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The Convergence of MEMs and Acoustics for Mobile Phones

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Abstract

The success of the Free-Standing Bulk Acoustic Resonator (FBAR) is both well known and documented. What is often lost in the picture is the influence of MEMs and how it will continue to co-evolve with acoustic filters to make smaller, higher performance (and most important) lower cost modules.

Both SAW devices and BAW devices started in commercial applications using ceramic-based, hermetically sealed packages. But then, packaging technologies quickly diverged. Mainstream SAW devices followed two paths: Evolution of the ceramic package or switching to a polymer based Wall & Lid. Early in the evolution of FBAR, we opted for an all-silicon package inspired by the work in the MEMs community. But moving forward, new packaging techniques will be needed.

In parallel with the evolution of packaging technologies, the battle for acoustic ascendency is fought with amazing tenacity. BAW devices (via FBAR) quickly dominated filters due to the intrinsic high Q, But, SAW technology fought back by introducing low cost TCSAWs. FBAR then raised the stakes by introducing Scandium as a dopant in the AlN piezoelectric layer, to increase the coupling coefficient (a must for wide band filters). SAW companies soon introduced guided wave SAWs (aka GWSAW, IHP or POI), with highQ, large coupling and low temperature coefficient of frequency. What is in store fo the future? This will be discussed, But…

The goal is simple: The Radio Front end with its 60 to 100 filters, multiple power amplifiers, switches, low noise amplifiers and MIPI controllers will need to be made smaller, thinner, with better power handling all at a much lower cost.

Bio

Rich Ruby, IEEE Fellow, Avago/Broadcom Fellow, U.C. Berkeley Distinguished Alumni; Rich started work in HP Labs on FBAR around 1992/1993. He brought the first FBAR product for cell phone applications in 2000. By 2003/2004, he had also introduced an all-silicon, packaged FBAR filters to the cell phone industries and made seminal improvements to the Q and coupling coefficient. In 2005, he also began to branch out from filter applications, developing an innovative GaAS Cap package for the microwave division and several innovative oscillator and low energy transmitter devices. He is currently spearheading development of Silicon SAW products (SiSAW) to round out the technology portfolio of Broadcom RF & Wireless Business.

He is the recipient of the Industrial Application of Physics Prize awarded by the American Institute of Physics, the C.B. Sawyer Memorial Award, the Bill Hewlett Award and the Barney Oliver Award, and most recently the Distinguished Alumni Award from the University of California Berkeley

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