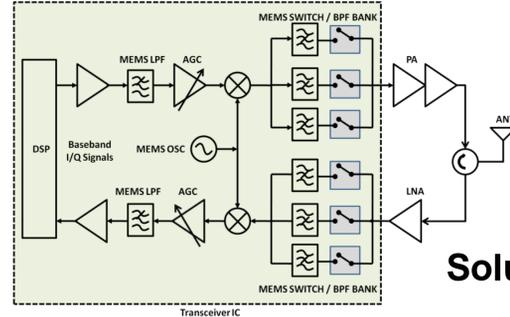
Current dominant technology on the market (i.e., FBAR and SAW)

- ✓ Low insertion loss
- ✓ Low motional resistance
- ✓ Out of Band Rejection
- ✗ Off-Chip components
- ✗ Device size
- ✗ Low quality Factor
- ✗ Highly dependant on the mechanical properties of piezoelectric materials

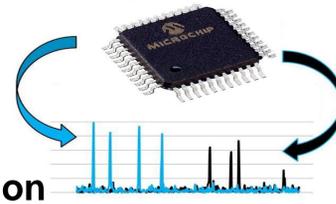


Current receivers are based on SAW, BAW, FBAR and crystal quartz oscillators which present a bottleneck to miniaturization

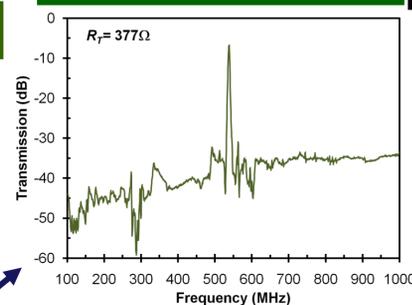
MEMS Technology Single Chip Transceiver



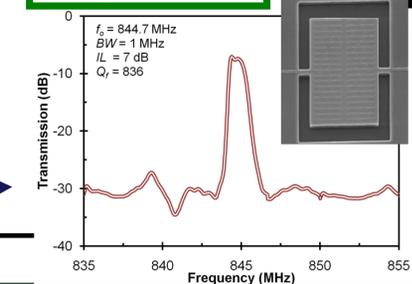
Solution



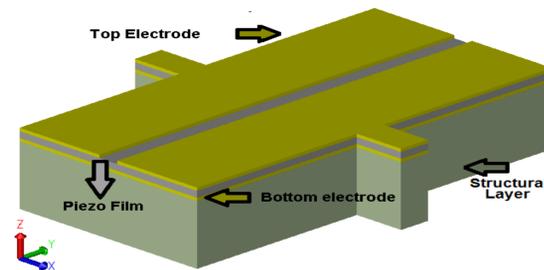
UH Filters



GSM, LTE Filters



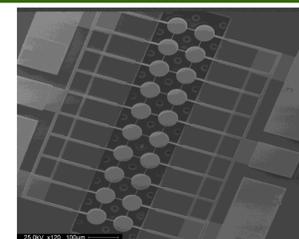
Piezoelectrically-Transduced Resonators



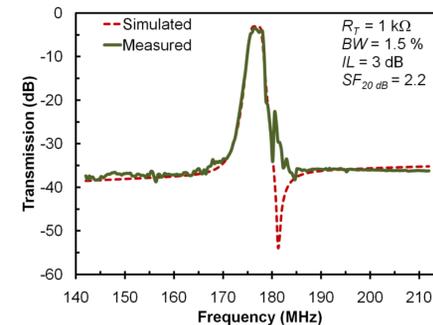
$$f_{resonance} = \frac{1}{2L} \sqrt{\frac{E}{\rho}}$$

E= Young's module
ρ= Material density
L= Lateral dimensions

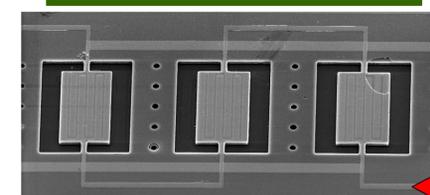
Mechanically-coupled filter



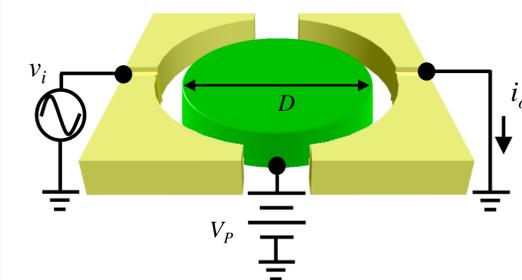
A piezoelectrically transduced contour mode resonator consists of a piezoelectric layer sandwiched between two electrodes. When a RF signal is applied across the device it produces a mechanical motion in the piezoelectric layer.



