The MEMS Generation Takes Its Place Beside Quartz

Silicon oscillators now offer quartz oscillator performance at a lower cost

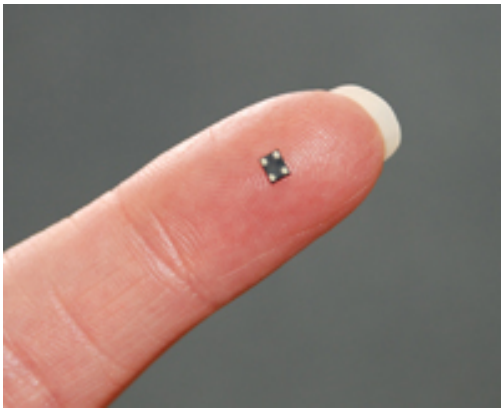
For decades, an accurate oscillator utilizing a silicon resonator remained an elusive technological dream, as research revealed its potential as an alternative to quartz oscillators without actually proving its worth. Recent MEMS (micro-electro-mechanical systems) resonator breakthroughs, such as improved long-term frequency stability and thermal hysteresis, have convinced some design engineers and management teams that the new technology's day has finally arrived.

Since World War II, quartz crystal resonators have been the standard in the frequency control arena due to their piezoelectric and mechanical properties. While there have been other contenders, such as ceramic, silicon and RLC resonators, none were able to match the quartz resonators due to their superior temperature stability, thermal hysteresis, and long term stability.

However, quartz crystal resonators do have limitations; they cannot suitably be integrated onto silicon CMOS wafers, their cost significantly increases when their package volume decreases, and they are vulnerable to performance degradation when subjected to severe levels of shock and vibration.

Faced with these concerns and growing demand (in 2007, more than an estimated 10 billion quartz crystals and oscillators were manufactured) the electronics industry has funded MEMS resonator research for more than four decades. The goal of this research was to develop frequency control products that, in some applications, could replace quartz crystal oscillators without sacrificing quality or performance.Overcoming HurdlesIn the past, reliable performance comparable to quartz was a big hurdle for MEMS timing products to overcome. MEMS resonators did not exhibit good temperature stability, thermal hysteresis, or long-term stability.

Now that these issues have been solved, firms like Ecliptek have embraced the fast-growing MEMS resonator timing market. Ecliptek offers the EMO product family of programmable oscillators. The EMO family of oscillator products includes 12 different product series encompassing four industry standard package sizes and three supply voltages (1.8, 2.5, and 3.3 VDC), providing frequency stabilities of +/- 50 ppm maximum over an operating temperature range of -40°C to 85°C.



The MEMS clock oscillators provided by Ecliptek contain a MEMS resonator, an oscillator stage, frequency-temperature compensation, a low noise phase-locked loop, and a tri-state output buffer stage. A 200-mm CMOS wafer fabrication process for reduced lot-to-lot MEMS resonator variation, industry standard QFN (Quad Flat No-Lead) packaging, and a COL (Chip On Lead) assembly process improves reliability while reducing assembly costs. This outcome compares well to quartz, which cannot take advantage of these manufacturing techniques and processes due to its mechanical structure.Timing is Everything

Reduced inventory carrying costs and time to market are key reasons why the use of MEMS oscillators is on the rise. Manufacturers can offer MEMS oscillators with a shorter lead time than either quartz fixed frequency oscillators or quartz programmable oscillators. By narrowing the delivery window, a company is able tolimit its liability from a time and financial perspective, and faster delivery does not come with a higher unit cost. MEMS oscillators are available in high volume with competitive prices.

Some industry insiders say it may be premature to laud MEMS-based oscillators. They argue that no new product in any industry becomes the leader until it has been swept up in a wave of “consumerization.”

This means the MEMS-based oscillator movement cannot afford to take anything for granted. To catch the speed of the changing consumer-product wave, MEMS companies must develop manufacturing techniques and processes that allow them to further reduce the package volumes of these already small devices. Also, these products must be available in even higher volumes and the companies need to still manage faster delivery times.

Even so, an expert in the field believes the future will grow brighter as MEMS is

integrated directly with CMOS. Integration will yield many benefits in continuous size reduction, better performance, and less manufacturing complexity. The overwhelming size advantage of MEMS solutions will provide an avenue for further size reductions in wireless nodes, multi-chip modules, and lead to the elimination of quartz from the PCB altogether.

New levels of performance, which rival quartz, already have taken MEMS programmable clock oscillators into new markets. In addition, buyers agree that MEMS improves the bottom line for firms eager to grow while going small.