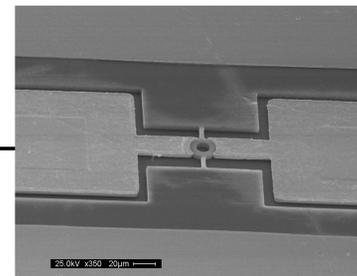
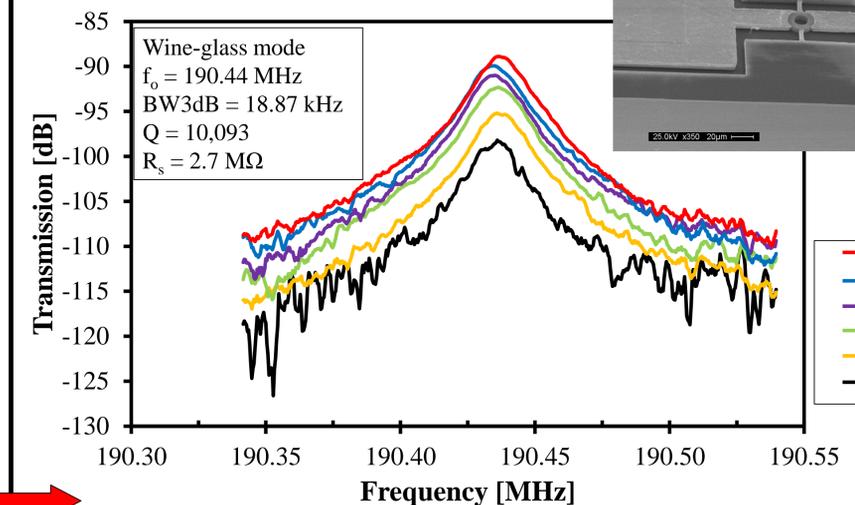
Capacitively-coupled filter



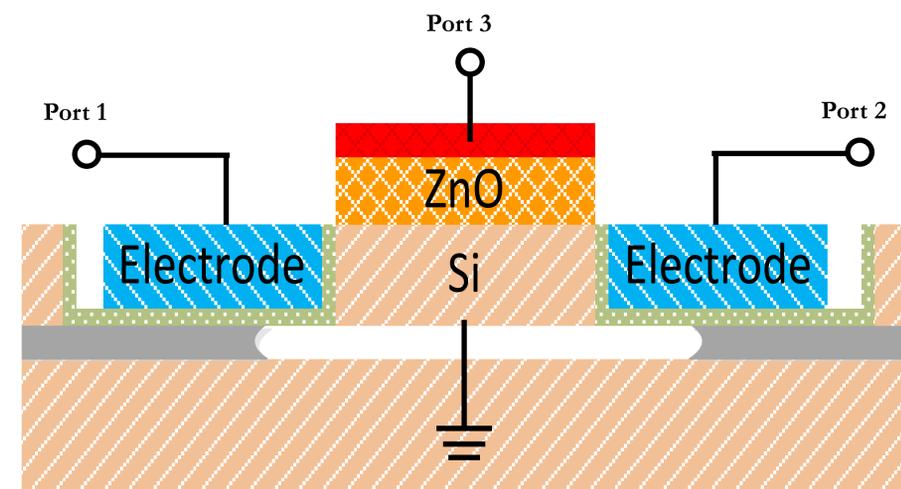
Capacitively-Transduced Resonators



- CMOS compatible
- Built-in ON/OFF switch
- Higher Quality Factor
- Linear and Non-linear characteristic



Dual-Transduced Resonators



Hybrid

- ✓ Inherited positive characteristics from both piezoelectric and capacitive resonators
- ✓ Multi-port design
- ✓ Asymmetric characteristic – reconfigurable
- ✓ Built-in faraday cage – low noise floor
- ✓ Lower motional impedance

Conclusion

MEMS resonators and filters based on piezoelectric and capacitive resonators, with frequencies in the range of 100 MHz to 4.8 GHz have been successfully demonstrated. Devices with frequencies of 1.8 GHz, 2.4 GHz and 4.8 GHz have shown promising preliminary results compared to the current state of the art of technologies such as FBAR and SAW. Future work will be focused on increasing the quality factor of the fabricated devices.